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On Incentives for an Efficient Flow of Knowledge within Multinationals

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Abstract

In this paper we develop a principal-agent, game-theoretic model of an MNC, intended to add to the understanding of how smart choices between incentives, monitoring, and structures are linked to an effective intra-firm flow of knowledge. We find that the equilibrium depends on the efficiency of substituting incentives for monitoring. Our study sheds light on arguments within the international management field about monitoring, incentives for managers, and managing knowledge transfer between subsidiaries.

Key words: multinational; incentives; monitoring

JEL classification: F23; M10; M20

1. Introduction

The flow of knowledge between subsidiaries is an important factor in the success of multinational corporations (MNCs) (Gupta and Govindarajan, 1994, and Subramaniam and Venkatraman, 2001). Gupta and Govindarajan (1994) contend that knowledge flow is the most important resource flows within an MNC. Their argument is that, in contrast to goods and funds, knowledge is transferred more effectively and efficiently inside organizations than in external markets. This is attributable to the fact that knowledge and information in the markets are affected by market imperfections such as recognition problems, disclosure problems, and negative externalities. Furthermore, Subramaniam and Venkatraman (2001, p. 360) argue that new global products are a key factor in the MNC's competitive advantage, suggesting that the MNC can create such products through the transfer and deployment of tactical overseas knowledge.

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Since the MNC's operational knowledge resides in its subsidiaries, and one can assume that subsidiary managers are self-interested utility maximizers, each headquarter (HQ) faces a challenge: How to design mechanisms that allow, encourage, promote, and support value-enhancing knowledge transfer (KT) among the subsidiaries? In this paper, we apply a principal-agent model to propose an efficient internal mechanism that will ensure a constant flow of knowledge with positive value between two subsidiaries of the MNC. In our stylized model, an MNC comprises of HQ and two subsidiaries, one of which has knowledge that might be valuable to the other. The desired outcome is for the knowledgeable subsidiary to transfer knowledge to the other only when the expected benefit is positive.

We conduct the analysis in two stages. First, we analyze the equilibrium incentives when the informed manager is compensated for her personal cost incurred upon KT only. These personal costs consist of the direct cost of assembling the information, preparing documents, ensuring that the information reaches the other subsidiary, and the opportunity cost of not spending the time on other value-relevant activities. We find that a monetary bonus is the appropriate inducement, but the firm does not necessarily pay more for KT because the bonus substitutes for base salary. The explanation for this result is that the manager of the subsidiary alone knows whether the expected value of KT is valuable. Tying his bonus to the KT ensures that KT takes place only if he predicts positive value.

In the second half of the analysis, we consider the case where the HQ takes costly monitoring activities which trade-off with incentives (because the monitoring cost reduces with incentives). Here we find the same basic compensation structure. However, the likelihood of KT increases and the maximum bonus can exceed the expected benefit from KT because of its interaction with monitoring. We find that the bonus for KT can be higher when the MNC has a more differentiated structure.

These analyses have contributions in three areas. First, they are a pioneering analytical attempt to tie internal structure elements and incentives into a unified principal-agent framework, where the MNC is comprised of headquarters/principal and subsidiaries/agents. Second, our study injects realistic elements into the standard principal-agent game by considering the trade-off between monitoring and incentives. The focus of the incentives literature is concerned with how the principal and the agent share the outcome. We show that when the actions of the agent have indirect effects (such as reduced monitoring), the agent may be "overcompensated." That is, her share, as a ratio of payment to outcome, will exceed one. In contrast, in straightforward principal-agent relationships, as studied by Holmstrom (1979), Rogerson (1985), and others, the agent's share must fall below one because if not, the residual share of the principal is negative. Finally, our results have managerial implications, such as our finding of the trade-off between the base salary and a bonus for KT and the effect of structure on incentives for making KT.

The paper proceeds as follows. Section 2 presents the model and Section 3 the solution (the first stage detailed above). Section 4 analyzes the game when monitoring costs are introduced explicitly. Section 5 offers a summary and conclusions.

2. The Model

2.1. The Basic Setting

The profit-maximizing MNC comprises of HQ and two subsidiaries (S1 and S2) which generate the combined profits of the MNC. Each subsidiary earns profits, π_i, $i = 1, 2$. The major distinction between the two subsidiaries is that S1 is a "global innovator" (Gupta and Govindarajan, 1994)—that is, it generates an outflow of knowledge that is useful for the efficient operations of S2. We further assume S1 receives no reciprocating knowledge from S2. An example of such relationship is when S1 and S2 are both research and development (R&D) units, but the R&D in S1 has a spillover that is relevant for S2's value chain.

The economic manifestation of this information structure is that the profits of S2 are augmented by the benefits of the knowledge transferred from S1 (while the profits of S1 are independent of the profits of S2; this assumption is relatively realistic in situations where the subsidiaries deal in different product/market segments). The benefit, B, is a random variable that takes values from a binary set $\{B_+, B_-\}$, where $B_+ > 0 > B_-$; that is, the benefit could be positive, B_+, or negative, B_-. The prior probability that the benefit is positive (negative) is known to all and is denoted by p $(1-p)$. To ensure that the expected benefit is positive, we shall add that $p > 0.5$.

2.2 The Principal-Agent Relationship

The HQ shares principal-agent relationships with the subsidiary managers: the expected profits of each subsidiary depend on its manager's effort, e_i, which can be either high, e_i^h, or low, e_i^ℓ; i.e., $e_i \in \{e_i^h, e_i^\ell\}$, where $e_i^h > e_i^\ell$. The effort of the managers is not observable by HQ. Furthermore, there is a conflict of interests between the HQ and the managers in that the former prefers that each manager exerts the high level of effort, e_i^h, while the latter are naturally averse to expending effort.

The profits of each subunit i, π_i, (before the KT), is a random variable that takes a value of high, π_{Hi}, or low, π_{Li}, where $\pi_{Hi} > \pi_{Li}$. We denote the conditional probability of π_{Hi} (π_{Li}) given that the manager exerts high effort by q_i^h $(1-q_i^h)$, and the probability of π_{Hi} (π_{Li}) given that the manager exerts low effort by q_i^ℓ $(1-q_i^\ell)$. That is, $\text{Prob}(\pi_{Hi} | e_i^h) = q_i^h$, $\text{Prob}(\pi_{Li} | e_i^h) = 1-q_i^h$, $\text{Prob}(\pi_{Hi} | e_i^\ell) = q_i^\ell$, $\text{Prob}(\pi_{Li} | e_i^\ell) = 1-q_i^\ell$. (To ensure that it is never the case that the base salary of any manager is negative so that he effectively pays the HQ, we assume that $e_i^h / e_i^\ell < q_i^h / q_i^\ell$).

As is standard in the principal-agent literature, we assume that the harder a manager works, the higher the probability of π_{Hi}, $0 < q_i^\ell < q_i^h < 1$. Consequently, the expected profits of a given subsidiary increase in the effort of its manager in the first-order-stochastic dominance sense, or $E(\pi_i | e_i^h) > E(\pi_i | e_i^\ell)$, $i = 1, 2$.

The risk-neutral HQ's objective is to maximize the profits of the MNC. The MNC's profits, π_{mnc}, combine the profits of the two subsidiaries, π_1 and π_2, plus the expected benefit, B, from the flow of information from S1 to S2 minus the compensation costs of the subsidiaries' managers, W_1 and W_2:

$$E(\pi_{mnc}) = \sum E(\pi_1+\pi_2-W_1-W_2)+E(B). \qquad (1)$$

The HQ designs the contracts of the managers. Since HQ and the subsidiaries' managers are risk neutral, we assume that the incentives are a linear function of two performance measures: the direct profits of the subsidiary, π_i, and the benefit to S2 from the flow of knowledge, B. That is, denoting by $\underline{W}_i$, β_i, and γ the base salary, the bonus when the profit is high, and the bonus of S1's manager for KT (as a percentage of the benefit), respectively, the compensation contract of the manager of S1 for the transfer of knowledge is:

$$W_{L1} = \underline{W}_1+\gamma B \tag{2a}$$
$$W_{H1} = \underline{W}_1+\beta_1 (\pi_{H1}-\pi_{L1})+\gamma B,\ \beta_1 \geq 0,\ \gamma \geq 0. \tag{2b}$$

The compensation contracts of the manager of S1 when he does not transfer knowledge and of the manager of S2 are:

$$W_{Li} = \underline{W}_i,\ i = 1, 2 \tag{2c}$$
$$W_{Hi} = \underline{W}_i+\beta_I (\pi_{Hi}-\pi_{Li}),\ \beta_i \geq 0,\ i = 1, 2. \tag{2d}$$

Note that we did not specify a different bonus on KT with positive versus negative value. The reason is that by setting $\gamma \geq 0$, the manager who sends information with negative value is punished, which is supposed to deter him from doing so.

We assume that S1 privately receives imperfect information, σ, on the value of the benefit of the KT. The information takes values from a binary set $\{\sigma_1, \sigma_2\}$, where information σ_1 is correlated with B_+ and σ_2 is correlated with B_-. That is, $\text{Prob}(\sigma_1 | B_+) = \text{Prob}(\sigma_2 | B_-) = r > 1/2$ and $\text{Prob}(\sigma_1 | B_-) = \text{Prob}(\sigma_2 | B_+) = 1-r < 1/2$. This information structure implies the expected profits of the MNC (conditional on the information of S1's manager) are maximized only if S1's manager transfers knowledge when σ_1 is observed. Note that, by Bayes' rule, the conditional expected benefit to S2 profits given information σ_1 is:

$$E(B | \sigma_1) = \frac{pr}{pr+(1-p)(1-r)} B_+ + \frac{(1-p)(1-r)}{pr+(1-p)(1-r)} B_-.$$

Note that $E(B | \sigma_1) > E(B) = pB_+ + (1-p)B_-$. The time-line of our model is depicted in Figure 1.

Figure 1. Timeline

t = 0	**t = 1**	**t = 2**	**t = 3**	**t = 4**
HQ designs the contracts of the managers.	Each manager decides on her effort level.	Nature chooses the direct profits of each subsidiary.	The manager of S1 receives some private information on the benefit of transferring knowledge to S2.	The manager of S1 decides on whether to transfer knowledge to S2. Thereafter, all players collect their payoffs.

We make the standard assumption that the manager's payoff depends on monetary compensation, W, positively and on exerting effort, e, negatively. That is, denoting the manager's utility function by U,

$$U(w,e) = W - e. \tag{3a}$$

We assume that the transfer of knowledge is costly to S1's manager because it requires additional actions to ensure that S2 receives reliable and relevant information from the raw data. Foss and Pedersen (2002) recognize that not only are there costs related to knowledge transfer, but there are also natural difficulties with giving up a resource that often is the basis for personal and organizational power. Denoting this personal cost by c, the manager makes a transfer if her expected payoff is positive:

$$E[U(W,e| B)] = E(W) - e - c \geq 0. \tag{3b}$$

Incentives induce the managers to choose the higher effort because the harder they work, the higher the likelihood that the profit will be high. The manager of S1 is offered two types of incentives: a bonus to induce him to work harder, $\beta_1(\pi_{H1}-\pi_{L1})$, and a bonus to transfer knowledge, γB, which can be negative if the benefit is negative ex-post. The manager of S2 is only offered a bonus to work harder, $\beta_2(\pi_{H2}-\pi_{L2})$.

We make another standard assumption, namely that each manager's expected payoff (compensation less disutility over effort) cannot fall below her earnings for working elsewhere. We denote the reservation utility levels by U_{0i}, where $U_{0i} \geq 0$.

3. The Equilibrium

In this section, we characterize the choices of the HQ and the subsidiaries. We solve the game backwards to find the subgame perfect Nash equilibrium. The last to make a move is the manager of S1. Then, the second from last to make a move are the managers of each subsidiary, who choose effort, and then we solve the HQ's problem when it designs the compensation schemes.

(I) The Decision to Transfer Knowledge

Upon observing her private information, the manager of S1 has to decide whether to incur the cost of transferring knowledge. Since, by that time, her decision on effort at t - 1 is a sunk cost, her relevant incremental payoff upon transferring knowledge is $\gamma E(B| \sigma) - c$ and upon abstaining from transferring knowledge is zero. She makes the transfer under two conditions:

(i) The manager observes σ_1,
(ii) $\gamma E(B| \sigma = \sigma_1) - c \geq 0$.

These two conditions are self-explanatory. Condition (i) states that the manager makes the transfer only when she observes σ_1 because only then the expected benefit is positive with $\mathrm{E}(B|\sigma=\sigma_1) = \mathrm{Prob}(B|\sigma=\sigma_1)B_+ + [1-\mathrm{Prob}(B|\sigma=\sigma_1)]B_-$, and note that $\mathrm{Prob}(B = B_+|\sigma=\sigma_1) = pr/pr+(1-p)(1-r) > 1/2$, and her compensation is higher (depending on γ). Condition (ii) states that utility maximizing manager transfers the knowledge only if she is compensated for her extra cost.

These two conditions imply that

$$0 < c < \gamma \mathrm{E}(B|\sigma=\sigma_1). \tag{4}$$

The bonus for transferring knowledge must reimburse the manager for her cost of the transfer.

(II) Choices of Effort

Every manager prefers exerting e_i^h to exerting e_i^ℓ if

$$\mathrm{E}(\mathrm{W}-e_i^h|e_i^h) \geq \mathrm{E}(\mathrm{W}-e_i^\ell|e_i^\ell),\ i = 1, 2. \tag{5}$$

Each manager exerts high effort, e_i^h, because it yields expected utility that is at least as large as the expected utility obtained for exerting low effort, e_i^ℓ.

For the manager of S1, who is the global innovator, condition (5) translates to

$$\begin{aligned} &q_1^h\beta_1(\pi_{H1}-\pi_{L1})+\gamma \mathrm{E}_\sigma(\mathrm{E}[B|\sigma]-c)+\underline{\mathrm{W}}-e_1^h \geq \\ &q_1^\ell\beta_1(\pi_{H1}-\pi_{L1})+\gamma \mathrm{E}_\sigma(\mathrm{E}[B|\sigma]-c)+\underline{\mathrm{W}}-e_1^\ell. \end{aligned} \tag{6}$$

Rearranging yields

$$\beta_1 \geq v_1 \equiv \frac{e_1^h - e_1^\ell}{(q_1^h - q_1^\ell)(\pi_{H1} - \pi_{L1})} > 0. \tag{7a}$$

The bonus for high profits as a percentage of increasing profits from π_{L1} to π_{H1} must be positive to compensate the manager for exerting high rather than low effort, given how hard it is to achieve high profits because of the prevailing technology (as captured by $q_1^h - q_1^\ell$).

Repeating the analysis for the manager of S2, we obtain

$$\beta_2 \geq v_2 \equiv \frac{e_2^h - e_2^\ell}{(q_2^h - q_2^\ell)(\pi_{H2} - \pi_{L2})} > 0. \tag{7b}$$

Equation (7b) is similar to (7a). Proposition 1 summarizes the conclusions from (7a) and (7b).

Proposition 1: (a) Each manager receives a bonus, and (b) the bonus to the manager of S1 for inducing high effort is independent of the bonus for transferring knowledge.

This result is immediate from (7a) and (7b) and the comparison between them. To motivate the managers to exert a high level of effort, their contracts include incentives schemes which reward them more for a higher outcome than for a lower outcome—i.e., $\beta_i > 0$. Because the personal cost of KT, c, and the cost of exerting effort, e, are independent, the corresponding bonuses are independent as well. (This is a special case of the well-known informativeness condition of Holmstrom (1979). KT has no marginal information on the effort of the agent, and hence is not considered for incentives to induce high effort.)

(III) The Design of Incentives by the HQ

When designing the incentives of the subsidiaries' managers, the HQ solves the following program:

$$\underset{\{W_1, W_2, \pi_1, \pi_2\}}{Max} \sum \mathrm{E}(\pi_1+\pi_2-\mathrm{W}_1-\mathrm{W}_2)+\mathrm{E}(B) \quad (8)$$

s.t.

$$\mathrm{E}[\mathrm{U}_1(\mathrm{W},e, B)] \geq \mathrm{U}_{01}, \quad (\mathrm{IR}_1)$$

$$\mathrm{E}[\mathrm{U}_2(\mathrm{W},e)] \geq \mathrm{U}_{02}, \quad (\mathrm{IR}_2)$$

$$\mathrm{E}[\mathrm{U}_1(\mathrm{W},e,B| \, e_1^{h})] \geq \mathrm{E}[\mathrm{U}_1(\mathrm{W},e,B \, | \, e_1^{\ell})], \quad (\mathrm{MH}_1)$$

$$\mathrm{E}[\mathrm{U}_2(\mathrm{W},e| \, e_2^{h})] \geq \mathrm{E}[\mathrm{U}_2(\mathrm{W},e| \, e_2^{\ell})], \quad (\mathrm{MH}_2)$$

$$\gamma \, \mathrm{E}(B \, | \, \sigma = \sigma_1)-c \geq 0, \quad (\mathrm{IC1.B})$$

$$\underline{\mathrm{W}}_i \geq 0, \beta_i \geq 0, i = 1, 2, \text{and } \gamma \geq 0.$$

The HQ maximizes the expected profits of the MNC subject to the contracts guaranteeing that each manager prefers to stay with the firm (individual rationality constraints IR_i), each manager is induced to exert high effort (moral hazard constraints MH_i), and the manager of S1 is induced to transfer knowledge only when the expected benefit is positive.

(IV) The Characterization of the Compensation Contracts

When knowledge is transferred, there are two mutually exclusive equilibria, depending on whether IR_1 is binding or not. For parsimony, we relegate to Appendix A the case that IR_1 is not binding and focus now on the more interesting case that it is binding. The compensation contracts of the subsidiaries' managers, as derived in the appendix, are summarized in Table 1.

Proposition 2 draws the conclusions from Table 1.

Proposition 2: (a) Each manager receives a base salary that is determined by her reservation utility and the disutility over high effort, (b) if HQ induces KT, the base salary of the manager of S1 is decreased, and (c) while γ is larger the larger the expected benefits of the KT, γ is always smaller than one.

The proof of Proposition 2 is immediate from Table 1. The principal-agent relationships dictate the design of the compensation of the managers and the incentives for KT by the manager of S1. The minimum expected payment to each manager must guarantee that she be compensated to obtain at least her reservation utility level and the disutility over high effort and, when necessary, the KT's cost. The fact that the base salary is determined by IR_i is well-known in principal-agent relationships (see, e.g., Grossman and Hart, 1983). Our novelty is that when the manager of S1 is induced to transfer knowledge, her base salary is reduced by the expected net payment for making the KT.

Table 1. A Summary of the Equilibrium

The contract component	The manager of S1 when she does not transfer knowledge and the manager of S2	The manager of S1 when she transfers knowledge
Base salary, $\underline{W}_i$	$U_{0i}+e_i^h-q_i^h(\pi_{H1}-\pi_{L1})v_1$	0
Bonus percentage, β_i	v_i	v_2
Bonus percentage for KT, γ	0	$\frac{c}{E(B)} < \gamma \leq \frac{E(B-c)}{E(B)}$

where $E(B) = prB_+ + (1-p)(1-r)B_-$ and $E(c) = [pr+(1-p)(1-r)]c$.

We find that the larger the expected benefit from transferring knowledge, the higher the information-transfer incentives the HQ is willing to pay—i.e., γ is larger. But, the manager may never be overcompensated to that extent that she is paid more than the increase in profits, or $\gamma < 1$.

4. The HQ's Central Decision Making

So far, we restricted attention to the role of the HQ as the designer of incentives. In reality, however, the HQ contributes to the profits of the MNC in two fundamental ways. First, it undertakes monitoring activities, such as establishing formal reviews by the MNC's controller. Second, it undertakes central projects that affect the decision making of the subsidiaries' managers, such as installing a new IT system that supplies new data more rapidly and helps in the daily running of each division.

The profit-contributing actions of the HQ affect the cost of the mangers' incentives. It is well known in the incentives literature that monitoring reduces the cost of incentives by providing additional signals on the unobservable effort (see the informativeness criterion of Holmstrom, 1979). Empirically, there is ample evidence on the trade-off between spending resources on direct monitoring and paying incentives to the managers to induce them to make the desirable decisions (see, e.g., Rajapalan and Finkelstein, 1992; Tosi et al., 1997; Beatty and Zajac, 1994; Zajac and Westphal, 1994; O'Donnel, 2000). Similarly, the central projects reduce the effort required by the subsidiaries' managers for the routine running of the subsidiaries. In what follows, we focus on monitoring, without loss of generality.

The trade-off between monitoring and incentives will be more suitable in MNCs with differentiative structure than MNCs with integrative structure. Lawrence and Lorsch (1967) noted that different parts of organizations typically differ with respect to time orientations, goals, formality, and other behaviors—differentiation. They also discuss how, contingent on the environment in which the organization finds itself, varying degrees of "collaboration ... to achieve unity of effort"—integration—is needed with organizational effectiveness (Lawrence and Lorsch, 1967, p. 47). We see these same differentiation and integration mechanisms in contemporary MNCs. Those MNCs with differentiated structure (they have many diverse subsidiaries in different parts of the world) will probably use more incentives to supervise their subsidiaries. On the other hand, many MNCs stress integrating mechanisms to help coordination and control subsidiaries. Studying the organization structures of MNC subsidiaries, we expect to find differentiation mechanisms with low monitoring and strong integrative mechanisms with high monitoring.

As before, the manager of S1 is offered two types of incentives: incentives to work harder, $\beta_1(\pi_{H1}-\pi_{L1})$, and incentives to transfer knowledge, $\gamma E(B|\sigma_1)$. The manager of S2 is offered incentives to worker harder, $\beta_2(\pi_{H2}-\pi_{L2})$ only.

We specify the monitoring costs as a linear function of incentives as follows (the linearity assumption is made for parsimony; it entails no loss of generality since its relaxation will not affect results qualitatively):

$$M = \theta - \mu \{\sum \beta_i (\pi_{Hi} - \pi_{Li}) + \gamma E_\sigma [E(B|\sigma)]\}, \tag{9}$$

where

θ = The direct monitoring cost in the absence of incentives
μ = A firm specific parameter that determines the efficiency of substituting incentives for monitoring costs due to structure, $\mu > 0$.

The monitoring cost's behavior builds on the above discussion. The higher the degree of differentiative structure, the higher the autonomy given to the managers so that HQ relies more on the incentives of the managers and less on direct monitoring to induce them. Hence, the higher the degree of differentiative structure, the stronger the effect of incentives on the monitoring costs.

When designing the incentives schemes of the subsidiaries, the HQ maximizes the following profit function:

$$\underset{\{W_1, W_2, \pi_1, \pi_2, \gamma\}}{Max} \sum E(\pi_1+\pi_2-W_1-W_2)+E(B)-\theta+\mu\{\sum \beta_i(\pi_{Hi}-\pi_{Li})+\gamma E_\sigma [E(B|\sigma)]\}. \tag{10}$$

The difference between this objective function and the one studied in Section 3 is that monitoring costs are now subtracted. Otherwise, the optimization program is the same in that it has the same constraints. We solve the HQ's problem in Appendix B and find the same results for the compensation contracts of the subsidiaries' managers (see column 2 in Table 1). The only exception is that when knowledge is transferred, the bonus of S1's manager reflects the sensitivity of the monitoring costs to the wage costs as follows:

$$\frac{c}{EB} < \gamma \leq \frac{E(B-c)}{(1-\mu)EB}. \tag{11}$$

Proposition 3: The manager's bonus percentage for transferring knowledge may exceed 100%—i.e., $\gamma > 1$.

The proof is immediate from equation (11). Result 3 states that the expected payment for KT may exceed the direct benefit, $\gamma > 1$. The intuition of this result is that even if $\gamma > 1$, still it is beneficial to pay these incentives because of the favorable impact on monitoring costs.

Proposition 4: For comparative statics of the maximum bonus for KT, denote the maximum bonus for KT by $\overline{\gamma}$. The higher the degree of differentiative structure the MNC has, the higher the bonus for KT—i.e., $\partial \overline{\gamma} / \partial \mu > 0$.

The proof is immediate from equations (11) and (9). Proposition 4 shows that the maximum bonus for KT is sensitive to structure of S1. The intuition lies in the substitution between incentives and monitoring costs, which depend on the structure of the MNC. The larger the substitution effect of incentives on monitoring costs, the higher the maximum payment that the HQ is willing to pay for information-transfer incentives.

5. Concluding Remarks

The flow of knowledge between subsidiaries is an important issue in MNC management in today's global world. The challenge of profit-maximizing enterprises, given the principal-agent relationships between headquarters and divisions, is to design appropriate incentives that guarantee positive knowledge flow and suppresses the flow of negative knowledge between subsidiaries without compromising the incentives of the managers of the subsidiaries to exert effort.

In this study, we approach this issue in a model that features a HQ and two effort-averse managers of subsidiaries. One subsidiary is a "global innovator" that has access to knowledge that may increase the profits of the MNC through its effect on the profits of the other subsidiary. Some results repeat already known findings in the incentives literature: base salary is affected by the reservation wage had the manager worked somewhere else while a bonus is paid to overcome moral hazard. The interaction with KT introduces new interesting results. Base salary is reduced for the S1 manager when HQ provides a monetary incentive for KT. Furthermore, when monitoring activity is interrelated with incentives, the effect of the incentives will be higher in reducing the monitoring costs when the MNC has a more differentiated structure.

Another important implication is the result regarding the substituting of monitoring by incentives in the MNC. It is especially important in a MNC because it is difficult to monitor a subsidiary due to asymmetry in information and geographic and cultural distance. The most interesting result is that the bonus of the subsidiary manager for KT as a percentage of the benefit from KT can exceed 100% due to the favorable impact on the monitoring costs.

At the risk of repeating ourselves, we hope to make a pioneering analytical attempt to tie internal structure and incentives in a unified principal-agent framework to shed light on how more complicated and realistic objective functions of the principal affects the incentives of the agent and to provide new testable propositions for empirical research.

Future research will incorporate additional elements that have been significant barriers to the optimal flow of KT. For example, O'Donnell (2000) shows that the absence of proximity makes it difficult for the HQ of the MNC to control the subsidiary. Therefore, the HQ should give the subsidiary autonomy and at the same time find other means to exert control over the activities in the subsidiary. The distance referred to here is not only geographical but also cultural. Krishna (1996) focuses on the cultural differences between nations. He concludes that an MNC's nationality will have an impact on firms in the global era. We accordingly foresee research incorporating national cultural dimensions into the exploration of managerial systems—incentives, structures, or information systems—for effective control over remote foreign subsidiaries. While far from simple, these multifaceted insights are needed to allow MNCs to harness the knowledge and other valuable resources enmeshed in their global networks of subsidiaries.

Appendix A.

Proof of Proposition 1.

The IR_1 and IR_2 are:

$$q_1^h \beta_1(\pi_{H1}-\pi_{L1})+E(\gamma B-c \mid \sigma=\sigma_1)+\underline{W}_1-e_1^h \geq U_{01} \qquad (IR_1)$$
$$q_2^h \beta_2(\pi_{H2}-\pi_{L2})+\underline{W}_2-e_2^h \geq U_{02}. \qquad (IR_2)$$

IR_2 is binding in order to increase the MNC's profits. However, given the favorable effect of knowledge transfers' incentives on the HQ's objective function, it is no longer clear that to maximize profits, IR_1 must be binding as well. Hence, we proceed with analyzing two distinct cases: in case 1 IR_1 is binding and in case 2 it is not.

Case 1: IR_1 is Binding

Substituting (7a) and (7b) into the respective IR_i, $i = 1, 2$, yields the solution if the HQ decides not to induce KT, as is summarized in the first column in Table 1. Noting that the HQ will not induce KT unless the expected benefit net of payment to the S1's manager is positive, in combination with (4) determine the latter's bonus upon transfer, which upon substituting in IR_1 and solving given (7a) yields the solution, as summarized in column 2.

Case 2: IR_1 is not binding

This is similar to Case 1, only that, because the bonus of KT is sufficiently large, the base salary when knowledge transferred is induced, is zero, $\underline{W}_1 = 0$.

Appendix B.

Step 1

The HQ's program is:

$$\underset{\{W_1, W_2, \pi_1, \pi_2, \gamma\}}{Max} \sum E(\pi_1+\pi_2-W_1-W_2)+E(B)-\theta+\mu\{\sum v_i\gamma E_\sigma[E(B|\sigma)]\}$$

s.t.

(IR_1) and (IC1.B) hold, $\underline{W}_i \geq 0$, and $\gamma \geq 0$, $i = 1, 2$.

As before, we isolate the effect of S1 on the objective function of the HQ:

$$E(\pi_1-W_1)+E(B) = q_1^h[\pi_{H1}-v_1]+(1-q_1^h)\pi_{L1}-\underline{W}_1+(1-\gamma)prB_+ +(1-\gamma)(1-p)(1-r)B_-. \quad (A1)$$

The monitoring costs behave as in (A6).

Step 2

Denoting by K′ the arguments in the HQ's objective function that are independent of γ, and by $E(B) = prB_+ +(1-p)(1-r)B_-$, we now solve the HQ's optimization program with respect to γ:

$$\underset{\{\underline{W}_1, W_2, \pi_1, \pi_2, \gamma\}}{Max} (1-\gamma)E(B)+\mu[pr(\gamma B_+-c)+(1-p)(1-r)(\gamma B_- -c)]-\underline{W}_1+K'$$

s.t.

$$\underline{W}_1+q_1^h v_1-e_1^h+[pr(\gamma B_+-c)+(1-p)(1-r)(\gamma B_- -c)] \geq U_{01} \quad (IR1)$$

$$\gamma > \frac{c}{prB_+ + (1-p)(1-r)B_-}. \quad (IC1.B)$$

$\underline{W}_1 \geq 0$ and $\gamma \geq 0$.

Denoting by η and δ the Lagrange multipliers of the IR and IC.1B, the Lagrangian is:

$$L = (1-\gamma)prB_+ +(1-\gamma)(1-p)(1-r)B_- +\mu[pr(\gamma B_+-c)+(1-p)(1-r)(\gamma B_- -c)]-\underline{W}_1+K'$$
$$+\eta[\underline{W}_1+q_1^h v_1-e_1^h+[pr(\gamma B_+-c)+(1-p)(1-r)(\gamma B_- -c)]-U_{01}]$$
$$+\delta[pr(\gamma B_+-c)+(1-p)(1-r)(\gamma B_- -c)].$$

Step 3

The Kuhn-Tucker conditions are as follows.

γ:

$$-[prB_{+}+(1-p)(1-r)B_{-}]+[\mu+\eta+\delta][prB_{+}+(1-p)(1-r)B_{-}] \leq 0 \quad \text{(K1)}$$
$$\gamma\{-[prB_{+}+(1-p)(1-r)B_{-}]+[\mu+\eta+\delta][prB_{+}+(1-p)(1-r)B]\}=0 \quad \text{(K2)}$$

$\underline{W}_1$:

$$-1+\eta \leq 0 \quad \text{(K3)}$$
$$\underline{W}_1[-1+\eta]=0 \quad \text{(K4)}$$

η:

$$\underline{W}_1+q_1^h v_1-e_1^h-U_{01} \geq 0 \quad \text{(K5)}$$
$$\eta\{\underline{W}_1+q_1^h v_1-e_1^h-U_{01}\}=0 \quad \text{(K6)}$$

δ:

$$[pr(\gamma B_{+}-c)+(1-p)(1-r)(\gamma B_{-}-c)] \geq 0 \quad \text{(K7)}$$
$$\delta[pr(\gamma B_{+}-c)+(1-p)(1-r)(\gamma B_{-}-c)]=0 \quad \text{(K8)}$$

Non-negativity:

$\underline{W}_1 \geq 0$ and $\gamma \geq 0$.

Rearranging (K1) and (K2) simplifies to:

$$\mu+\delta+\eta-1 \leq 0 \quad \text{(K1')}$$
$$\gamma[\mu+\delta+\eta-1]=0. \quad \text{(K2')}$$

Step 4

By virtue of the fact that we analyze the case where IR is not binding, $\eta = 0$. This implies that (K9) holds as a strict inequality, i.e., (K10) holds because $\underline{W}_1 = 0$. Next, suppose that $\delta > 0$, i.e., (IC1.B) holds as a strict equality. Substituting $\underline{W}_1 = 0$ and the binding (IC1.B) into the nonbinding (IR_1), yields:

$$q_1^h v_1-e_1^h > U_{01} > 0. \quad \text{(A2)}$$

By our regularity condition that $q_1^h v_1-e_1^h < 0$, we obtain the required contradiction. This implies that either no KT takes place, $\gamma = 0$, and we are back to case 1 (i.e., IR_1 is binding), or (IC1.B) holds as a strict inequality. We proceed with the second alternative. If $\delta = \eta = 0$ and $\gamma > 0$, then by (K8′), (K7′) holds because $\mu\,\Delta_{1y} = 1$.

Observe the incremental effect of the KT on the objective function of the HQ.

$$d\pi_{mnc} = [(1-\gamma)+\gamma\mu][prB_{+}+(1-p)(1-r)B_{-}]-\mu[pr+(1-p)(1-r)]c. \quad \text{(A3)}$$

HQ induces KT only because $d\pi_{mnc} \geq 0$. So, we obtain γ.

$$\frac{c}{EB} < \gamma \leq \frac{E(B-c)}{(1-\mu)EB}. \tag{A4}$$

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