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**The MNC as a Knowledge Structure:
The Roles of Knowledge Sources and Organizational
Instruments in MNC Knowledge Management**

by

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The MNC as a Knowledge Structure: The Roles of Knowledge Sources and Organizational Instruments in MNC Knowledge Management

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Abstract

Recent research on the differentiated MNC has concerned *knowledge flows* between MNC units. While linking up with this literature, we extend in two directions. First, we argue that conceptualizing the MNC as a *knowledge structure* furthers the understanding of intra-MNC knowledge flows. Thus, we see MNC knowledge elements as being structured along such dimensions as their type and degree of complementarity to other knowledge elements, and their sources, for example, whether they are mainly developed from external or internal knowledge sources. These dimensions matter in terms of knowledge flows, because they influence the costs and benefits of knowledge transfer and, hence, the actual level of knowledge transferred. Second, based on this conceptualization, we argue that MNC management can influence the development, characteristics and transfer of knowledge through choices regarding organizational instruments (control, motivation and context). We test six hypotheses derived from these arguments against a unique dataset on subsidiary knowledge development. The dataset includes information on organizational instruments, sources of subsidiary knowledge, and the extent of knowledge transfer to other MNC units. It covers more than 2,000 subsidiaries located in seven different European countries.

Key words: Knowledge structure, complementarity, knowledge transfer, the MNC

JEL Codes: F2, L2, M1

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I. Introduction

In spite of the present popularity of knowledge-based approaches, we are still lacking an adequate theoretical and empirical understanding of many of the causal mechanisms and contextual factors in relations among knowledge, learning, and competitive advantage (MacEvily and Chakravarthy 2002). We see two main, closely related, causes of this relative ignorance. First, the main emphasis — particularly in the strategy literature — has been on *inter-firm* knowledge heterogeneity rather than on *intra-firm* knowledge heterogeneity. Comparatively little research has been devoted to understanding the ways in which knowledge may be stratified, distributed, partly overlapping, complementary or, in another word, *structured* inside firms. Second, little attention has been paid to how internal organizations interact with the creation and use of knowledge.

Recent work on the differentiated multinational corporation (MNC) is very concerned with knowledge flows between MNC units and often explicitly considers the role of organizational instruments in the process of knowledge transfer (e.g., Hedlund 1986; Bartlett and Ghoshal 1986, 1989; Birkinshaw 1996; Gupta and Govindarajan 1991, 1995, 2000; Holm and Pedersen 2000a). However, even this literature is still in the early stages of understanding the central aspects, mechanisms, and contextual factors in the process of managing knowledge in MNCs. Progress on these matters is arguably handicapped by the absence of a consistent conceptualization of the MNC as a knowledge-based entity that stresses *intra-firm* heterogeneity, as well as the interaction of internal organization, knowledge creation and knowledge use. The present paper seeks to remedy some of these weaknesses by theorizing neglected aspects of MNC knowledge management.

We begin by offering a conceptual development of the notion of an MNC's knowledge structure. This structure may be dimensionalized in terms of, for example, dispersal, complexity, tacitness, complementarity, and sources of knowledge elements. Some of these dimensions, notably tacitness and complexity, have already been addressed in the literature, (e.g., Zander and Kogut 1995). We therefore focus on more neglected knowledge structure dimensions: *complementarity* between and *sources* of knowledge elements. Processes of managing knowledge within the overall MNC network take place in the context of the MNC knowledge structure, making this structure an important determinant of the costs and benefits of such processes. The implication is that costs and benefits of MNC knowledge transfer can only be fully understood in the context of the MNC knowledge structure. The manner in which knowledge is structured in the MNC (e.g. sources and complementarity of knowledge) matters to the flow of knowledge among MNC-units, although this aspect has been largely neglected in the literature.

We then discuss how the MNC knowledge structure may be influenced by management decisions. First, we consider *organizational instruments*, such as decisions that influence relations between subsidiaries or between subsidiaries and the center. Second, we consider the *sources of knowledge* that subsidiaries tap as something that MNC management can influence. Specifically, we distinguish between knowledge sourced internally from the subsidiary and the MNC network, and knowledge sourced externally from network relations and local clusters. These sources matter to MNC knowledge management because knowledge tapped from different sources differs, for example, in terms of tacitness or complexity. Therefore, the costs and benefits of knowledge transfer are influenced by the source. Third, for the reasons just given, management will seek to influence the utilization of diverse knowledge sources through organizational instruments.

We derive six hypotheses from these arguments and test them against a unique dataset on subsidiary knowledge development that includes information

on the organizational setting, sources of subsidiary knowledge and the extent of knowledge transfer to other MNC units.

In sum, this paper contributes to the extant literature on the differentiated MNC in a number of ways. First, steps are taken towards a conceptualization of the MNC as a knowledge structure. Second, some important dimensions of this knowledge structure are developed - the complementarity and sources of knowledge elements. Third, we argue that a knowledge structure conceptualization furthers the understanding of MNC knowledge transfer, because this conceptualization directs attention to the costs and benefits of knowledge transfer. Fourth, we argue that an important part of MNC knowledge management influencing the knowledge sourcing that MNC units undertake. Fifth, we develop and test hypotheses on this basis.

II. Theoretical Model and Hypotheses

Background

Knowledge and learning are at the root of understanding how competitive advantage is gained and sustained. This statement has become almost axiomatic in recent literature. The “knowledge-based view” of the firm encapsulates this observation (e.g., Kogut and Zander 1992; Grant 1996). However, much of the extant work has been conducted on a very high level of abstraction or aggregation that excludes the finer details of organizational and knowledge structures inside firms (i.e., intra-firm knowledge heterogeneity) (but see, e.g., Hansen 1999).

Arguably, this has some unfortunate consequences, of which three are considered here. First, much of the literature assumes that, whereas knowledge is very costly to transfer across markets, it is transferable at close to zero cost inside firms. Thus, the prominent argument that firm boundaries are shaped by capabilities (e.g., Kogut and Zander 1992) reflects an underlying claim that knowledge is (much) less costly to transfer inside firms than between firms. While such a claim should be treated as an empirical hypothesis rather than as a

starting point for analysis, the claim easily arises when intra-firm knowledge heterogeneity is suppressed and emphasis is placed on inter-firm heterogeneity. Second, a further consequence of suppressing intra-firm knowledge heterogeneity is that intra-firm learning becomes difficult to frame. As Kogut and Zander (1992) rightly argue, any theory of (organizational) learning requires an underlying theory of (organizational) knowledge. However, to the extent that the relevant theory of organizational knowledge abstracts from intra-firm knowledge heterogeneity, organizational learning cannot be understood in terms of changes to the knowledge structure inside firms. Third, the costs and benefits of knowledge transfer are hard to ascertain *in lieu* of a theory of intra-firm knowledge heterogeneity. This is because the motive for knowledge transfer is usually the wish to combine knowledge elements that have hitherto existed separately, and because the difficulties of knowledge transfer are at least partly related to the specific characteristics of the knowledge at both the sending and receiving organizational units.

Similar critiques may be directed against recent literature on the differentiated MNC, which attempts to concentrate on knowledge *flows*, abstracting from the composition of knowledge elements (i.e., stocks) across the MNC network (i.e., the MNC knowledge structure) (e.g., Gupta and Govindarajan 1991, 1995, 2000). Moreover, despite its concern with knowledge flows, the differentiated MNC literature has not made much out of flows from the external environment to the subsidiaries, which is a manifestation of a broader neglect of the *sources* of subsidiary knowledge stocks (e.g., local networks, local universities, local markets, internal R&D, etc.). Finally, although the differentiated MNC literature has paid attention to the relation between knowledge and organization (e.g., Ghoshal, Korine and Szulanski 1994), causality is usually taken to be unidirectional. The organization of the MNC is seen as reflecting the characteristics of

transferred knowledge, whereas the point that this organization may be chosen to influence the characteristics of knowledge is seldom seen, if at all.

In contrast, we argue that the MNC can indirectly influence the characteristics of knowledge, such as the proportion between tacit and explicit knowledge in their knowledge structures, by means of organizational instruments. They can do so by influencing the subsidiary choice of knowledge sources, because these sources are associated with different mixes of tacit and explicit elements. This is one illustration of the more general point that a greater concern with how knowledge elements are structured across the MNC will provide a better understanding of MNC knowledge management.

The MNC as a Knowledge Structure: Some Building Blocks

The notion that firms may be understood in terms of knowledge *structures* (and not just knowledge *assets*) was first explicitly put forward by Lyles and Schwenk (1992). They introduce the notion of an “organizational knowledge structure” to refer to shared thoughts at the organizational level about “... goals, cause-and-effect beliefs, and other *cognitive* elements.” However, firms are characterized by a differentiated consensus in these beliefs, so that in the firm’s “core” the degree of consensus is high, while in the “periphery” it is low. They go on to dimensionalize the organizational knowledge structure in terms of *complexity* which refers to “... the amount of information ... within a knowledge structure” (p. 163) and “... the degree to which cognitive units are interrelated” (p. 164), and in terms of *relatedness*, which refers to the degree of coupling (tight vs. loose) between elements in the core and periphery of knowledge structures.

Knowledge elements. We adopt a broader conceptualization of the organizational knowledge structure. To get an idea of this, think of the overall MNC knowledge structure as a set of nodes and their connections. Then the individual nodes refer to *knowledge elements* such as, for example, a marketing capability in a subsidiary in a certain country, or a patent held by the corporate center. Nodes may be identical, as when two subsidiaries exploit the same patent.

Lyles and Schwenk's notion of organizational knowledge structures can be represented as the set of identical nodes over subsidiaries and MNC headquarters. Nodes may represent tacit or explicit knowledge, or knowledge with or without public good character.

Characteristics of knowledge elements. Knowledge elements may possess several salient characteristics, such as their tacit knowledge content and their complexity. These characteristics have been extensively discussed in the literature (e.g., Winter 1987; Kogut and Zander 1992; Lyles and Schwenk 1992; Simonin 1999), to which we add a characteristic that has been comparatively neglected - the *sources* of knowledge elements.

Internal and external knowledge sources. From the perspective of an MNC subsidiary, there are two knowledge sources. Knowledge may come from sources that are *internal* to the MNC and is transferred from other MNC units (i.e., other subsidiaries or the Center) or is developed in the subsidiary itself (e.g., through R&D, processes of routinization, etc.). Alternatively, knowledge sources may come from *external* partners (customers, suppliers, etc.) or other agents (e.g., high quality research institutions, etc.).

Knowledge inputs into the process of building knowledge also differ across subsidiaries because subsidiaries confront different knowledge sources. Some subsidiaries may rely relatively more on internal knowledge sources, while others may rely more on external ones. In turn, this will impact the knowledge that is built and also influence the costs and benefits of transferring such knowledge. Thus, knowledge that is based on internal knowledge sources may be transferable at low cost inside the MNC, particularly knowledge which is developed within the core of the MNC knowledge structure (i.e., core MNC technologies and organizing principles) explicitly as a complement to other knowledge elements in the MNC network.

Conceptually, one may distinguish between two external sources of knowledge that may be available to subsidiary firms. The first category may be

called “*network-based knowledge*”, the gaining of knowledge from long-lasting interaction with specific external parties, such as customers or suppliers, and the use of that knowledge in the firm’s activities (Ford 1990; Dyer and Nobeoka 2000). The second category may be termed “*cluster-based knowledge*.” This kind of external knowledge is not the result of long-lasting interaction with specific parties. Rather, it is based upon knowledge inputs from sources such as a well-educated work force or local knowledge institutions like technical universities, etc. (Porter 1990; Porter and Sölvell 1999). Here, we treat both categories as one, namely as “external knowledge sources.”

The distinction between internal and external sources of knowledge is different from more conventional activity-based definitions of knowledge, such as production, marketing or R&D knowledge. The latter types may all, in principle, have both internal and external components to varying degrees. An advantage to the distinction promoted here is that it may be *more* plausibly related to the (other) characteristics of knowledge discussed earlier than are the activity-based definitions of knowledge. For example, it is hard to argue on *apriori* grounds that, for example, production knowledge is inherently more complex, ambiguous or tacit, and therefore harder to transfer, than marketing knowledge. In contrast, this type of argument may be more justified with respect to our distinction, although this should be done with considerable caution.

Knowledge complementarities. If knowledge elements may be understood as nodes in a web, there are also *connections* between those elements. These connections may be understood in terms of lateral or bilateral dependencies. Such perceived dependencies underlie intra-MNC knowledge transfers. More refined conceptualizations, representations and taxonomies of interdependencies can be easily developed (e.g., Thompson 1967: 15-18; Buckley and Carter 1999). The notion of complementarity (Milgrom and Roberts 1990) is particularly helpful for conceptualizing interdependencies. Loosely, knowledge elements are complementary when there are gains from combining them (the degree of complementarity being measured by the size of the gain). For example,

knowledge elements pertaining to marketing controlled by one subsidiary (or the MNC headquarters) may be a useful addition to existing marketing knowledge in another subsidiary, so that the relevant knowledge elements are *additive* (Buckley and Carter 1999). Alternatively, subsidiary knowledge may be an input prior to the building of knowledge in another part of the MNC, as when knowledge of local tastes are transferred to centralized R&D functions, so that the relation of complementarity is *sequential* (ibid.). Finally, dependencies may go both ways. For example, knowledge gained from combined marketing knowledge in a number of subsidiaries may be transferred back to these as best practice knowledge. Strategies and actions based on knowledge elements in different MNC units may be interdependent, requiring coordination (cf. Thompson 1967; Buckley and Carter 1999).

Determinants of net benefits of knowledge combination. The perceived net benefits of combining complementary knowledge elements depend on three elements. First, net benefits depend on the *characteristics* of the relevant knowledge elements: *how* complementary they are and what *kind of* complementarity is involved, how much tacit knowledge is involved in the relevant knowledge elements, how they add to or decrease complexity, etc. Second, they depend on the governance costs *implied* by these characteristics - the costs of motivating organization members to transfer and absorb knowledge, and coordinate these processes. Third, net benefits depend on the costs of transfer (personal or codified communication, embodied transfer). For example, transferring highly tacit knowledge elements under conditions of complex complementarity is likely to be very taxing for the organization in terms of governance and transfer costs. The presence of strongly overlapping knowledge elements (i.e., shared beliefs in Lyles and Schwenk 1992) may be hypothesized to reduce such costs (Kogut and Zander 1992).

In sum, MNC knowledge structures may be seen as being composed of 1) knowledge elements, which may be characterized in a number of dimensions, such as by their sources, and 2) connections between these knowledge elements,

which may be conceptualized in terms of complementarities. Net benefits depend on the costs of governing and transferring knowledge in order to realize complementarities.

This is a simple, but quite flexible framework. For example, both the transfer of existing knowledge and the creation of new knowledge are covered, since both may be analyzed as complementarities (i.e., as additive/sequential and complex complementarities, respectively). The framework is consistent with, but adds to, the basic perspectives of recent work on the differentiated MNC: that MNC units control heterogeneous stocks of knowledge, and that the MNC may obtain competitive advantages from orchestrating knowledge flows between units in such a way that knowledge is transferred to an area where it will increase value-added. However, we identify those dimensions along which the MNC knowledge structures may be classified. This allows us to add insight into the nature of the decision problem faced by MNC management.

Developing and Transferring Knowledge as Key Managerial Decision Problems

Under norms of rationality, MNC management wishes to maximize net benefits. Looking only at knowledge transfer, this translates into maximizing the difference between the expected (gross) benefits from transferring knowledge, as determined by complementarity, and the expected costs of such transfer, as determined by the governance and transfer costs, which in turn is influenced by knowledge characteristics such as tacitness, overlap, public good properties, etc. This maximization effort is usually cast in terms of choosing those organizational arrangements (governance and transfer mechanisms) that minimize the relevant costs of undertaking transactions (i.e., transfer) involving knowledge with *given* characteristics (e.g. Kogut and Zander 1993). The possibility of a reverse causality, in which organizational arrangements are chosen so that they influence the relevant characteristics, has not previously been investigated.

It has been argued that the MNC owes its existence to its superior ability (relative to markets) to transfer knowledge and that this superior ability may, at the same time, be a source of competitive advantage relative to purely domestic firms (Hedlund 1986). However, the resource costs of developing and transferring knowledge may often be substantial. According to Kogut and Zander (1993: 630) "... these costs are derived from the efforts to codify and teaching complex knowledge to recipient" (see also Szulanski 1996). On the other hand, the benefits of transferring knowledge may be substantial, as indicated by, for example, Subramaniam and Venkatraman's (2001), who find that transnational product development capability is highly dependent upon the transfer of knowledge in MNCs.

This suggests that MNC management will do *more* than maximize net benefits from exploiting complementarities between existing MNC knowledge elements and choosing those organizational arrangements that minimize the costs of transfer and governance. MNC management will also seek to control the *determinants* of those benefits and costs, and try to influence the characteristics of the knowledge elements, such as the sources of subsidiary knowledge. This main argument is summarized in figure 1:

XXXXXXXXX *Insert Figure 1 Here* XXXXXXXXX

However, rather little is known empirically about the determinants of intra-MNC knowledge flows. Gupta and Govindarajan (2000: 474) observed that, with some notable exceptions (e.g., Hamel 1991; Kogut and Zander 1993; Zander and Kogut 1995; Simonin 1999), "... very little systematic empirical investigation in the determinants of intra-MNC knowledge transfers has so far been attempted." Therefore, the following sections consider the knowledge sources of MNC subsidiaries and organizational instruments in some detail and discuss their implications for the transfer of knowledge in MNCs.

Knowledge Sources and Knowledge Transfer

As a general matter, impediments to knowledge transfer may be classified as either motivational or cognitive barriers (Cohen and Levinthal 1990; Zander and Kogut 1995; Gupta and Govindarajan 2000). In this section, we are primarily concerned with cognitive barriers to transfer, reserving motivational factors for later treatment. Cognitive barriers to transfer are usually conceptualized in terms of such constructs as causal ambiguity, complexity, tacitness, absorptive capacity, and the like. These variables are difficult to operationalize and measure (but see Cohen and Levinthal 1990; Kogut and Zander 1993; Simonin 1999; Gupta and Govindarajan 2000).

A more operational approach is to start directly from the sources of subsidiary knowledge (cf. above) and argue that these sources give rise to knowledge with different characteristics, i.e. different kinds of complementarities, different levels of complexity and tacit knowledge content, etc. In turn, this implies that the costs and benefits of knowledge transfer differ depending on the sources of the knowledge being transferred.

Sidestepping motivational issues for a moment, the success of knowledge transfer is primarily a matter of cognitive matters, such as the existence and richness of transmission channels (Bartlett and Ghoshal 1989; Ghoshal, Korine and Szulanski 1994), the characteristics of the transferred knowledge in terms of such dimensions as tacitness and ambiguity (Zander and Kogut 1995; Szulanski 1996), and the absorptive capacity of the target unit(s) (Gupta and Govindarajan 2000). We submit that these cognitive dimensions are systematically related to knowledge sources. The further implication is that the costs and benefits of knowledge transfer and, therefore, the overall level of knowledge transfer, depend on knowledge sources.

More specifically, we argue that knowledge based on mainly internal knowledge is likely to be more easily transferable within the MNC than external knowledge. Such knowledge is more likely to have many overlapping elements with other parts of the MNC knowledge structure than knowledge that is based on external knowledge sources. Knowledge that is built on the basis of internal

knowledge inputs can be transmitted through existing channels and although it may contain, for example, tacit elements, the absorptive capacity of target units is likely to be high. Therefore, we propose the following hypothesis:

***Hypothesis 1:** Subsidiary-level knowledge building that is mainly based on internal knowledge sources will be positively correlated with knowledge transfer from subsidiaries to other MNC units.*

In contrast, subsidiary-level knowledge building that is based on external knowledge sources will result in knowledge that is of a more peripheral character and is likely to be less easily transferable to other MNC units. This type of knowledge is, to a large extent, derived from the specific problems and needs of the external parties with which a subsidiary interacts, and/or consists of knowledge of local skill levels, tastes, regulatory authorities, etc., much of which may be hard to transfer or of little use for other MNC units. In other words, the costs of transferring such knowledge may high, while the benefits may be low. Accordingly, we argue that the more a subsidiary is prone to accumulate external knowledge, the less knowledge will it transfer to other MNC units. Given the above discussion, we can put forward the following hypothesis:

***Hypothesis 2:** Subsidiary-level knowledge building that is mainly based on external knowledge will be negatively correlated with intra-MNC knowledge transfer.*

A key point of the differentiated MNC literature is that important knowledge may develop in what we call the periphery of the MNC knowledge structure. This may seem to contrast H2. However, notice that in order for such knowledge to be transferable and combinable with complementary knowledge elements in other MNC units, it has to be interpreted and formulated in such a way that it will be accessible to other units. Overlapping knowledge elements have to be present. One way to accomplish this is to relate knowledge based on external knowledge sources to knowledge based on internal knowledge sources. For example, the former may be reformulated so that it is complementary to

knowledge elements held in other MNC units. This reasoning suggests the following hypothesis:

***Hypothesis 3:** The interaction effect between knowledge based on internal knowledge and knowledge based on external knowledge sources is positively correlated with knowledge transfer from subsidiaries to other MNC units.*

As knowledge based on internal and external knowledge sources is associated with different costs of transfer and with different benefits (i.e., complementarities), we expect MNC management to try to influence the sources of knowledge that subsidiaries tap. However, influencing these sources through, for example, location decisions, is not the only means of optimizing the accumulation and transfer of knowledge. Management can also make use of organizational control and motivation mechanisms.

Organizational Instruments and the Development of Knowledge in Subsidiaries

Many contributions to the MNC literature recognize that the process of knowledge transfer is likely to be supported by different organizational means of control and motivation (e.g., Bartlett and Ghoshal 1989; Gupta and Govindarajan 1991, 1995; Buckley and Carter 1999). Indeed, a key theme is that interdependencies (complementarities) between knowledge flows strongly condition the choice of management systems and processes for managing subsidiary relations (e.g., Gupta and Govindarajan 1995). We add to these ideas in the following ways. First, the choice of organizational mechanisms of control and motivation also influence the process of *building* knowledge, not just the process of transferring it. This is because the application of different mechanisms leads to different kinds of knowledge being built. Second, causality may go in the reverse direction in the sense that the choice of organizational mechanisms of control and motivation also influence the transferability of knowledge. These points are detailed in the following.

Subsidiary autonomy and the process of knowledge building. The knowledge structure of the MNC contains shared elements as well as elements that are not shared but reside strictly within a given subsidiary. The latter knowledge elements may include knowledge about local tastes, technologies, regulators, suppliers, etc. In order to efficiently utilize the local elements of knowledge, delegation of rights to make decisions that involve such local knowledge to those that best know how to turn the relevant knowledge to productive uses, namely local subsidiary management, will be necessary. Along such lines, it can be argued that granting more decision rights to an MNC subsidiary, thereby giving it more autonomy, improves the incentives for the subsidiary to engage in the accumulation of local knowledge (cf. Aghion and Tirole 1997). Local, subsidiary-specific knowledge is more likely to be based on external knowledge, making it hard for MNC headquarters and top-management to direct the subsidiary's acquisition of such knowledge because of the knowledge asymmetry (Jensen and Meckling 1992). Thus, stimulating the development of external knowledge in a subsidiary - for example, in the hope of increasing local marketing and product development - may involve granting a high degree of autonomy to the subsidiary. This leads to our fourth hypothesis:

Hypothesis 4: Subsidiary-level processes of building knowledge from external knowledge inputs are positively influenced by the degree of autonomy granted to the subsidiary.

Interdependencies and the process of knowledge building. Subsidiary knowledge may also be built from internal knowledge inputs, such as knowledge produced through interaction with other MC units. The emphasis is on building knowledge that is at least potentially transferable. The process of building knowledge in a subsidiary will, therefore, reflect perceived complementarities with knowledge elements in other parts of the MNC in order to realize potential benefits. Thus, we put forward the following hypothesis:

Hypothesis 5: Subsidiary-level processes of building knowledge from internal knowledge inputs are positively influenced by the perceived interdependencies (complementarities) between the focal subsidiary and other MNC units.

Furthermore, the development of internal knowledge is likely to be stimulated by the transfer of goods and/or services between MNC units. This is because the transfer, known as intra-MNC trade, is in itself a force pulling in the direction of a widening of communication channels. This prompts the discovery of new opportunities for realizing complementarities between knowledge components (Kirzner 1973). We put forward the following hypothesis on this basis:

Hypothesis 6: Developing internal knowledge in MNC subsidiaries is positively influenced by the amount of trade between the focal subsidiary and other MNC units.

The hypotheses are summarized in the following model.

XXXXXX *Insert Figure 2 here* XXXXXX

III. Data and Method

Data Collection

The data for this paper was collected as part of the Centres of Excellence (CoE) project that engaged researchers in the Nordic countries, the United Kingdom, Germany, Austria, Italy, Portugal and Canada (see Holm and Pedersen 2000a&b). The CoE-project was launched in May 1996 with the purpose of investigating headquarter-subsidiary relationships and the internal flow of knowledge in MNCs. In order to collect comparable quantitative data on acquisition of subsidiary knowledge, it was decided to construct a questionnaire that could be applied in all the involved countries. This was accomplished after

several project meetings and extensive reliability tests of the questionnaire on both academics and business managers.

For practical reasons, each project member was responsible for gathering data on foreign-owned subsidiaries within their own country. Thus, all subsidiaries in the database belong to MNCs. In the data gathering, subsidiary managers, rather than headquarters, were respondents. One advantage of choosing subsidiary respondents is that they are directly engaged in the market and are therefore more acquainted with its characteristics. Although we may expect any subsidiary to have a reliable awareness and understanding of its own knowledge elements, it would be an advantage to gather information on intra-MNC knowledge flows from other corporate units as well. However, it would be an unmanageable task first to identify the subsidiaries in each country and then to identify the relevant management units in the foreign MNCs.

The paper is based on data from seven countries, namely Austria, Denmark, Finland, Germany, Norway, Sweden and the UK. All countries are located in the northern part of Europe. The four Nordic countries are relatively small, while Germany and the UK are among the largest in Europe. Approximately 80 percent of the questionnaires were answered by subsidiary executive officers, while financial managers, marketing managers or controllers in the subsidiary answered the remaining 20 per cent. The response rate varies between 20 (UK) and 55 percent (Sweden), depending on the country of investigation. The quality of the data is quite high, with a general level of missing values of not more than five percent.

XXXXXXXXX *Insert Table 1 Here* XXXXXXXXX

As shown in Table 1, the total sample covers information on 2,107 subsidiaries. It comprises all kinds of subsidiaries in all fields of business. The sample size ranges from 202 (UK) to 530 (Sweden), with the size of the sample being rather similar, with the exception of Sweden. The average number of employees in the subsidiaries is 742 and the median is 102. Within the five smaller

countries, the average size of the subsidiaries are very similar, while Germany and the UK, due to the larger size of their markets, comprise substantially larger subsidiaries. As it seems natural to expect larger subsidiaries to comprise more knowledge elements and therefore more potential for knowledge transfer, *ceteris paribus*, we need to control for this bias in the data material when conducting tests of the above hypotheses.

For all subsidiaries sampled, information exists on the subsidiary knowledge elements, notably subsidiary level competencies, the sources of the competencies, organizational context variables, and the extent to which knowledge has been transferred to other MNC-units. The subsidiaries were asked to indicate the level of competence for six different activities performed by the subsidiary on a seven-point Likert scale, from 1=very weak competence to 7=very strong competence. The relevant six activities are: research (basic and applied), development (of products and processes), production (of goods and services), marketing and sales, logistics and distribution, and purchasing. The average score on the seven-point scale of the level of competence is shown in Table 2.

XXXXXXXXX *Insert Table 2 Here*XXXXXXXXX

In general, the subsidiaries indicate that they comprise a relatively high level of competence for all activities with average values ranging from 4 to 6 on the seven-point scale. The pattern is very similar for all six countries, with the highest competence levels for production and marketing/sales, and somewhat lower levels for the four other activities. As expected, the larger German and UK subsidiaries have higher competence levels than the other subsidiaries in the sample, with slightly higher values than the total sample for all six activities.

Measures

All data were collected through the questionnaire and most variables are multi-item measures that were measured using seven-point Likert scales. However, items such as the number of employees were measured using actual

values. The following sections provide the exact wording used for questionnaire items.

Knowledge transfer. Our definition of knowledge transfer captures the application rather than the transfer *per se* of the subsidiary knowledge in other MNC units. Accordingly, the subsidiaries were asked to what extent the knowledge they control has been of use to other MNC units. Respondents indicated this on a seven-point Likert scale, where 1 was defined as “to no use at all for other units” and 7 was defined as “very useful for other units” for all the six above-mentioned activities. *Knowledge transfer* is a multi-item construct calculated as the average score reported by respondents across these six items (Alpha=0.74).

Internal knowledge. The construct of “internal knowledge” (i.e., subsidiary-level knowledge built mainly from internal knowledge inputs) captures both the subsidiaries’ own effort at producing knowledge and the knowledge developed through interaction with other MNC units. The subsidiaries’ own knowledge production was measured by asking respondents to assess the level of investments in the subsidiary in the past three years, where 1 equaled “very limited” and 7 equaled “substantial”. The level of investments was assessed for all the six above-mentioned activities. In order to measure the knowledge developed through interaction with other MNC units, the respondents were asked to assess the impact of various internal organizations on the development of the subsidiary's competencies, where 1 equaled “no impact at all” and 7 equaled “very decisive impact”. Three organizations were identified: internal MNC customers, internal MNC suppliers, and internal MNC R&D units. In the models used to test our hypotheses, we use a composite measure, *Internal knowledge*, based on the average across all nine items (Alpha=0.73).

External knowledge. The construct of “external knowledge” (i.e., subsidiary-level knowledge built mainly from external knowledge inputs) captures both the importance of external parties, such as customers and suppliers, and the local cluster as sources of knowledge development in the subsidiary. The

inputs from external partners were measured by asking respondents to assess the impact of various external organizations on the development of the subsidiary's competencies, where 1 equaled "no impact at all" and 7 equaled "very decisive impact". Four organizations were identified: external market customers, external market suppliers, specific distributor and specific external R&D units.

Building on the elements of Porter's (1990) diamond model, respondents were asked to assess the business environment in which they compete along the following dimensions: availability of business professionals; availability of supply material; quality of suppliers; level of competition; government support; favorable legal environment; and existence of research institutions (1 equaled "very low" and 7 equaled "very high"). In the diamond model, the items are presented as different dimensions. However, Porter's (1990) own emphasis on the holistic nature of the model and the high inter-correlation between many of the items motivated us to construct a composite index. *External knowledge* is calculated as the average score reported by respondents across these eleven items (Alpha=0.68).

Interdependence (Complementarity). This variable measures the extent to which MNC units are dependent on (other) subsidiaries and *vice versa*. The MNC dependence on the subsidiary knowledge was assessed by asking the respondents the following question: "What would be the consequences for other units in the Foreign Company if they no longer had access to the competencies of the subsidiary?" (1 equaled "no consequences" and 7 equaled "very significant consequences"). In a similar vein, the subsidiary dependence on knowledge from other MNC units was captured by the following question: "What would be the consequences for the subsidiary if it no longer had access to the competencies of other MNC units?" (1 equaled "no consequences" and 7 equaled "very significant consequences"). Taken together, these two items reflect the interdependence between the focal subsidiary and other MNC units.

Intra-MNC trade. The level of intra-MNC trade is an indicator of the breadth of the internal trade links. It is measured as a single item - the share of

subsidiary sale going to other MNC units in 1996. The subsidiary sale to other MNC units includes both semi-products and final goods and services.

Autonomy. Based on the scale developed by Roth and Morrison (1992), respondents were asked to identify the level at which certain decisions were made, where 1 equaled foreign corporate (HQ), 2 equaled sub-corporate (e.g. division), 3 equaled subsidiary level. The decisions were as follows: hiring top subsidiary management; entering new markets within the country; entering foreign markets; changes to subsidiary organization; introduction of new products/services; approval of quarterly plan/schedules. Our measure, *Autonomy*, is based on the average of these six items (Alpha=0.61).

Controls. To control for structural characteristics of the subsidiary that might also influence the extent of knowledge transfer, we controlled for the following factors: number of subsidiary employees in 1996 (a proxy for size), its mode of formation (a dummy: greenfield or acquisition), and the host country of the subsidiary (six dummies: using UK as a base case). We expect that larger subsidiaries will be more likely to transfer knowledge to other MNC units, consistent with our theoretical arguments of a cumulative process of knowledge development in foreign subsidiaries. We have no predictions on the role of entry mode and the country dummies for the extent of knowledge transfer.

IV. Results

Tests of Hypotheses

The six hypotheses may be summarized in three basic models as follows.

- 1) Internal knowledge = Interdependencies + Intra-MNC trade + Error
- 2) External knowledge = Autonomy + Error

$$3) \text{ Transfer of knowledge} = \text{Internal knowledge} + \text{External knowledge} + \text{Internal knowledge} * \text{External knowledge} + \text{Controls} + \text{Error}$$

Hypotheses 1-3 are reflected in model 3, while hypothesis 4 is expressed in model 2. Finally, hypotheses 5-6 are expressed in model 1. However, since the above models represent decisions that are interdependent (i.e., they have to be considered jointly), the use of single equation models may yield biased results and obscure interesting theoretical possibilities. As the above models are interdependent, it is possible that the joint optimization of all involved decisions may lead to sub-optimization of one or more individual decisions. Statistically, the interdependence might be reflected in that error terms of the three models are somehow correlated. Hence, the correct model to estimate these decisions is a simultaneous equation model as three-stage least square, which circumvents the problem of interdependence by using instrument variables (often the exogenous variables) to obtain predicted values of the endogenous variables (in our case: knowledge transfer, internal knowledge, and external knowledge).

The correlation coefficients and descriptive data (mean values and standard deviation, minimum and maximum values) on all exogenous variables are provided in Appendix 1. There is a very high correlation between the interaction term and the main effects of internal and external knowledge (0.92 and 0.66) as expected. However, none of the other correlation coefficients indicated the possibility of multicollinearity (i.e. $r > 0.5$).

We have applied the three-stage least square regression techniques (3SLS) with instrument variables to test all six hypotheses simultaneously. All exogenous variables (interdependencies, intra-MNC trade, autonomy, subsidiary employees, mode of formation, and country dummies) are used as instrument variables in the estimation of the model. The result of the total model is reported in Table 3. Numbers in parentheses represent standard errors.

XXXXXXXXX *Insert Table 3 Here* XXXXXXXXX

Overall, the system of the three equations (models) works well, with a system weighted R-square of 0.44. This indicates that almost half of the observed variation in the extent of knowledge transfer is explained by the variables in the model. We turn now to the tests of our explanatory hypotheses.

Starting with hypotheses 5 and 6, recall that they posited a relationship between the interdependence and intra-MNC trade and internal knowledge development. These hypotheses are tested in the first equation and they are strongly supported. Both organizational variables have a significantly positive relationship with the development of internal knowledge (both at the one percent level). Hypothesis 4, which suggested that subsidiary autonomy impacts the building of knowledge that is mainly based on external knowledge sources, is also supported with a significant positive relationship, albeit only at the five percent level.

Hypotheses 1-3, which together propose that the development of internal and external subsidiary knowledge facilitates the level of knowledge transfer, are tested in the third equation. All three hypotheses are supported, indicating that development of internal knowledge has a positive effect (at the one percent level), while the development of external knowledge has a direct negative impact (five percent level) on the transfer of knowledge to other MNC units. However, the interaction effect of internal knowledge and external knowledge has a strong positive (one percent level) relationship with the level of knowledge transfer. These results point to the conclusion that while internal knowledge has a direct and positive effect on knowledge transfer, the effect of external knowledge is more indirect, going through the interaction with internal knowledge. This suggests that subsidiary knowledge built from external knowledge sources must somehow be integrated with internal knowledge before knowledge transfer takes place.

The number of subsidiary employees turns out to be insignificant, while acquisitions do transfer more knowledge than greenfields to other MNC units (formation is significant). Recall that the UK was used as a base case for the six

country dummies. Therefore, the country dummies shows that subsidiaries from Denmark, Norway and Sweden transfer significantly less knowledge to other MNC units than do the foreign owned subsidiaries hosted in the UK (and Finland, Germany, and Austria). This might be explained by the small size of the Scandinavian markets and their location on the European periphery.

V. Concluding Discussion

The present paper seeks to contribute to the recent differentiated MNC literature on intra-MNC knowledge transfer. It goes beyond this literature in a number of ways.

A major problem in the literature is that the main emphasis has been on *inter-firm* knowledge heterogeneity rather than on *intra-firm* knowledge heterogeneity. The reason for this is that much of the literature has focused on knowledge spillovers between independent firms and has compared different organizational forms in terms of their effectiveness at transferring knowledge. It is symptomatic that the literature on managing knowledge in joint ventures and strategic alliances is larger than the literature on managing knowledge in the MNC. However, the suppression of *intra-firm* knowledge heterogeneity makes it difficult to frame processes of intra-firm knowledge transfer (and other MNC learning processes as well). In fact, the motive for knowledge transfer is usually the wish to somehow combine knowledge elements that have hitherto existed separately. The relation between the transferred knowledge elements and the existing stock of knowledge (the MNC knowledge structure) has implications for costs and benefits of knowledge transfer.

Thus, we have made the argument that the understanding of knowledge transfer between MNC units will be furthered by taking starting with a conceptualization of the MNC as a knowledge structure. Such a conceptualization is not present in the extant literature. Therefore, there is no explicit, coherent view of what it means to say that the MNC is a knowledge-based entity. While we

cannot claim to have produced such a view in the present paper, we have taken some steps towards what a knowledge structure view of the MNC may look like. The basis of our reasoning is the argument that *in lieu* of such a view, the understanding of MNC knowledge management processes will be incomplete. Adopting a knowledge structure view that portrays the MNC as a web of connected nodes brings the costs and benefits of knowledge management directly into focus.

We also noted that understanding MNC knowledge management implies taking knowledge processes (i.e., building and transferring knowledge) as endogenous to organizational instruments. It was argued that MNC management might choose control variables (organizational instruments) to influence certain state variables (the creation and transfer of knowledge), with the existing MNC knowledge structure forming the starting point for such an exercise.

The analysis points to the realization of complementarities between transferred knowledge and existing knowledge as the main benefit of knowledge transfer, while the costs of knowledge transfer stem from costs of transfer (i.e., media of transfer) and costs of governing (i.e., providing motivation). Therefore, the net benefits of knowledge transfer depend on the costs of governing and transfer in order to realize complementarities. While the costs of knowledge transfer have been treated in the literature on MNC knowledge transfer as “stickiness of knowledge transfer”, the benefits have largely been ignored. We have taken steps towards an analysis that places costs and benefits on an equal footing.

An important implication is that this framework allows more scope for managerial discretion in the intra-firm transfer of knowledge than often seen in the literature. Thus, management can do more than align organizational mechanisms so that knowledge is efficiently transferred. By choosing organizational instruments, the characteristics of knowledge that is built and transferred inside the MNC can be influenced. In our operationalization of this approach to MNC knowledge management, we concentrated on how

management may influence key characteristics of the MNC knowledge structure. In particular, we focused on how MNC management may influence the sources of subsidiary knowledge by means of organizational instruments. We largely found support for the main argument of the paper that MNC management, through choices regarding organizational control, motivation and context, can influence the development, characteristics and transfer of knowledge. Such organizational choice variables as the level of subsidiary autonomy (own decision-making), level of intra-MNC-trade, and interdependence among the subsidiary and other MNC units were all shown to have a bearing on the development of different sources of subsidiary knowledge.

Furthermore, sourcing knowledge mainly on an internal basis has a direct positive effect, while sourcing knowledge mainly on an external basis has a negative effect on subsidiary knowledge transfer. However, the indirect effect of externally sourced knowledge going through an interaction (and transformation) with internally sourcing knowledge also has a positive effect on subsidiary knowledge transfer. This indicates that to the extent that management chooses a specific way of sourcing knowledge, it also implicitly chooses the characteristics of the sourced knowledge and the ease with which it can be transferred inside the MNC. This is because knowledge from different knowledge sources has different characteristics and is thus transferred at different cost.

Finally, there are various problems with our approach that need to be briefly raised. The measures that indicate organizational means and context (interdependence, intra-MNC trade, autonomy) admittedly do so only rather imperfectly, and we would have preferred to have much more direct measures. For example, it is somewhat unclear what kind of organizational means or context the measure Intra-MNC Trade exactly represents. However, these are unavoidable limitations of the dataset.

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Table 1 *Sample size and subsidiary employees in the different countries*

COUNTRY	SAMPLE SIZE	SUBSIDIARY EMPLOYEES (mean)
Austria	313	318
Denmark	308	284
Finland	238	200
Germany	254	1.574
Norway	262	130
Sweden	530	244
UK	202	3.787
Total	2.107	742

Table 2 *Average competence level score on a seven-point scale*

COUNTRY	Research	Development	Production	Marketing /sales	Logistics/ distribution	Purchasing
Austria	3.1	4.4	5.8	6.1	5.7	5.2
Denmark	4.8	5.2	6.0	5.9	5.7	5.3
Finland	4.3	4.9	5.9	5.9	5.5	5.3
Germany	4.6	5.3	6.3	6.2	5.9	5.7
Norway	4.2	4.9	5.6	5.7	5.3	5.2
Sweden	4.7	5.3	5.9	5.9	5.5	5.2
UK	4.9	5.3	6.1	6.1	5.9	5.5
Total	4.4	5.1	6.0	6.0	5.6	5.3

Table 3: *The three-stage least squares estimation of a simultaneous equation model.*

	Equations		
	INTERNAL KNOWLEDGE	EXTERNAL KNOWLEDGE	TRANSFER OF KNOWLEDGE
Intercept	2.38 (0.06) ^{***}	3.71 (0.08) ^{***}	1.29 (1.43)
Interdependence	0.10 (0.02) ^{***}		
Intra-MNC trade	0.08 (0.01) ^{***}		
Autonomy		0.09 (0.04) ^{**}	
Internal knowledge			0.99 (0.24) ^{***}
External knowledge			-1.33 (0.56) ^{**}
Internal knowledge* External knowledge			0.28 (0.01) ^{***}
Employees			0.00002 (0.00002)
Formation			0.26 (0.06) ^{***}
Country dummies:			
- Austria			0.32 (0.24)
- Denmark			-0.39 (0.13) ^{***}
- Finland			0.10 (0.18)
- Germany			0.20 (0.26)
- Norway			-0.50 (0.11) ^{***}
- Sweden			-0.49 (0.11) ^{***}
F-value	90.61 ^{***}	2.30 ^{**}	73.40 ^{***}
R-square			0.44
N	2056	2056	2056

***, ** and * = significant at 1, 5 and 10 percent, respectively.

Figure 1: Conceptual Model

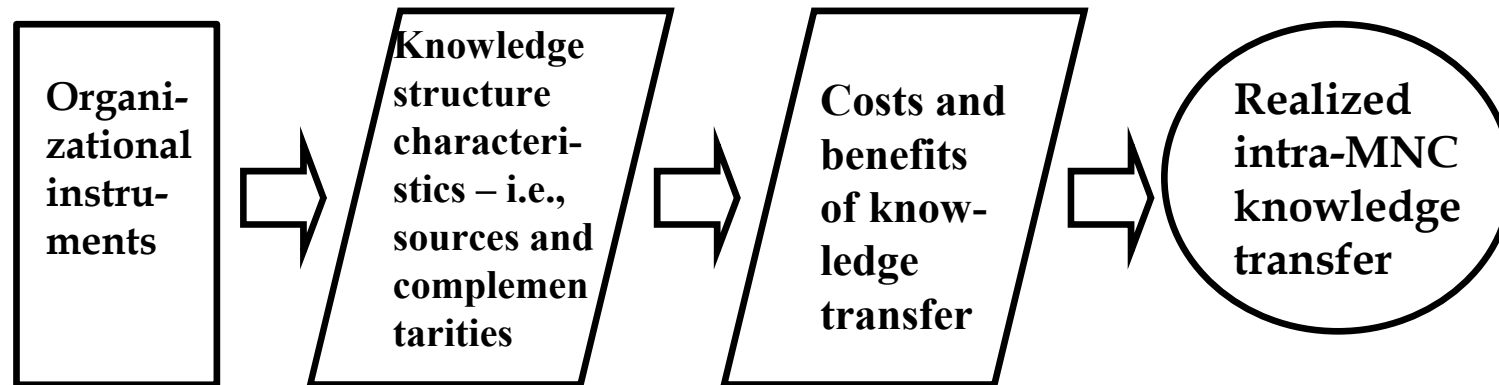
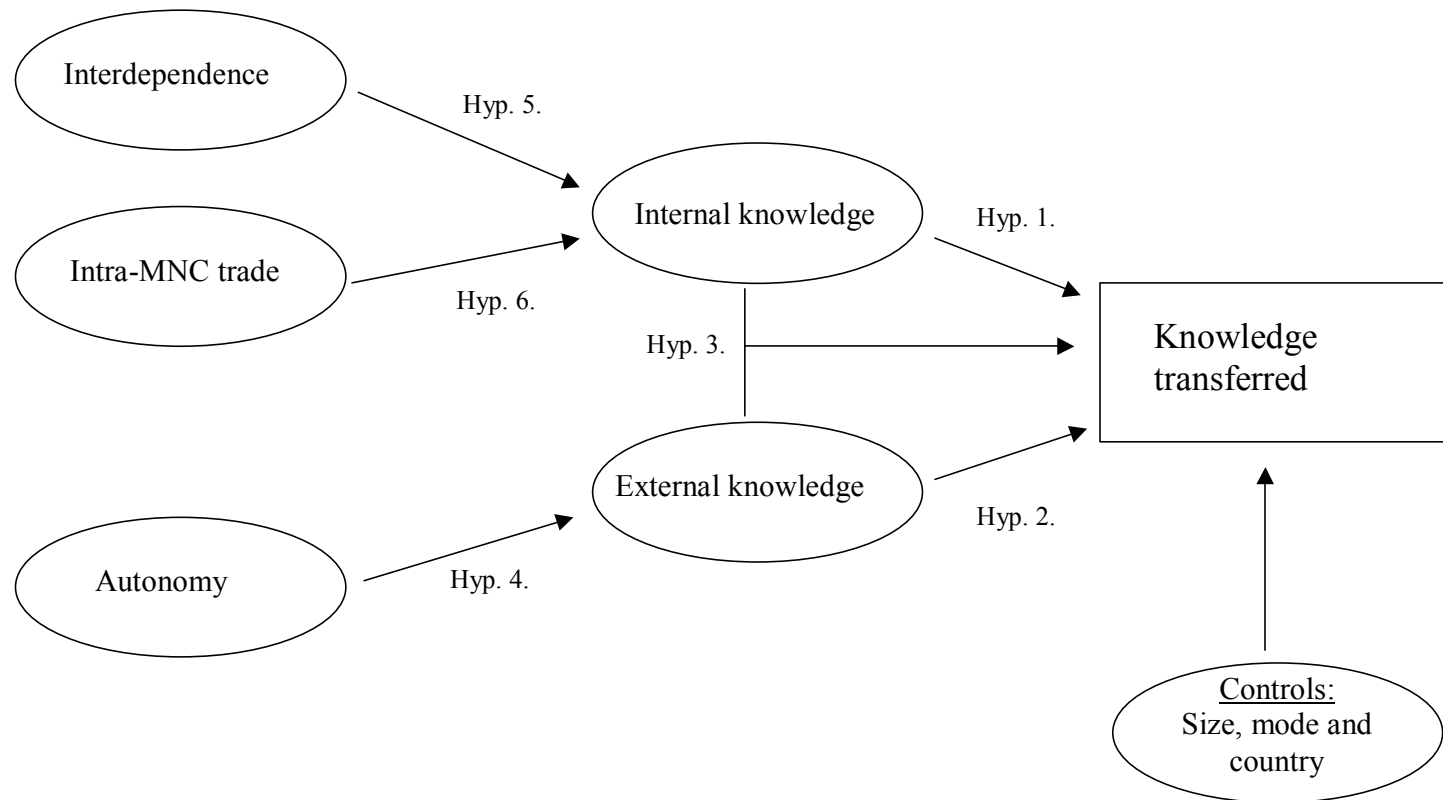


Figure 2: The Hypothesized Model



Appendix 1. Correlation matrix (N=2056) for all independent variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1) Interdependence	1.00														
2) Intra-MNC-trade	0.30***	1.00													
3) Autonomy	0.18***	0.06	1.00												
4) Internal knowledge	0.24***	0.23***	-0.10***	1.00											
5) External knowledge	0.20***	0.14***	0.01	0.36***	1.00										
6) Internal*External knowl.	0.27***	0.24***	-0.07***	0.92***	0.66***	1.00									
7) Employees	0.02	0.08***	0.02	0.03	0.01	0.02	1.00								
8) Formation	-0.15***	0.08***	-0.12***	0.11***	0.07***	0.11***	0.03	1.00							
9) Austria	0.01	0.04*	0.11***	-0.12***	0.07***	-0.06***	-0.01	-0.16***	1.00						
10) Denmark	-0.03	0.05**	-0.03	0.03	0.02	0.03	-0.02	0.11***	-0.17***	1.00					
11) Finland	-0.01	-0.07***	-0.02	-0.05**	0.03	-0.03	-0.02	-0.01	-0.15***	-0.15***	1.00				
12) Germany	0.19***	0.14***	0.01	0.12***	0.21***	0.18***	0.03	0.09	-0.15***	-0.15***	-0.13***	1.00			
13) Norway	-0.15***	-0.13***	0.01	-0.07***	-0.10***	-0.09***	-0.02	-0.07***	-0.16***	-0.16***	-0.13***	-0.14***	1.00		
14) Sweden	-0.09***	-0.03	-0.03	0.03	-0.17***	-0.05**	-0.02	0.04*	-0.24***	-0.24***	-0.21***	-0.21***	-0.22***	1.00	
15) UK	0.05**	0.01	-0.05**	0.08***	-0.02	0.05**	0.08***	-0.01	-0.14***	-0.14***	-0.12***	-0.12***	-0.12***	-0.19**	1.00
Means	3.88	2.50	1.97	2.96	3.88	11.8	742	0.58	0.14	0.15	0.11	0.12	0.12	0.25	0.10
Std. dev.	1.40	1.75	0.42	1.07	0.75	5.53	1283	0.49	0.36	0.35	0.32	0.32	0.33	0.43	0.29

***, **, and * is significance at 1%, 5% and 10%, respectively.