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Knowledge and Organization in the Theory of the Multinational Corporation: Some Foundational Issues

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Abstract. This paper addresses the interaction of knowledge and organization in IB research, particularly research on the MNC. The argument is advanced that although the MNC literature is quite advanced with respect to its treatment of firm-level knowledge, several closely connected problems remain. In particular, there has been an over-emphasis on knowledge flows and an under-emphasis on knowledge stocks; the micro-foundations of MNC knowledge are unclear; and there is a no clear understanding of the causal relations between knowledge stocks and flows and organizational control. A control theory approach that may resolve some of these problems is then sketched.

Key words: control theory, knowledge, organizational control, the MNC

1. Introduction

One of the key intellectual innovations in business administration in the last two decades has arguably been the gradual emergence of a ''knowledge-based'' approach to the firm, emerging in somewhat different guises and partly in parallel in fields such as international business (e.g., Bartlett and Ghoshal, 1989; Kogut and Zander, 1993) organization theory (Grandori, 2001; Grandori and Kogut, 2002), strategic management (e.g., Kogut and Zander, 1992; Grant, 1996), and the economic theory of the firm, whether informed by heterodox economics (Langlois, 1992) or even mainstream economics (Garicano, 2000). The approach is intended as more than a theory of the firm, namely as a general and discriminating approach to how knowledge influences economic organization (cf. Langlois, 1992; Kogut and Zander, 1992).

In spite of its fascinating and ambitious research agenda, most parts (if not all) of this stream of research is not founded on behavioral ''first principles'' (as

in economics); many of the central constructs remain unclearly defined and are not clearly dimensionalized, (e.g., notions of "routines" or "capabilities," cf. Felin and Foss, 2005); and research is often based on a grounded theory approach.[1] Yet, it is hard to dispute that the knowledge-based approach is on to something important (Foss, 1996; Holmström and Roberts, 1998; Williamson, 1999; Grandori and Kogut, 2002; Nickerson and Zenger, 2004). Precisely because of this, it is crucial that the knowledge-based approach is subjected to sympathetic critique. The present essay is offered in this spirit.

Because the knowledge-based approach is being developed in diverse fields and accordingly exists in somewhat guises, this essay only discusses the manifestation of the knowledge-based approach in the international business literature, more specifically in the literature dealing with the multinational corporation. A justification for this relatively narrow approach is that the knowledge-based MNC literature in a number of ways is arguably the most advanced manifestation of the knowledge-based approach, both theoretically and empirically.

Given this focus, the following points are developed. First, the current treatment of knowledge and organization in the theory of the MNC is critically discussed, and it is argued that in spite of the present popularity of "knowledge-based" approaches in the international business literature, the field is still far from a coherent knowledge-based understanding of the MNC. There is no clear and coherent conceptualization of what it means to say that the MNC is a "knowledge-based entity." There is (still) little understanding of how organizational control impacts processes of knowledge sharing (transfer), integration, and creation. Conversely, understanding of how existing stocks of knowledge ("capabilities") constrain the application of mechanisms of organizational control is lacking. Thus, causality is unclear, in the sense that extant research is not really clear about under which conditions knowledge characteristics are best seen as antecedents to the choice of mechanisms of organizational control, and, conversely, under which conditions mechanisms of organizational control can be chosen so as to influence the characteristics and flows of knowledge. In other words, the causal-temporal structure of managerial choices relating to knowledge and organization in the MNC is not clear.

Part of the problem is that we do not have much of a useful apparatus to help us *frame* these kind of issues. The call here is not necessarily for finely honed, formal models á la economics. This may, perhaps, be an ultimate ambition. However, what is arguably strongly needed in the theory of the MNC, and possibly the international business field at large, are apparatuses that are in between the loose, verbal account and the full-blown formal model. We may call such apparatuses "heuristic frames" (Winter, 1987), because they identify the variables that we are talking about, and lay out their

temporal-causal relations in a ''heuristic'' and not fully formal manner. This leads into the second point of this talk: The issues may very usefully be framed by means of using *control theory* as a relevant heuristic frame (cf. Singh and Doz, 1983; Postrel, 2003). The remainder of the essay is organized around these two points.

2. Knowledge Gaps in the MNC Literature?

2.1. KNOWLEDGE AND ORGANIZATION IN THE MNC LITERATURE

Tallman (2003) has recently drawn attention to a ''... transition of the dominant conceptual model of the multinational firm from the market failure approach of internalization theory and transaction cost economics theory to the market imperfections approach of capabilities or knowledge-based theories of the firm'' (Tallman, 2003, p. 495) that took place during the 1990s. This changed lens has arguably produced a host of new insights. A fundamental one is the emerging conceptualization of the MNC as a knowledge-sharing network whose existence and form can be understood in terms of its ability to transfer, create, integrate and deploy certain kinds of knowledge more efficiently than markets are capable of (Kogut and Zander, 1993). In other words, there is a strong argument that somehow knowledge and the need to create and transfer knowledge determine organization. Pondering the issue of what ''knowledge approaches can contribute to organizational theory,'' Grandori (Grandori and Kogut, 2002, p. 225) observes that what has been added is ''a new 'contingency' factor for understanding organizational arrangements ... Knowledge complexity, differentiation, and specialization, complementarity and interdependence are emerging as important contingencies affecting effective organization and governance solutions.''

It is to the lasting credit of the theory of the MNC that it took knowledge seriously as a key factor in understanding economic organization long before the mainstream economics of organization did this. As late as Holmström and Roberts (1998, p. 90), two of the leaders in formal organizational economics, observed that

> Information and knowledge are at the heart of organizational design, because they result in contractual and incentive problems that challenge both markets and firms ... In light of this, it surprising that leading economic theories ... have paid almost no attention to the role of organizational knowledge.

Observe that at the time that this statement was made, organizational knowledge had already been a favorite construct in the international business field for a decade or a more, and a knowledge-based approach was very clearly emerging (e.g., Bartlett and Ghoshal, 1989), challenging, or at least

complementing, the "leading economic theories" in that field (cf. also Tallman, 2003). And the idea that economic organization – specifically, the comparative contracting issue of whether to export, license, establish foreign operations, etc. – may be influenced by the characteristics of firm-specific assets other than that of asset specificity had surely been around much longer (e.g., Buckley and Casson, 1976).

In general, it seems that the theory of the MNC has some lead-time with respect to understanding how knowledge and organization connects, particularly relative to the economics of organization, but perhaps also relative to organizational theory at large. In particular, the recent emphasis in the so-called "differentiated MNC literature" (e.g., Hedlund, 1986; Gupta and Govindarajan, 2000; Doz et al., 2001; Foss and Pedersen, 2002) on orchestrating knowledge flows between MNC units has brought – mainly empirically based – insight into the organizational requirements of knowledge transfer, and the literature as a whole does identify key tradeoffs in organizational design, such as those between keeping knowledge local or sharing it.

To be sure, these are tradeoffs that may apply to any firm, but they are perhaps best and most vividly understood in the context of the MNC. In fact, the argument may be made that the international business field would seem to be a preeminent testing ground of knowledge-based theories, particularly as these pertain to economic organization, because the knowledge issues that may drive economic organization – such as costs of communicating across a market interface or within a firm – are likely to be more pronounced in an international than a national context. Thus, cultural, cognitive, mental, emotional, etc. barriers to knowledge sharing and transfer are, as a crude generalization, lower within units of the same firm within national borders than they are across national borders. Not surprisingly, the investigation of the importance of stickiness for knowledge transfer in MNCs and (some of) the cognitive and motivational characteristics of such stickiness (Szulanski, 1996; Gupta and Govindarajan, 2000) have come to define a veritable cottage industry in MNC research. Recent special issues of the *Journal of International Business Studies* (Focused Issue, 2004) and the *Strategic Management Journal* (Summer Special Issue, 2004) take stock on this kind of research.

In general, the knowledge-based theory of MNC organization have made numerous important strides forward in the last decade or so, including an increasingly rigorous empirical methodology, progress with respect to dimensionalizing various knowledge constructs, and an improved understanding of how the characteristics of knowledge condition organizational arrangements for transferring knowledge between MNC units.

2.2. THREE RELATED PROBLEMS

In spite of such advances, some very fundamental problems appear to be left. In fact, these are problems that seem to plague the whole ''knowledge movement'' in business administration. They are arguably caused by the unclear (or perhaps rather multiple) disciplinary foundations of this kind of research. Specifically, the problems are the following related ones:

(1) A lack of micro-foundations – that is, theorizing is not grounded in clear models of agency.
(2) An imperfect understanding of the MNC knowledge structure – this makes the foundations for the preoccupation with knowledge flows unclear.
(3) An unclear causality between a number of central constructs – this threatens empirical testing and managerial relevance.

Consider these *seriatim*.

2.3. ABSENCE OF MICRO-FOUNDATIONS

Like the knowledge-based literature in general, notions of firm-level ''capabilities,'' ''competencies,'' ''knowledge assets,'' ''absorptive capacity,'' etc. abound in the MNC literature. True, the latter literature is often more concrete and less abstract than the parallel literatures in strategic management and evolutionary economics. But the emphasis on aggregate (''macro-level'') concepts such as ''capabilities'' characterizes all these literatures. Thus, it is routinely argued that an MNC unit may have absorptive capacity; that the MNC network as a entity may possess distinct knowledge transferring and generating capabilities, etc.

Aggregate concepts are, of course, not illegitimate *per se*, provided their foundation in individual behavior is understood. However, this is hardly case for a notion such as the MNC having a distinct ''innovative capability'' in virtue of it being an MNC. Unfortunately, definition too often tend to proceed in terms of defining ill-defined concepts in terms of other ill-defined concepts (such as defining ''capabilities'' in terms of ''competencies'' and ''routines'') (Williamson, 1999). Relatedly, definition often tend to involve a mass of different constructs at different analytical levels, for example, heuristics and strategies, organizational processes and arrangements, cognitive issues (e.g., ''organizational memories''), and incentives (''truces'') (e.g., Levitt and March, 1988). Concepts such as ''capabilities'' are, however, virtually never defined with reference to individual agency (Foss, 2003; Felin and Foss, 2005)!

The reason arguably is the simple one that there is no theory of individual agency in recent knowledge-based work, and therefore no individual-level constructs to base aggregate constructs on. Therefore, much of this literature flagrantly violates methodological individualism, and implicitly adopts a

methodological collectivist approach to explanation. For example, when causal relations between capabilities and economic organization, or between capabilities and organizational performance, and little or no attention is being paid to the micro-analytic issues involved, we are witnessing methodological collectivism at work. Again, a kind of "reduced form" approach is not illegitimate *per se*, if it is possible to account for the relevant micro-mechanisms. But this is usually sidestepped. Sometimes this may be a conscious choice (e.g., Spender, 1996), but most often, it probably is not.

These points matter for MNC research. Thus, the lack of micro-specificity makes explanation vulnerable to critique from approaches (such as transaction cost economics) that *do* take an explicit micro-perspective and can point to other, more subtle, explanatory mechanisms than those identified in the knowledge-based approach (cf. Foss, 1996; Williamson, 1999). The lack of micro-specificity also leads to implicit assumptions. Thus in much of the knowledge-based view, the assumption appears (implicitly) to be made that knowledge inside firms is considerably more homogenous, and therefore less costly to communicate, than knowledge between firms. Even recent work on the differentiated MNC that explicitly focuses on cognitive and motivational impediments to knowledge transfer between MNC units appears to make this assumption, for example, by invoking some MNC-wide "organizing principles" as the homogenous (meta-) knowledge that ultimately allows MNCs to transfer knowledge at lower cost than markets are capable of. Clearly, however, such ideas should be taken to be hypotheses rather than starting points for the analysis.

2.4. LACK OF UNDERSTANDING OF THE MNC KNOWLEDGE STRUCTURE

Although work on the MNC, and particularly recent work on the differentiated MNC, does not assume that all intra-MNC knowledge is essentially homogenous, it remains true that 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 MNCs (see Lyles and Schwenk, 1992). In fact, in general much more attention has been devoted to understanding knowledge *flows* between MNC subsidiaries than to understanding the stratification of knowledge *stocks* across the MNC. This is not satisfactory, for flows emerge from stocks, as it were, and they change other stocks.

2.5. UNCLEAR CAUSALITY

Given the missing micro-foundations and the lack of understanding of the MNC knowledge structure, it is not surprising that the interaction between

knowledge and organization is less clearly conceptualized and framed in the MNC literature than one could wish for. However, a further set of problems related to thinking about the interaction of knowledge and organization in the MNC has to do with causality and temporality. Does knowledge constrain organization, or is it rather somehow the way around, or is there some degree of simultaneity in their determination, or is it the case that different kinds of organizational control influence knowledge flows, whereas knowledge stocks function as constraints on the feasible values of organizational instruments, etc.? These are important scientific questions, and there are obvious managerial implications of getting the causality right. However, the MNC literature does not offer much of a theoretical framework to handle this kind of questions.

3. Research Opportunities

3.1. INSPIRATION FROM ORGANIZATIONAL ECONOMICS?

Whereas it is arguable that the MNC literature is more advanced than the economics literature on organization with respect to its treatment of knowledge, the latter is considerably more advanced with respect to its treatment of incentives and property rights and how allocations of these influence value-creation through the impact on various externality problems. There is a lot to be said for bringing these two bodies of thought even more closely together. There is also something to be said in favour of the notion of letting an economics-based "rational action approach" take the lead in such an endeavour (see Buckley and Casson, 2001).

Early economics-based contributions to the emerging MNC literature highlighted the "internal market" aspects of the MNC (Buckley and Casson, 1976). This remains a good starting point for analysis. Specifically, we may look at "internal market failures" related to the internal supply of various kinds of public goods and open access resources, and how firms may deal with such failures (Vining, 2003). Knowledge resources at various levels of the MNC may be analysed in pretty much the standard terms of the theory of public goods (i.e., degrees of excludability, rivalry in use, strategic behaviour in connection with eliciting information, bargaining problems, etc.).

This may help us understand better the peculiar management problems associated with building, transferring and integrating knowledge in the MNC – and do so with explicit and well-established micro-foundations. Thus, we will become knowledgeable about how reward systems, monitoring, and the allocation of decision and ownership rights in MNCs influence these knowledge processes. However, an important extra benefit is a better understanding of the MNC as a knowledge structure.

3.2. ADVANCING UNDERSTANDING OF THE MNC AS A KNOWLEDGE STRUCTURE

One may think of the overall MNC knowledge structure as a set of nodes connected by arrows. 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. Notions of organizational knowledge structures (as in Lyles and Schwenk, 1992) and perhaps "core competences" and the like 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. Unidirectional arrows represent one-way *spillovers*; arrows that go in both ways represent *complementarities* between knowledge elements.

How does organization, and organizational economics ideas, relate to such a knowledge-based conceptualization? A useful first beginning may be to conceptualise knowledge resources in the terms alluded to above, as being different in terms of their degree of *excludability*. To some extent this is already done in the MNC literature; thus, the familiar tacit-explicit knowledge distinction is (also) about the extent to which knowledge is excludable from other potential users.

However, a key insight in the relevant economics literature, which seems only partly reflected in the MNC literature, is that *excludability is endogenous* to managerial action. Thus, depending on the relevant costs and benefits, knowledge can be made available to multiple agents. Much more is involved in this than the transfers of knowledge between MNC units that are so intensively discussed in recent literature. Also involved is the fact that agents or MNC units may choose to make the knowledge they control excludable in various ways, for example, because this gives them bargaining power in dealings with other MNC units (Foss and Pedersen, 2002). A further dimension is that excludability has to do with knowledge characteristics, as already indicated. However, knowledge characteristics are not exogenously given; they are endogenous to instruments of organizational control (among other things). Thus, incentives may be provided for revealing knowledge, organizational knowledge management initiatives may be started, and expatriation initiatives clearly influence the dissemination of knowledge within the MNC, all of which makes knowledge less excluded and excludable. Alternatively, knowledge may deliberate be kept local and tacit.

This line of reasoning suggests that what I earlier called the "MNC knowledge structure" is to some extent endogenous to organizational arrangements and managerial actions. In other words, fully understanding the way in which knowledge inside the MNC is shared, dispersed, transferred,

integrated, etc. requires that attention be paid to the latter ''control variables,'' to use a terminology that will be explained in the following.

4. Knowledge and Organization in the MNC: A (Sketch of a) Control Theory Heuristic Frame

4.1. THE NEED FOR FRAMEWORKS

So far, the argument has been made that there is an ill-understood interaction between MNC knowledge, individual behaviour and organizational control. One of the reasons for this situation is that it is hard to see which models can assist understanding: The issues seem so complex and intricate that modelling them in the rigorous fashion of the formal economist perhaps must remain a hopeless ambition. On the other hand, current thinking on issues in the intersection between MNC knowledge, individual behaviour and organizational control is too unsystematic and unclear, as argued earlier. Buckley observed 13 years ago that what is required in the core theory of international business research is ''... careful redefinition of the relationship between key explanatory variables so that new developments grow organically from the theory rather than being added in a piecemeal and arbitrary fashion'' (Buckley, 1990, p. 663). This statement still holds true.

What we can strive for are frameworks that ''... identify the relevant variables and the questions that the user must answer in order to develop conclusions tailored to a particular industry and company'' (Porter, 1994, p. 428). And we can do more than that, for we can also strive towards identifying and agreeing on which variables we wish to think of as relatively fixed, at least in the short run, and which variables we may think of a given to short-run managerial manipulation, and, finally, how these variables relate over time. In other words, we can and should think systematically about how we conceive of the time structure of managerial choice related to the interaction between knowledge and organization variables (Postrel, 2003). The constraints on this ''modeling problem'' appear to be that we wish

- ... to make room for *conscious* managerial choice, but, given the complexity of the choice problem(s) facing MNC management, we may not wish to portray decision-makers as cognitive gods, that is, some notion of *bounded rationality* may be appropriate;
- ... utilize some of the ''*stylized facts*'' relating to the time structure of managerial choice, for example, that firm-level routines and capabilities may only change slowly, while some kinds (certainly not all) of organizational control (e.g., relating to delegation and the provision of incentives) can be changed in the short(er) run;
- ... to embed the interaction of MNC knowledge and organization in a strategic context where the ''MNC knowledge structure'' is to some

extent endogenous to organizational arrangements and managerial actions.Following the leads of Rubin (1973), Winter (1987), Singh and Doz (1983), and Postrel (2003), ideas from *control theory* may be particularly helpful for framing the issues.[2] Admittedly, this is not the only possible heuristic frame, but is arguably the one that best meets the above restrictions on the relevant modeling problem.

4.2. CONTROL THEORY

The fundamental idea in control theory is summed up in the Alcoholics Anonymous serenity prayer: ''God grant me the serenity to accept the things that I cannot change, courage to change the things I can, and wisdom to know the difference'' (cited in Winter, 1987, p. 162).

Generalizing and adding a bit to the ''wisdom'' part, very little can be changed in the very short run, some things can be changed in the longer run, and almost everything can be changed in the very long run. (Economists will recognize this from Marshallian price theory). The ''courage'' to change things is strategic decision making within such a temporal framework.

More formally, control theory makes a distinction between three types of variables, namely ''control variables,'' ''state variables,'' and ''environmental variables.'' Control variables are those variables that can be set instantaneously at the various values within their feasible ranges (i.e., control variables may be constrained). State variables are those that change under the influence of the control variables. State variables may be constrained by boundary conditions that determine starting values. Environmental variables are parameters. Transition equations describe how changes in state variables are related to the levels of state variables, and the values of control and environmental variables. An objective function describes how the overall objective relates to state, control and environmental variables.

The relevance of these distinctions for the problems that were considered earlier is that they indicate one way to structure and make sense of the causal-temporal structure of managerial choices relating to organization and knowledge. In the context of the arguments of the earlier sections, MNC knowledge stocks may be thought of as state variables, and various kinds of organizational control (monitoring, incentives, order-giving) may be thought of as control variables. Note also that control variables – those that most directly reflect managerial choice – may be constrained within certain intervals. This directs our attention to the foundations of managerial choice behaviour. Thus, Winter (1987, p. 162) suggests that *managerial attention* is the ultimate constraint on managerial choice, and Postrel (2003, p. 4) notes that for this reason, ''... the allocation of attention is the ultimate control variable at the disposal of the firm'' (an idea that goes back at least to Penrose,

1959). This provides at least the beginnings of a theory of individual behaviour, for economizing with bounded rationality may in this manner be placed center stage in our thinking about how knowledge and organization connects.

4.3. A MODEL SKETCH[3]

So, here is one way in which thinking about the causal-temporal structure of managerial choices relating to knowledge and organization in an MNC setting may be represented. To repeat, the purpose of the following is simply to suggest that thinking may be somewhat advanced by laying out explicitly what one considers to be the relevant variables and how they connect, what Winter (1987) calls a "heuristic frame." For this reason, the following is grossly simplified, makes several affronts to realism, and involves highly questionable assumptions (e.g., that "knowledge characteristics" may be represented as "a state variable" and that the external environment can be "freezed"). So be it.

I take the objective of the MNC to maximize profits over some time horizon (there are t time periods) by means of building knowledge assets, and deploying them through the use of organizational control to their best uses, for example, by means of intra-MNC knowledge transfer. Ultimately, building knowledge assets is attractive because it may result in new product characteristics and/or lower costs of production. However, there are various (investment and organizational) costs of building, sharing, integrating, etc. such assets. Moreover, managerial attention is limited, so it has to be economized.

4.3.1. *Control Variables*

The "building" aspect of earning profits from knowledge assets suggests the importance of managerial choice. The relevant managerial control variables are, first, a vector of instruments of organizational control, O_t. These may include designing incentives for knowledge building and ways of transferring best practices, monitoring these activities, etc..[4] A second important control variable is investments in knowledge building, I_t, in the form of investments in organizational control designed to foster knowledge building, purchasing knowledge on the relevant markets, hiring new knowledge workers, acquiring knowledge-intensive new firms and integrating them into the MNC network, etc. The Penrose–Winter–Postrel argument concerning scarce attention in organizations suggests the importance of devoting attention to organizational control, a_t, as a control variable.

4.3.2. *State Variables*

The state variables are, first, the aggregate MNC knowledge stock, S_t; second, attention capacity, A_t; third, knowledge characteristics, H_t.[5] Of course,

treating such a thing as "knowledge characteristics" as a variable is a very crude simplification. If it assists intuition, think of it as some measure of, say, the tacitness of the MNC knowledge stock. The important thing is that knowledge characteristics may change under the impact of the application of organizational instruments. For example, knowledge sharing programs may be coupled with explicit monetary rewards to assist in making knowledge more explicit and easier to share.

4.3.3. *Environmental variables*

The environmental variables include wages, w; and a stochastic knowledge shock process that represents innovations outside the firm, $\{\gamma_t\}$.

4.3.4. *Objective Function*

We fix prices, $\mathbf{p}$; production capacity, $\mathbf{K}$; capital costs, $\mathbf{r}$, and abstract from the actions of rivals. Given this, the instantaneous profits for the firm can be written as[6]:

$$\pi_t = \mathbf{p}q_t - \mathbf{K}\mathrm{r} - C_t - I_t - wA_t, \text{where} \tag{1}$$

$$q_t = \min[D_t, \mathbf{K}]. \tag{2}$$

$$D_t = D(V_t - \mathbf{p}). \tag{3}$$

$$V_t = V(O_t, H_t, A_t). \tag{4}$$

$$H_t = H(O_t, I_t) \tag{5}$$

$$C_t = C(q_t, \mathbf{K}, O_t, A_t, S_t, H_t, \{\gamma_t\}). \tag{6}$$

Here, D is demand and V is the willingness to pay. Willingness to pay depends on product characteristics that in turn can be influenced by means of organizational control. The idea is that instruments of organizational control can be adopted to initiate and accomplish, for example, the transfer of knowledge of how to provide certain product certain characteristics from one MNC unit to another one. Knowledge characteristics influence the costs and benefits of such transfer processes. Attention also influences willingness to pay, because attention may be allocated to innovating new product characteristics.

Organizational control also enters into the determination of production costs, together with output, capacity, the aggregate MNC knowledge stock, S_t and stochastic shocks to technology. The idea here is the same as above: Instruments of organizational instruments may be chosen to influence the transfer of knowledge about production processes; to the extent that best practice is successfully transferred, production costs are lowered. Moreover, such instruments may be chosen to influence process innovation; for example, rewards may be tied to the discovery of incremental improvements of processes. Finally, knowledge characteristics also determine overall MNC costs of production. This is because knowledge characteristics co-determine the transfer of best-practice technology. Thus, MNCs that can easily transfer best-practice technology likely have lower overall costs of production than those MNCs where transfer is more difficult. The allocation of attention influences costs of production; for example, managerial attention may be allocated to breaking bottlenecks in the production process, reducing cost of production.

4.3.5. *Transition Equations*

The three state variables are updated in the following way:

$$S_t = S_{t-1} + s(I_t, O_{t,}). \tag{7}$$

$$A_t = A_{t-1} + a(I_t, O_t). \tag{8}$$

$$H_t = H_{t-1} + h(I_t, O_{t,}). \tag{9}$$

Thus, the MNC knowledge stock evolves under the application of organizational control instruments and investments in knowledge building; attention capacity may be expanded through such investments as purchasing knowledge on the relevant markets, hiring new knowledge workers, and acquiring knowledge-intensive new firms; and the characteristics of the MNC knowledge structure evolves under the application of instruments of organizational control applied to manipulating this structure as well as investments in knowledge building.

4.3.6. *Feasible Sets and Initial Conditions*

In any period control variables are set within their relevant feasible sets. Investments in knowledge acquisition, I_t, are obviously constrained upwards by the size of internal cash flows and the character of capital markets. I_t may be negative, as when knowledge erodes (''organizational forgetting''?). It is

constrained in the downward direction by the complete erosion of the MNC knowledge stock. Given the primitive way that organizational control, O_t, have been characterized, it is perhaps premature to go into detail about how it is constrained. However, such elements of the O_t vector as incentive pay is constrained, for the individual agent, by how much of the total wage that can be paid as variable pay (namely (close to) 100%).

4.4. IMPLICATIONS

One could try to solve the dynamic programming problem implied by (1)–(8), a pretty complex affair given the size of the problem. However, the main point of the exercise is to *exemplify* by means of sketching a heuristic frame how thinking about key relations between important variables may be furthered. Thus, although the above heuristic frame is simplistic, it nevertheless helps us to focus attention on some key points.

As stated, it lays bare the temporal-causal structure between key variables related to the building and transfer of knowledge in the MNC and the role played by organizational control in this process. In particular, the argument has been made that some variables are more constraining than others. Thus, ''capabilities'' is shorthand for the constraints represented by the existing MNC knowledge stock, the existing amount of available attention, and the characteristics of knowledge. This goes some way towards a better conceptualization of the nature of capabilities and what they accomplish. Understood as state variables they both constrain and enable the MNC's shorter-run actions. The control theory heuristic frame therefore clarifies which are the ''stock-like'' variables and which are the ''flow-like'' variables and how the relate.

The key to understanding how capabilities develop in the MNC lies in understanding the functional forms s (), a (), and h () in the transition equations (6)–(8). The development of capabilities may be understood in terms of, relatively operational, control variables, notably organizational control and investments in building knowledge.

The functional forms in the transition equations suggests that the relevant control variables, that is, organizational control and investments in building knowledge, may be either substitutes or complements with respect to their impact on the relevant state variables. This suggests an empirical research agenda of considerable managerial relevance.

MNCs may differ because the functional forms of their transition equations, that is, s (), a (), and h (), differ. Thus, not all firms are equally capable in building and transferring knowledge inside the MNC, augmenting the MNC knowledge stock from outside sources, and influence the characteristics of knowledge so as to facilitate knowledge transfer.

Over time the allocation of attention means that the MNC cannot be the best at all activities. The reason is that allocation constraints mean that firms cannot devote optimum attention to all activities (Postrel, 2003, p. 10). In terms of the model, attention influences both process innovation and the introduction of new product characteristics and these activities compete for scarce attention. Increasing returns to allocating attention to one activity causes knowledge specialization. The ultimate constraint on the building of capabilities may be the available attention.

The heuristic frame not only implies more precision about the relations between the key variables, it also suggests a sort of micro-foundation for thinking about knowledge in the MNC. The emphasis on the allocation attention and on managers as being forward looking but bounded rational is one component of such a foundation.

5. Conclusions

This essay began by pointing out that it is to the lasting credit of the MNC literature that it at a very early stage treated knowledge issues in the context of organization. However, the literature also suffers from lack of clarity with respect to the temporal-causal relations between key organizational and knowledge-related variables. Among the reasons for this are the absence of clear micro-foundations for MNC research and the absence of a conceptualization of the MNC as a knowledge structure. MNC research has progressed from different disciplinary bases and has often relied on an emergent, grounded approach to theory development.

Control theory provides a convenient (and *not* the only possible) heuristic frame for thinking about issues relating to knowledge and organization in the MNC, that is, identifying which are the relevant variables and how they connect. A simple approach has been sketched, building on Winter (1987) and (particularly) Postrel (2003). In spite of its simplicity, the approach produced a number of implications. In particular, it allows us to think in a more disciplined manner about the nature, characteristics, and development of MNC knowledge, about what are the constraints on the development of such capabilities, and how knowledge stocks and knowledge flows interact in the process under the impact of mechanisms of organizational control.

Notes

[1] Interestingly, some of the main exceptions to this somewhat generalizing characterization, such as Nickerson and Zenger (2004) and Oxley and Sampson (2004), further knowledge-based ideas by grounding them in transaction cost notions, thereby breaking with the initial premise of contributions such as Kogut and Zander (1992) that these ideas could be furthered in isolation from transaction cost economics. A recent more conventionally

knowledge-based contribution that explores the knowledge-organization links and does not conform to the Generelization is Birkinshaw et al. (2002).

[2] The classical mathematics reference is Pontryagin et al. (1962). The use of control theory to address knowledge issues was first suggested by Rubin (1973) (modelling Penrose 1959) and was taken further by Winter (1987). Singh and Doz (1983) applied control theoretic idea to modelling headquarters/subsidiary relations. Postrel (2003) applies control theory to the resource-based view of the firm.

[3] The following is a modification of Postrel (2003).

[4] Although these variables are, of course, discrete, they may be modelled as being continuous within their feasible ranges; for example, incentive intensity lies in the interval [0,1] (the β of agency theory).

[5] Any organization theorist will also tell us that important aspects of organization belong to the class of state variables, notably organizational beliefs and culture. Indeed, some may argue that there is no clear line of demarcation between these aspects of organization and such knowledge assets as "organizational competence." All this may be granted; however, for the sake of simplicity, we neglect all this.

[6] The actual objective function is of course the expected presented discounted value of (1).

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