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Monitoring and Coordination in MNCs: Implications for Transfer Pricing and Intra-Firm Trade

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Abstract

The ability of multinational corporations (MNCs) to shift profits among divisions has been often perceived as an attempt to avoid taxes. We investigate how two factors – (i) the asymmetry of information between the headquarters and the affiliate's managers about local cost conditions and (ii) the limited ability of the headquarters to monitor and control the level of effort exerted by the subsidiary's managers – affect the MNC's efficiency and the level of international trade that is conducted via intra-firm trade. Our results imply that transfer price deviations from benchmark standards need not imply that MNCs manipulate transfer prices to avoid taxes but rather reflect the MNC's attempt to coordinate internal activities.

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I. Introduction

Economists and policymakers have long been interested in the internal operations of multinational corporations (MNCs). While most of the theoretical work has attempted to either explain the existence and emergence of the MNC or characterize the allocative and pricing effects of the MNC's internal transactions, policymakers have primarily focused on the latter issue. Their concern has centered on the ability of a MNC to use transfer prices to shift profits among divisions. A number of studies have found significant deviations of the internal transfer price from an arm's-length standard. These deviations may provide support for the view held by many host nations that MNCs manipulate transfer prices to avoid taxes.[1]

Tax avoidance, however, is only one reason why we might observe deviations from an arm's-length standard. As discussed in Caves [1982] and Hood and Young [1979] external and also internal factors have significant effects on resource allocation across subsidiaries as well as on their production efficiency. The traditional literature, however, focuses almost exclusively on the effects of external factors such as corporate tax differences across countries, tariffs, etc. on the setting of transfer prices.

This literature fails to take into account the fact that transfer price manipulation may exacerbate distortions caused by factors internal to the firm. For example, Caves [1982] argues that the effort exerted by the affiliate's managers may not be observed by the headquarters. This in conjunction with the fact that local managers' compensation is often based on their division's profitability severely complicates the top management's internal coordination problem because the headquarter's desire to use the transfer price to minimize the MNC's global tax liabilities may encourage slack effort by its subsidiaries' managers.[2]

Furthermore, the affiliate's managers often possess information that is not directly available to the headquarters. This is yet another organizational problem confronting the MNC. In particular, the affiliate's management

1. Vaitsos [1974] and Lall [1973] are two widely cited early studies. Bernard and Weiner [1989] provide more recent evidence. Horst [1971] and Eden [1985] present models explaining how taxes and tariffs can lead to manipulative transfer pricing.
2. For a more detailed discussion of this issue see Caves [1982], Chapter 3.

may have better information about the skills and quality of its local labor force or about the cost of other locally available inputs than the central management of the MNC.[3] Since the affiliate's management and the headquarters seek to maximize different objectives, there is an inherent incentive for the former not to share her private information with the latter. Thus, if the headquarters assigns a transfer price for transactions with the affiliate based on a cost-plus rule, the local management might prefer to report that its local costs are higher than they truly are. While misreporting may increase the affiliate's profits, it will adversely affect the MNC's global profits by causing the headquarters to make inappropriate resource allocation decisions. This discussion suggests that a better understanding of the MNC's behavior and performance requires integrating the effects of distortions caused by both external and internal factors.

In this paper we investigate the effects of the distortions induced by imperfect monitoring and coordination between the MNC headquarters and subsidiaries. We show how the top management can devise coordination schemes involving the transfer price, intra-firm trade, and managerial compensation to mitigate these distortions. Our investigation clarifies the extent that internal coordination and monitoring of activities within the MNC limit its ability to engage in transfer price manipulations to avoid taxes.

We focus on an environment wherein the top management is unable to observe the affiliate's ex post performance (*i.e.*, the affiliate's costs, and therefore also the affiliate's profits). One could conceive of a different environment where the affiliate's ex post performance can be observed if sufficient auditing is conducted. The extent to which auditing is undertaken depends on its costs and on its accuracy in revealing the unknown parameter. Baron [1989] and Baron and Besanko [1987] offer analysis of and discuss the implications of ex post observability.

Our analysis focuses primarily on the role played by two prominent internal factors: (i) the asymmetry of information between the headquarters and the affiliate managers about local cost conditions ("adverse selection") and

3. We use the terms "division managers" and "affiliate managers" interchangeably to refer to the local management of the subsidiary. We use the terms "central management", "parent", and "top management" interchangeably to refer to the decision makers located in the headquarters of the MNC.

(ii) the inability of the headquarters to observe the affiliate managers' effort ("unobservable effort").[4] First, we model adverse selection as a scenario when the top management (TM) can not observe the quality of labor, but he does observe the affililiate manager's (AM's) choice of effort. Then, we extend the analysis to the case where the AM's effort cannot be observed by the TM. We use the "full information" case (*i.e.*, when the TM observes both the quality of labor and also the AM's choice of effort) as a benchmark to evaluate and compare the behavior and performance of the subsidiary, as well as the overall performance of the MNC, under both adverse selection and the combined unobservable effort/adverse selection scenarios. We find that adverse selection and unobservable effort will cause the transfer price and the price-cost margins to depart from their full information counterparts. These deviations can be positive if the effect of asymmetric information is dominant and negative if the effect of unobservable effort is dominant.

The remainder of the paper is organized as follows. In Section II we set up the MNC's coordination problem. In Section III we present the "full information" benchmark and in Section IV we analyze the effects due to "adverse selection". The combined adverse selection/unobservable effort scenario is analyzed in Section V. In Section VI we present an example that highlights the differences between the optimal coordination schemes. In section VII we verify the robustness of our results under alternative compensation schemes. We show that the conclusions arrived at in sections III-V, which are based on the working assumption that the AM's compensation takes the form of a fixed profit sharing rule, are qualitatively unchanged when the AM's compensation takes the form of either a variable profit sharing rule or a lump-sum payment. In Section VIII we make a few concluding comments.

II. The Model

We consider a vertically integrated MNC with subsidiaries located in different countries. The affiliate, located in country A, produces an intermediate good which it ships to the parent, located in country P. Since the trans-

4. Recently, using different modeling assumptions, Prusa [1989], Gresik and Nelson [1991], Raff [1991], Stoughton and Talmor [1991], and Donnenfeld and Prusa [1993] have all studied the effects of informational asymmetries on MNC behavior.

actions involving the intermediate good are between divisions of the MNC, they are evaluated at the internal price, τ, *i.e.*, the per unit transfer price.

The parent division further processes the intermediate good, x, into a final product, y, which is sold only in the parent's country. We assume that the parent is the sole producer of this final product and therefore can act as monopoly. The parent's total revenue from sales of the final good is $R(y)$, with $R'(y) > 0$, and $R''(y) < 0$ (where primes denote derivatives). Since the MNC's divisions are located in different countries each division's declared profit will be taxed at country-specific corporate tax rates. Let t^A denote the corporate (profit) tax charged in country A and t^P denote the tax charged in country P; we assume that $t^A > t^P$.[5] The technology used by the affiliate requires two inputs, labor and managerial effort. Let $C(\theta, e)$ denote the affiliate's per unit cost of producing the intermediate good, x; e denotes managerial effort, and θ denotes the (inverse) productivity of labor. We assume that $C(\theta, e)$ is continuous and thrice continuously differentiable in both its arguments. Furthermore, we assume (i) $C_e(\cdot) < 0$, (ii) $C_\theta(\cdot) > 0$, (iii) $C_{e\theta}(\cdot) \leq 0$, and (iv) $C_{ee}(\cdot) \geq 0$. Assumption (i) and (iv) imply that costs are decreasing and convex in managerial effort; assumption (ii) implies that a more productive labor force yields a lower cost of production (*i.e.*, *low* θ is associated with low costs); assumption (iii) implies that managerial effort and labor are cooperative inputs and thus managerial effort becomes more valuable as a cost saving device the lower is the productivity of the labor force.

The parent division transforms x units of the intermediate good into y units of the final good by using a fixed coefficients technology;[6] that is $y = \gamma x$. Without loss of generality, let $\gamma = 1$. The costs of processing the intermediate good into the final good is $C^P(x)$. We assume that $C^{P\prime}(x) > 0$ and $C^{P\prime\prime}(x) \geq 0$ (where primes denote derivatives).

We focus on three instruments that the MNC can use for internal coordination: (i) quantity of intra-firm trade, x, (ii) the transfer price, τ, and (iii) the level of effort exerted by the affiliate's manager, e. Throughout the analysis

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5. The tax rates, t^A and t^P, are effective tax rates which might be inclusive of tax credits. Tax credits ensure that the problem of double taxation will not arise. For an extensive discussion of the tax provisions relating to the MNC see Caves [1982].
6. The restriction of fixed coefficients technology is only a simplifying assumption and only expedites the exposition.

we assume that the headquarters sets x and τ. Regarding the choice of effort, if the TM could observe the effort, then by using an appropriate reward/penalty scheme, he can impose his desired level of effort on the AM. Thus, the parent's ability to observe effort is equivalent to the parent choosing effort.[7] On the other hand, effort cannot be assigned if it is not observed by the TM; nevertheless the TM can influence the AM's choice of effort via his choice of x and τ.

The TM's optimal governance scheme depends on the accuracy of his knowledge about the local labor force. We assume that the AM has accurate information about the quality of its labor force, *i.e.*, she observes θ. In contrast, the parent may only have limited information about the quality of affiliate's local labor force. Even though the parent may not observe θ, he knows that θ is drawn from a distribution $F(\theta)$ with density $f(\theta)$ on the support $[\underline{\theta},\overline{\theta}]$. We assume that $z(\theta) \equiv F(\theta)/f(\theta)$ is nondecreasing.[8]

We hypothesize that the parent's objective is to maximize the MNC's net global profit. However this may not be the AM's objective. Hence, the TM needs to design a governance scheme which induces the AM to behave in a manner which is consistent with net *global* profit maximization. We posit that the TM designs a scheme which requires the AM to report the quality of its labor force, $\hat{\theta}$. Based on this report, the TM will assign a transfer price, $\tau(\hat{\theta})$, the level of effort to be exerted by the AM, $e(\hat{\theta})$, and the quantity of intra-firm trade, $x(\hat{\theta})$.

The affiliate's net profit when its manager reports $\hat{\theta}$ as the quality of its labor when in actuality it is θ is

$$\Pi^A(\hat{\theta}) = (1 - t^A)[\tau(\hat{\theta})x(\hat{\theta}) - C(\theta, e)x(\hat{\theta})]. \tag{1}$$

The observability of $\hat{\theta}$ implies that the reported profits, $\Pi^A(\hat{\theta}; \theta)$, are unobservable to the TM.

The AM seeks to maximize her utility. The AM's utility increases in mon-

7. According to Caves [1982] management systems in MNCs are classified as "close" or "open" depending on the intensity of the parent's supervision of the subsidiaries and information links between the divisions.

8. This is a common regularity assumption often found in the literature on adverse selection. It is satisfied by a variety of distributions, including the normal, uniform, and beta.

etary compensation and decreases in effort. Typically, the AM's compensation depends in some way on the profitability of her division. Hood and Young [1979] and Caves [1982] extensively discuss the prevalence of the TM using divisional profitability to evaluate and compensate the local management. We model the AM's compensation as a profit-sharing rule. We assume the affiliate's managers receive a fraction α of the subsidiary's post-tax profits, while $1-\alpha$ accrues to the MNC. For most of our analysis we focus on a fixed sharing rule, α. Because of its simplicity, a fixed sharing rule is commonly used method of compensation. Alternative compensation rules might consist of a variable proportional sharing rule, $\alpha(\hat{\theta})$, and/or a lump-sum payment $\omega(\hat{\theta})$. We consider these alternatives in section VII and find that our main conclusions remain unaltered.

We can write the AM's net utility from reporting $\hat{\theta}$ when the true quality of its labor is θ as

$$U(\hat{\theta};\theta) = \alpha\Pi^A(\hat{\theta};\theta) - \psi(e), \tag{2}$$

where $\psi(e)$ depicts the disutility (in monetary units) from exerting effort.[9] We assume $\psi'(e) > 0$, $\psi''(e) > 0$.

Any feasible governance scheme proposed by the parent must guarantee that the AM earns nonnegative net utility, if she truthfully reports θ. This is the AM's participation constraint, which is written as

$$U(\theta;\theta) \geq 0 \tag{3}$$

The parent division's net profit, given that the AM reports $\hat{\theta}$, is

$$\Pi^P(\hat{\theta};\theta) = (1-t^P)\left[R(x(\hat{\theta})) - C^P(x(\hat{\theta})) - \tau(\hat{\theta})x(\hat{\theta})\right]. \tag{4}$$

Note that the parent's profit depends on the reported $\hat{\theta}$ but does not depend on the true θ.

The MNC's objective is to maximize net global profit,[10]

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9. The assumption that the AM's utility function is separable in monetary compensation and effort is restrictive, but it is a common assumption in the principal-agent literature. Without such an assumption it would be very difficult to obtain analytical solutions.

10. Here we abstract from issues related to currency denomination and exchange rates.

$$\Pi(\hat{\theta};\theta) = (1-t^P)\left[R(x(\hat{\theta})) - C^P(x(\hat{\theta}))\right]$$

$$-(1-\alpha)(1-t^A)C(\theta, e(\hat{\theta};\theta))x(\hat{\theta}) - \beta\tau(\hat{\theta})x(\hat{\theta}). \qquad (5)$$

where $\beta = \alpha(1-t^A)+(t^A-t^P) > 0$. It is clear from (5) that tax differences ($t^P < t^A$) and profit-sharing considerations (as depicted by α) will create an incentive for the MNC to declare low profits in country A and high profits in country P. To accomplish this the MNC will attempt to shift profits from the affiliate to the parent by setting a low transfer price. However, any proposed scheme must guarantee the AM nonnegative net utility. This in turn limits the minimum transfer price that can be assigned.

III. Full Information

In order to have a benchmark which we can use for comparison with the other scenarios, we begin by assuming that the AM's effort can be observed by the parent. Effort observability can be interpreted as if the parent assigns the level of effort it desires the AM to exert. The following sequence of events describes the MNC's coordination problem: (1) nature chooses $\theta \in [\underline{\theta}, \bar{\theta}]$, which is observed both by the TM and the AM; (2) the parent announces and implements a scheme $\{\tau(\theta), x(\theta), e(\theta)\}$. Since in this scenario θ is observed by the TM, and since the TM sets $x(\theta)$ and $e(\theta)$, it follows that the affiliate's costs are observed.

For notational convenience, let $U(\theta) \equiv U(\theta; \theta)$, $\Pi^A(\theta) \equiv \Pi^A(\theta; \theta)$, and $\Pi(\theta) \equiv \Pi(\theta; \theta)$. To obtain the optimal scheme the headquarters solves the following program:

$$\max_{\{x(\theta), e(\theta), \tau(\theta)\}} \Pi(\theta) \qquad (6)$$

subject to $U(\theta) \geq 0$. In the full information program the headquarters can use the transfer price to allocate profits between divisions. Since $\alpha > 0$ and $t^A > t^P$ the TM will find it optimal to minimize the affiliate's declared profit and therefore will assign a transfer price so that the AM's participation constraint holds with equality for all θ; that is, for all realizations of θ the AM receives only the minimum amount of monetary compensation which guarantees her participation. Substituting the participation constraint into (6) and differentiating with respect to $x(\theta)$ and $e(\theta)$ yields

$$R'(x(\theta)) - C^{P\prime}(x(\theta)) - C(\theta, e(\theta)) = 0, \tag{7}$$

$$\delta\psi'(e(\theta)) = -(1-t^P)x(\theta)C_e(\theta, e(\theta)), \tag{8}$$

where $\delta = \beta/(\alpha(1-t^A)) > 0$. Let $\{x^{FI}(\theta), e^{FI}(\theta)\}$ be the solution to (7) and (8). Using $\{x^{FI}(\theta), e^{FI}(\theta)\}$ and the participation constraint we find the optimal transfer price,

$$\tau^{FI}(\theta) = \frac{1}{x^{FI}(\theta)}\left[\frac{\psi(e^{FI}(\theta))}{\alpha(1-t^A)}\right] + C(\theta, e^{FI}(\theta)). \tag{9}$$

The economic interpretation of the optimal scheme under full information is straightforward. From (7) the quantity of intra-firm trade, $x^{FI}(\theta)$, equalizes the marginal revenue of the final good's sales with the MNC's total marginal costs. The MNC's total marginal costs consist of the sum of the affiliate's first-stage marginal cost of production and the parent's second-stage marginal cost of transformation. Note that the tax differences do not distort the valuation of the affiliate's costs. The AM's level of effort is set to equalize the marginal benefit of effort (the right hand side of (8)) with the marginal disutility of effort (the left hand side of (8)). Finally, from (9) note that the optimal transfer price can be interpreted as a cost-plus rule. The transfer price exceeds the affiliate's average cost of production by the minimum amount that compensates the AM for her effort as reflected by the first term on the right hand side of (9). This term depicts the average disutility per unit of output adjusted for taxes and profit-sharing.

It should be pointed out that our analysis will highlight the deviations due to asymmetric information and effort unobservability relative to the "full information" case. We believe that these deviations from the full information benchmark capture departures from any other meaningful benchmarks, including the arm's length standard.[11]

IV. Adverse Selection

We now extend the analysis to capture the effects of asymmetric informa-

11. It is straightforward to change the participation constraint to allow the AM to earn positive net utility. Hence, the full information solution is qualitatively equivalent to an arm's length standard where the AM earns (constant) positive net utility.

tion when effort is observed and monitored. Since now only the AM observes the quality of labor, θ, she may prefer to report a different quality, $\hat{\theta}$, to the parent. The TM desires to design a scheme which induces the AM to report the true quality of labor. In view of this informational asymmetry the parent must announce its governance scheme without knowing the true realization of θ. This scheme consists of requiring the AM to make a report, $\hat{\theta}$. Based on this report the AM is required to exert effort $e(\hat{\theta})$ and produce and transact the quantity $x(\hat{\theta})$ at the transfer price $\tau(\hat{\theta})$.

Note, however, that the AM may prefer to report a quality, $\hat{\theta}$, that differs from the true θ. By the revelation principle we can restrict without loss of generality the analysis to only those schemes that are incentive compatible.[12] In other words, the TM desires to design a scheme which induces the AM to report the true quality of labor. Under this scheme, although the affiliate's costs are unobserved by the TM, the AM's reported costs and the affiliate's actual costs are the same, even though the costs are not verifiable.

The TM constructs the optimal scheme by solving the following program:

$$\max_{\{x(\theta),e(\theta),\tau(\theta)\}} \int_{\underline{\theta}}^{\bar{\theta}} \Pi(\theta) f(\theta) d\theta \tag{10}$$

subject to

$$U(\theta;\theta) \geq U(\hat{\theta};\theta), \qquad \forall \hat{\theta};\theta \in [\underline{\theta},\bar{\theta}], \tag{11}$$

$$U(\theta;\theta) \geq 0, \qquad \forall \theta \in [\underline{\theta},\bar{\theta}]. \tag{12}$$

In the above program (11) depicts the incentive compatibility constraint while (12) depicts the participation constraint. When constraint (11) is satisfied the AM will always be at least as well off by reporting the true θ as reporting any other $\hat{\theta}$.

In order to solve this program it is convenient to replace the participation and the global incentive compatibility constraints with their local representation.

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12. See Dasgupta, Hammond, and Maskin [1979] and Myerson [1979] for a formal treatment of the revelation principle. See also Baron and Myerson [1982], Guesnerie and Laffont [1982], and Laffont and Tirole [1986] for applications of the revelation principle to principal-agent models.

Lemma 1: *The local representation of (11)–(12) is:*[13]

$$U(\bar{\theta}) \geq 0, \tag{13}$$

$$U(\theta) = U(\bar{\theta}) + \alpha(1-t^A)\int_{\theta}^{\bar{\theta}} C_{\theta}(\tilde{\theta})x(\tilde{\theta})d\tilde{\theta}, \tag{14}$$

$$\frac{x'(\theta)}{x(\theta)} \leq -\frac{C_{e\theta}(\theta,e(\theta))}{C_{\theta}(\theta,e(\theta))}e'(\theta). \tag{15}$$

Using the local representation we can rewrite the TM's maximization problem as[14]

$$\max_{\{x(\theta),e(\theta),\tau(\theta)\}} \int_{\underline{\theta}}^{\bar{\theta}} \Big\{(1-t^P)[R(x(\theta)) - C^P(x(\theta)) - C(\theta,e(\theta))x(\theta)]\Big\} f(\theta)d\theta$$

$$- \int_{\underline{\theta}}^{\bar{\theta}} \Big\{\delta\psi(e(\theta)) + \beta C_{\theta}(\theta,e(\theta))x(\theta)z(\theta)]\Big\} f(\theta)d\theta - \delta U(\bar{\theta}). \tag{16}$$

From (16) we note that tax and profit-sharing considerations (as depicted by $\delta > 0$) will induce the parent to set $U(\bar{\theta}) = 0$.

Pointwise differentiation of (16) with respect to $x(\theta)$ and $e(\theta)$ yields the following first order conditions:

$$R'(x(\theta)) - C^{P\prime}(x(\theta)) - C(\theta,e(\theta)) = \frac{\beta}{1-t^P}C_{\theta}(\theta,e(\theta))z(\theta), \tag{17}$$

$$\delta\psi'(e(\theta)) = -(1-t^P)x(\theta)C_e(\theta,e(\theta)) - \beta C_{e\theta}(\theta,e(\theta))x(\theta)z(\theta). \tag{18}$$

Let $\{x^{AS}(\theta), e^{AS}(\theta)\}$ be the solution to (17) and (18). We can also solve for the optimal transfer price,

$$\tau^{AS}(\theta) = \frac{1}{x^{AS}(\theta)}\left[\frac{\psi(e^{AS}(\theta))}{\alpha(1-t^A)}\right] + C(\theta,e^{AS}(\theta)) + \frac{1}{x^{AS}(\theta)}\int_{\theta}^{\bar{\theta}} C_{\theta}(\tilde{\theta},e(\tilde{\theta}))x(\tilde{\theta})d\tilde{\theta}. \tag{19}$$

The optimal governance scheme under adverse selection has a sensible economic interpretation. The parent sets the quantity of intra-firm trade

13. Proof is available upon request.

14. Note that the expression (15) depicts the local second order condition of the incentive compatibility constraint. If we were to incorporate this expression into the TM's optimization problem it would be very difficult to obtain an explicit solution for this program. For the time being we shall solve the program without incorporating constraint (15). Once a particular functional form is chosen for the affiliate's cost function one would need to verify that the solution satisfies (15).

$x^{AS}(\theta)$ to equalize marginal revenue with total marginal costs, as depicted in (17). In contrast with the full information case total marginal costs now include an additional term, $\beta C_{\theta}(\cdot)z(\theta)/(1-t^{P})$. This expression can be interpreted as the shadow cost due to the AM's private information about labor quality. In addition, the level of effort, $e^{AS}(\theta)$, is set to equalize the marginal disutility of effort (the left hand side of (18)) with the marginal benefits of effort (the right hand side of (18)). Note that the marginal benefit of effort under adverse selection includes the term, $-\beta\, C_{e\theta}(\cdot)x(\theta)z(\theta)$ which is positive. This expression can be interpreted as the informational induced change in the marginal benefit of effort. That is, when the AM contemplates what θ to report she must take into account the effect of her report of θ both on intra-firm trade and also on the effort she will be required to exert. Hence, for a given quantity of intra-firm trade the TM discourages high reports (*i.e.*, $\hat{\theta} > \theta$) by requiring the manager to exert more effort the lower is the reported labor quality.

The optimal transfer price under adverse selection also has the interpretation of a cost-plus rule, as depicted in (19). However, in contrast with the cost-plus rule implemented under full information, now the transfer price compensates the AM not just for production costs and the disutility of her effort, but also provides an additional payment which is captured by the last expression on the right hand side of (19). This (per unit) payment reflects the value of the AM's private information; when provided it makes it optimal for the manager to truthfully report the quality of her labor force since it compensates the AM for her informational advantage with respect to the TM.

To highlight the role of asymmetric information it is worthwhile to compare the solutions under adverse selection with those under full information:

Proposition 1: *Comparing the optimal governance schemes under full information, and under adverse selection reveals that (i) for any given (common) level of effort, there is less intra-firm trade under adverse selection; (ii) for any given (common) quantity of intra-firm trade, more effort is required under adverse selection; and (iii) for any given (common) quantity of intra-firm trade and (common) effort level, the transfer price is higher under adverse selection.*

The reduction in intra-firm trade is due to the higher costs of transacting

under asymmetric information. The effort distortion stems from the fact the TM uses effort as an instrument to induce truthful reporting of the quality of the local labor force. The transfer price distortion is due to the fact that the TM must offset the AM's incentive to exploit her informational advantage by providing her with higher compensation than under full information.

Taken together, (i) and (ii) reveal that overall, for any given θ asymmetric information has an ambiguous effect on intra-firm trade and effort. The ambiguity stems from the fact that while asymmetric information tends to lower trade (from (i)), it also tends to increase the effort required of the AM (from (ii)). However, the higher effort implied by (ii) lowers the costs of production and therefore expands trade, which tends to offset (i). Conversely, the lower trade implied by (i) lowers the effort required of the AM, which offsets (ii). Therefore the overall effect of asymmetric information on intra-firm trade and effort is ambiguous. Further, since the effect of asymmetric information on trade and effort is ambiguous, it is clear from (9) and (19) that the effect on the transfer price is also ambiguous.

The fundamental source of the ambiguity is the way in which managerial effort interacts with labor input. This interaction is captured by the term $C_{e\theta}\}(\cdot)$.[15] If $C_{e\theta}(\cdot) = 0$ (*i.e.*, managerial effort is separable from labor input) the effect of asymmetric information on $x(\theta)$ and $e(\theta)$ can be unambiguously stated. Specifically, the first order condition (18) reveals that effort now depends on θ only indirectly. Thus, for any given quantity of intra-firm trade, $e^{FI}(\theta) = e^{AS}(\theta)$. With cost functions that satisfy this restriction the TM need not use effort to discourage misreports. Now recall from the comparison of (7) and (17), that for a given level of effort, asymmetric information reduces intra-firm trade relative to full information. Since effort and the quantity traded are positively related (from equation (18)), it follows that asymmetric information also reduces the level of effort.

The above discussion also implies that the information asymmetry will cause the transfer price to be set at a level higher than when this asymmetry is absent. In other words, the transfer price will deviate from the benchmark due to the MNC's internal organization problems. Moreover, host gov-

15. In section 6 we present an example highlighting the effects of asymmetric information for the case when $C_{e\theta}(\cdot) < 0$.

ernment regulation of transfer prices will exacerbate the MNC's control problem. Hence, departures from the benchmark should not be construed to imply manipulative transfer pricing.

V. Adverse Selection and Unobservable Effort

So far the analysis was conducted under the assumption that the headquarters could observe and monitor the AM's level of effort. This assumption was made mostly for the purpose of disentangling the effects of adverse selection from those due to effort unobservability. Since the AM maximizes net utility rather than profits, when her effort is not observable to the TM, the former will shirk. Furthermore, due to the unobservability of θ, the AM's effort choice can not be inferred.

The effort distortion is exacerbated by the fact that the AM's monetary reward depends on the affiliate's profits, which are taxable, whereas the AM's utility from exerting less effort is not taxable. Consequently, for these reasons the AM will tend to engage in slack effort or *X*-inefficiency ⟨Leibenstein [1966]⟩. In the following we investigate the governance scheme that the TM constructs in order to induce the AM to align her choice of effort with global profit maximization.

It is worth noting that there are differences in the sequence of events when effort is and is not observed. In the former case, the effort schedule is announced by the TM before the AM reports $\hat{\theta}$. In the latter case, the AM selects effort simultaneously with her report of $\hat{\theta}$.

This difference has important consequences for the optimal governance scheme designed by the TM. Once again, by the revelation mechanism we restrict the analysis to only those schemes that are incentive compatible. As in the case of adverse selection, even though the affiliate's costs are unobserved by the TM, the AM's reported costs and the affiliate's actual costs are the same, despite the fact that the costs are not verifiable.

In order to maximize global net profits the TM needs to construct a scheme $\{x(\theta), \tau(\theta)\}$ which solves the following program:

$$\max_{\{x(\theta),\tau(\theta)\}} \int_{\underline{\theta}}^{\bar{\theta}} \Pi(\theta) f(\theta) d\theta \tag{20}$$

subject to

$$e^{ASUE}(\theta, x(\hat{\theta})) = \{e \mid \alpha(1-t^A)C_e(\theta, e)x(\hat{\theta}) + \psi'(e) = 0\}, \tag{21}$$

$$U(\theta;\theta) \geq U(\hat{\theta}, \theta), \quad \forall \hat{\theta}, \theta \in [\underline{\theta}, \bar{\theta}], \tag{22}$$

$$U(\theta;\theta) \geq 0, \quad \forall \theta \in [\underline{\theta}, \bar{\theta}]. \tag{23}$$

In this program, AM's effort choice, $e^{ASUE}(\cdot)$, depends on the reported value of labor quality, $\hat{\theta}$, as well as the true value, θ, which is only observed by the manager.

As in section IV it is convenient to replace the participation and the global incentive compatibility constraints with their local representation. After deriving the local representation we can rewrite the unobservable effort/ adverse selection program (20)-(23) as the following unconstrained program:[16]

$$\max_{\{x(\theta), \tau(\theta)\}} \int_{\underline{\theta}}^{\bar{\theta}} \left\{(1-t^P)[R(x(\theta)) - C^P(x(\theta)) - C(\theta, e^{ASUE}(\cdot))x(\theta)\right\} f(\theta)d\theta$$

$$- \int_{\underline{\theta}}^{\bar{\theta}} \left\{\delta\psi(e^{ASUE}(\cdot)) + \beta C_\theta(\theta, e^{ASUE}(\cdot))x(\theta)z(\theta)\right\} f(\theta)d\theta - \delta U(\bar{\theta}). \tag{24}$$

Once again since $\delta > 0$ it is clear from (24) that $U(\bar{\theta})$ will be set equal to zero.

Pointwise differentiation of (24) with respect to $x(\theta)$ yields

$$R'(x(\theta)) - C^{P\prime}(x(\theta)) - C(\theta, e^{ASUE}(\cdot)) = \frac{\beta}{1-t^P} C_\theta(\cdot)z(\theta)$$

$$+ \left[\frac{\delta}{1-t^P}\psi'(e^{ASUE}(\cdot)) + x(\theta)C_e(\theta, e^{ASUE}(\cdot))\right] \frac{\partial e^{ASUE}(\cdot)}{\partial x}$$

$$+ \left[\frac{\beta}{1-t^P}\right] C_{e\theta}(\cdot)x(\theta)\frac{\partial e^{ASUE}(\cdot)}{\partial x} z(\theta) \tag{25}$$

Let $x^{ASUE}(\theta)$ denote the solution to (25). We can also solve for the transfer price,

$$\tau^{ASUE}(\theta) = \frac{1}{x^{ASUE}(\theta)}\left[\frac{\psi(e^{ASUE}(\theta, x^{ASUE}(\theta)))}{\alpha(1-t^A)}\right] + C(\theta, e^{ASUE}(\theta, x^{ASUE}(\theta)))$$

$$+ \frac{1}{x^{ASUE}(\theta)} \int_\theta^{\bar{\theta}} C_\theta(\tilde{\theta}, e^{ASUE}(\tilde{\theta}, x^{ASUE}(\tilde{\theta})))x(\tilde{\theta})d\tilde{\theta}. \tag{25}$$

16. Technical details of derivation are available upon request.

When faced with both unobservable effort and adverse selection the TM sets the quantity of intra-firm trade to equalize marginal revenue with total marginal costs; the total marginal costs consist of a production component, an effort component, and an information component (as depicted in (25)).

When we compare (25) with (17) we find that under the combined scenario two additional distortions arise. First, there is a positive direct effect of the quantity traded on effort, as depicted by the bracketed expression of the right-hand side of (25).[17] The direct effect reflects the positive relationship between quantity traded, x, and the induced level of managerial effort, e. This effect raises the parent's marginal cost and therefore tends to lower $x(\theta)$. Second, there is a negative indirect effect captured by the term $C_{e\theta}(\cdot)$ $x(\theta)z(\theta)\partial e^{ASUE}(\cdot)/\partial x$, which lowers the marginal cost and thus tends to increase $x(\theta)$. The indirect effect is a by-product of the combination of unobservable effort and adverse selection. More precisely, since effort and labor are cooperative inputs (*i.e.*, $C_{e\theta} \leq 0$) and effort and output are positively related, the indirect effect reflects the parent's incentive to offset the reduction in the AM's effort that is implied by the decrease in the quantity traded stemming from the pure adverse selection effect. When $C_{e\theta}(\cdot) = 0$ the indirect effect is absent and the addition of asymmetric information to the unobservable effort problem leads to a reduction in $x(\theta)$ (relative to its level under pure adverse selection). This in turn leads to a reduction in the AM's effort level.

This discussion leads to the following proposition.

Proposition 2: *Assume that $C_{e\theta}(\cdot) = 0$. Comparing optimal governance schemes under combined adverse selection/unobservable effort with adverse selection reveals that the quantity of intra-firm trade and the level of managerial effort are lower under the combined scenario. The transfer price schedules under the two scenarios can not be unambiguously ranked.*

Note, however, that when $C_{e\theta}(\cdot) \neq 0$ the comparison of the optimal governance schemes yields ambiguous conclusions. As we show in the next section, for some class of of cost functions, we can unambiguously characterize the optimal governance schemes.

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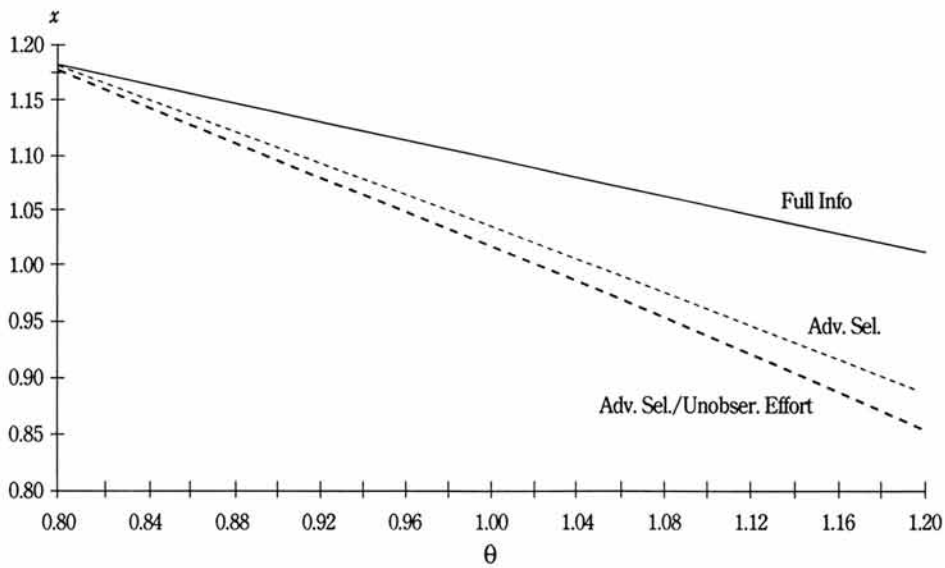
17. Using (21) one can show that the bracketed expression is positive.

VI. An Example

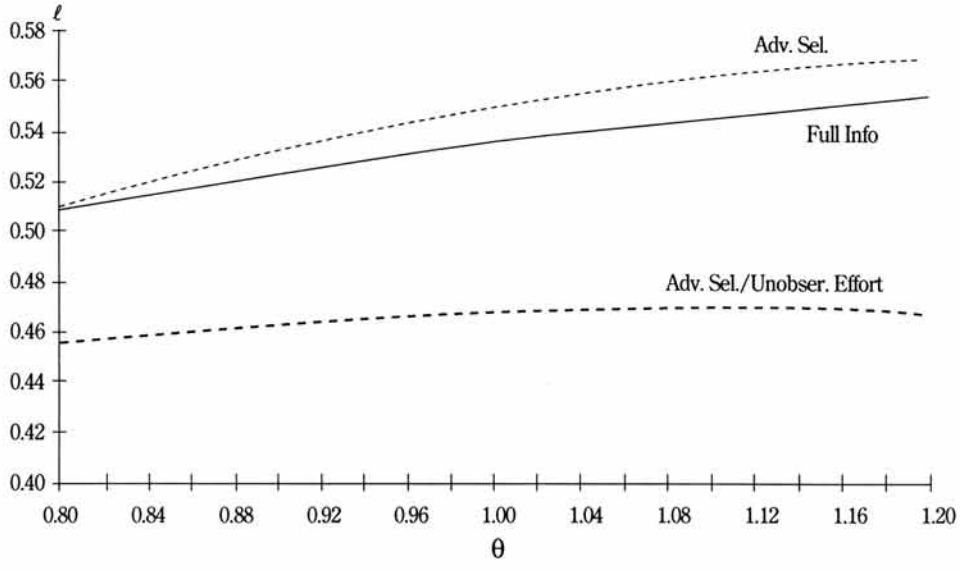
In this section we derive unambiguous results for a general cost function at the expense of restrictions on other aspects of the general formulation. Specifically, we will analyze a multiplicative cost function, $C(\theta, e) = \theta/e$. For simplicity we also assume a uniform distribution of θ; a constant marginal cost function for the parent, $C^P(x) = cx$; a linear demand, $R(x) = (a - bx)x$, $a > b > 0$; and a quadratic disutility of effort, $\psi(e) = e^2$. The parameters for the examples are $\alpha = 0.5$, $a = 6$, $b = 1.75$, $c = 0.3$, $\theta \in [0.80, 1.20]$, $t^A = 0.6$, $t^P = 0.3$. In Figures 1-3 we illustrate the behavior of the optimal schemes for each scenario. Figure 4 depicts the price-cost margin, $(\tau(\theta) - C(\theta, e))/C(\theta, e)$.

We will first look at intra-firm trade. Under all the scenarios the quantity of intra-firm trade is decreasing in θ, as depicted in Figure 1. Note that the addition of adverse selection causes intra-firm trade to decline at a faster rate because of the higher costs of trading due to the shadow cost of the informational asymmetry. The combined adverse selection/unobservable effort scenario results in an even smaller volume of intra-firm trade. In this case, the MNC is plagued by high affiliate costs due to both the shadow cost of the AM's private information and also to low managerial effort.



Intra-firm Trade

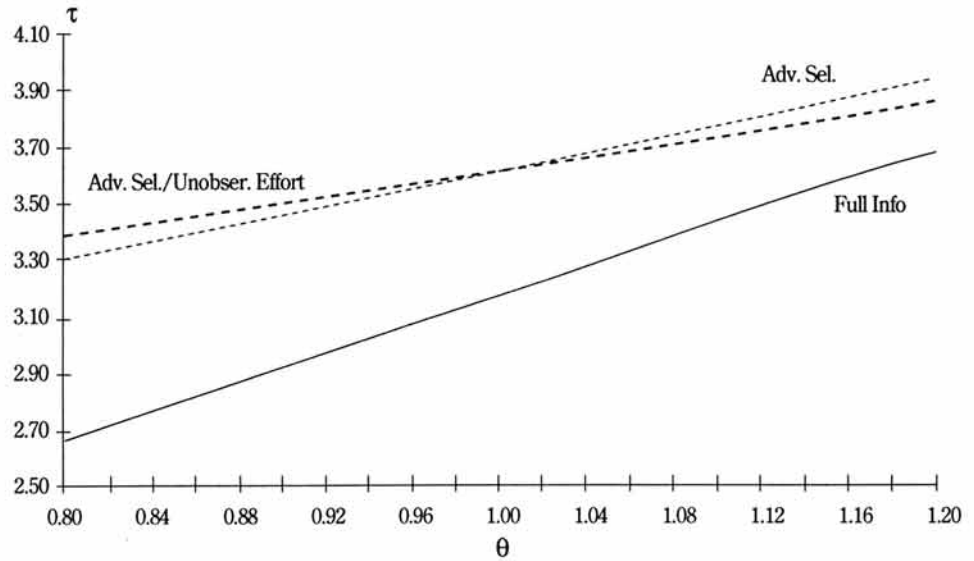
Figure 1



Effort
Figure 2

Looking next at effort, we find that adverse selection and unobservable effort have much different effects on the AM's level of effort. First note that under adverse selection the TM demands that the AM exert more effort than under full information, as depicted in Figure 2. As discussed in section IV, the TM uses effort along with the quantity of intra-firm trade to discourage misreports. Under the combined scenario, effort is lower than under either full information or adverse selection.

As depicted in Figure 3, the transfer price increases with θ under all scenarios. The participation constraint implies that the transfer price must exceed unit costs since the TM must compensate the AM for her effort. From Figure 2 it is clear that effort rises much more slowly than θ which implies that unit costs rise with θ. Therefore, the transfer price must increase with θ as well. Under full information the transfer price is just sufficient to induce the AM to participate. However, under adverse selection and combined adverse selection/unobservable effort the AM earns positive net utility for all $\theta < \bar{\theta}$. Hence it is not surprising that the transfer price schedule under adverse selection lies above the full information schedule. The behavior of the transfer price schedule under the combined scenario is quite intri-

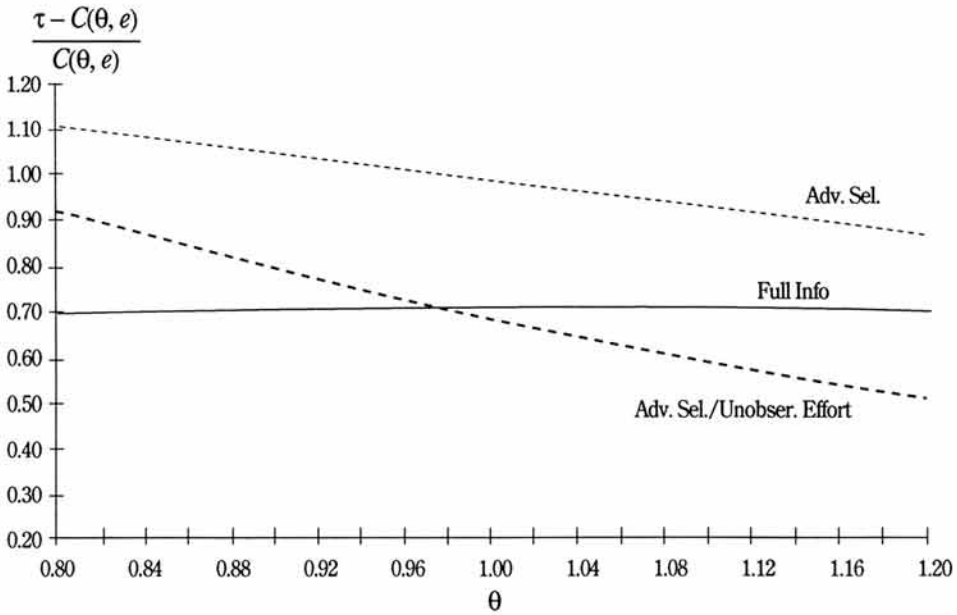


Transfer Price
Figure 3

cate. For low θ the informational rents are higher under the combined scenario. This translates into a higher transfer price under the combined scenario. As θ increases, informational rents decrease, which allows for a (relatively) lower transfer price under the combined scenario.

The behavior of the price-cost margin is significantly influenced by asymmetric information and unobservable effort. Asymmetric information raise the cost of production but at the same time it generates information rents which lead to a higher transfer price. The overall effect of asymmetric information is to increase the price-cost margin gap relative to full information as illustrated in Figure 4. The presence of asymmetric information in addition to unobservable effort generates a nontrivial behavior of the price-cost margin. Specifically, when compared with its full information counterpart we see that the price-cost margin is larger when the productivity of the local labor force is high and is smaller otherwise.

This example suggests that despite tax differences that should induce low transfer prices, some MNCs (those predominantly plagued by asymmetric information) will have price-cost margins above the benchmark while others (those plagued chiefly by unobservable effort) will assign a transfer price that is below the benchmark. We emphasize that this deviations are rooted



Price-Cost Margin
Figure 4

in the MNC's internal coordination problems and do not stem from its desire to avoid declaring profits in high tax countries. In fact, these coordination problems induce distortions to x and e and τ that can imply that the firm declares more profits in the high tax country (country A).

VII. Extensions

The analysis conducted so far was based on the assumption that the AM's monetary compensation is a fixed share of the affiliate's profits. We will now extend the analysis and show that the distortions present under the fixed sharing rule will continue to arise under two alternative schemes, a variable sharing rule, $\alpha(\theta)$ and when the AM is compensated via a lump-sum payment, $\omega(\theta)$.

A. Variable Sharing Rule

We now assume the affiliate's managers receive a fraction $\alpha(\hat{\theta})$ of the subsidiary's post-tax profits, while $1 - \alpha(\hat{\theta})$ accrues to the MNC. In this case,

the $\alpha(\hat{\theta})$ schedule becomes part of the TM's governance scheme. Under this alternative compensation scheme the AM's net utility from reporting $\hat{\theta}$ when the true quality of its labor is θ can be written as

$$U(\hat{\theta};\theta) = \alpha(\hat{\theta})\Pi^A(\hat{\theta};\theta) - \psi(e). \tag{2'}$$

As with the fixed sharing rule, the MNC's objective is to maximize net global profit

$$\Pi(\hat{\theta};\theta) = (1-t^P)\left[R(x(\hat{\theta})) - C^P(x(\hat{\theta}))\right]$$
$$-(1-\alpha(\hat{\theta}))(1-t^A)C(\theta, e(\hat{\theta};\theta))x(\hat{\theta}) - \beta(\hat{\theta})\tau(\hat{\theta})x(\hat{\theta}), \tag{5'}$$

subject to the AM's participation constraint. We assume that the sharing rule $\alpha(\theta)$ is bounded,

$$0 \le \underline{\alpha} \le (\hat{\theta}) \le \overline{\alpha} \le 1. \tag{27}$$

The boundary restrictions intend to capture legal requirements imposed on the MNC. For example, the lower-bound may reflect minimum local minority ownership requirements, which are especially prevalent in developing countries. This requirement may also reflect restrictions on profit remissions imposed by host governments ⟨Caves [1982], Chapter 10⟩. On the other hand, a natural limit on the upper-bound of the proportional sharing rule is 100% of affiliate profits.[18]

Any attempt to set $\alpha > 1$ would likely raise objections by the host and home governments. For example, if $\alpha > 1$, the home government will view the large AM compensation payment as an attempt to reduce tax payments.

Solving the full information program, we substitute the participation constraint into (5′) and incorporate the restrictions imposed on the sharing rule, (27), results in the following constrained maximization problem

$$\mathcal{L} = (1-t^P)\left[R(x(\theta) - C^P(x(\theta)) - C(\theta, e(\theta))x(\theta)\right] - \frac{\beta(\theta)\,[U(\theta)+\psi(\theta)]}{\alpha(\theta)(1-t^A)}$$
$$+\lambda_1(\theta)\,[\overline{\alpha} - \alpha(\theta)] + \lambda_2(\theta)\,[\alpha(\theta) - \underline{\alpha}], \tag{28}$$

18. Although we assume that a is bounded on [0, 1] to capture legal requirements, qualitatively our results will continue to hold for any non-negative bounds on α.

where λ_1 and λ_2 are the Lagrangian multipliers associated with constraints (27). Differentiating $\mathcal{L}$ with respect to $x(\theta)$, $e(\theta)$, and $\alpha(\theta)$ yields

$$R'(x(\theta)) - C^{P\prime}(x(\theta)) - C(\theta, e(\theta)) = 0, \tag{7'}$$

$$\frac{\beta(\theta)}{\alpha(\theta)(1-t^A)}\psi'(e(\theta)) = -(1-t^P)x(\theta)C_e(\theta, e(\theta)), \tag{8'}$$

$$\frac{(t^A - t^P)[U(\theta) + \psi(\theta)]}{\alpha(\theta)^2(1-t^A)} = \lambda_1(\theta) - \lambda_1(\theta). \tag{29}$$

The complementary slackness conditions are

$$\begin{aligned} &\lambda_1(\theta)\,[\bar{\alpha} - \alpha(\theta)] = 0, \\ &\lambda_2(\theta)\,[\alpha(\theta) - \underline{\alpha}] = 0. \end{aligned} \tag{CS}$$

The first order condition with respect to α, as depicted by (29), implies that the TM will set the proportional sharing rule equal to its highest feasible level for all θ, *i.e.*, $\alpha(\theta) = \bar{\alpha}$. In other words, the TM finds it optimal to choose a fixed sharing rule.

Let $\{x^*(\theta), e^*(\theta)\}$ be the solution to (7') and (8'). Using $\{x^*(\theta), e^*(\theta), \bar{\alpha}\}$ and the participation constraint we solve for the optimal transfer price,

$$\tau^*(\theta) = \frac{1}{x^*(\theta)}\left[\frac{\psi(e^*(\theta))}{\bar{\alpha}(1-t^A)}\right] + C(\theta, e^*(\theta)). \tag{9'}$$

Comparing the first order conditions with a variable sharing rule, (7'), (8'), (9'), with those obtained under a fixed profit sharing rule, (7), (8), (9) reveals that under the full information scenario the optimal governance schedules are qualitatively unchanged.

B. Lump-sum Compensation

In contrast with the proportional scheme which based compensation on the affiliate's net realized profits, with the lump-sum scheme the AM's compensation is deducted from the affiliate's gross profits. Under this scheme the affiliate's net profits are

$$\Pi^A(\theta) = (1-t^A)\,[\tau(\theta)x(\theta) - C(\theta, e(\theta))x(\theta) - \omega(\theta)].$$

Assuming that the AM's monetary payment is taxed at the personal income tax, t^M, we can write the AM's participation constraint as
$U(\theta) = (1 - t^M)\,\omega(\theta)\,\psi(e(\theta)) \geq 0$.[19]

The MNC net global profits are

$$\Pi = (1-t^P)\,[R(\cdot) - C^P(\cdot)] - (1-t^A)\,C(\cdot)x(\theta)$$
$$-(t^A - t^P)\tau(\theta)x(\theta) - (1-t^A)\omega(\theta).$$

From the participation constraint, $\omega(\theta) = \psi(e(\theta))/(1 - t^M)$. After substituting this expression into the MNC's net global profit and requiring that the affiliate's profits are non-negative, the first order conditions with respect to $x(\theta)$ and $e(\theta)$ can be written

$$R'(x(\theta)) - C^{P\prime}(x(\theta)) - C(\theta, e(\theta)) = 0, \tag{7''}$$

$$\frac{\psi'(e(\theta))}{1-t^M} = -x(\theta)C_e(\theta, e(\theta)). \tag{8''}$$

Comparing (7″) and (8″) with (7) and (8) reveals that under full information there are no qualitative differences in the optimal trade and tariff schedules under lump-sum compensation and the fixed-sharing rule.

These extensions clearly indicate that it is the differences in taxes (either corporate or personal) faced by the TM and the AM that lead to inefficiencies under a variety of compensation schemes, even though informational asymmetries are not present. Moreover, it is clear that the inefficiencies due to asymmetric information that arose under the fixed sharing rule will also arise with the variable sharing rule and the lump-sum compensation schemes.

VIII. Concluding Comments

This paper examined the effects of the limitations resulting from imperfect monitoring and coordination within the MNC on its efficiency and performance. We have considered three alternative compensation schemes, a

19. Our results do not hinge on the relative sizes of personal income and corporate taxes.

fixed sharing rule, a proportional sharing rule, and a lump-sum payment. We have paid special attention to the implications of the MNC's internal organization problems for the volume of international trade generated by intra-firm transactions as well as its implications for the internal prices, *i.e.*, the transfer price. The inefficiencies that we focused on stemmed from (i) the asymmetry of information between the MNC headquarters and its subsidiaries and (ii) the unobservability of the level of managerial effort exerted by subsidiaries' managers.

Our findings with regard to the transfer price may shed some light on the debate about choice of the appropriate yardstick for transactions within the MNC which are needed for tax and tariff purposes by policy makers in both host and home countries. This also suggests that empirical studies that use market prices as a benchmark for evaluating the MNC's degree of manipulation of the transfer price should expect sizeable deviations from their arm's length standard.

A more general conclusion that emerges from our analysis is that a proper examination of the benefits resulting from internalization of international transactions, *i.e.*, conducting international trade via intra-firm transactions rather than inter-firm transactions, needs to take into account the costs of operating the MNC, *i.e.*, the costs of internalization. Although it is reasonable to expect that internalization might be the more desirable mode of conducting international trade in particular commodities, more work needs to be done to establish a firm ground for such a conclusion.

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