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Commercial Policy towards Multinational Corporations under Imperfect Information*

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Abstract

This paper examines host country government (HCG) commercial policy towards imports resulting from intrafirm trade conducted by a multinational corporation (MNC). The effectiveness of the HCG's commercial policy is impaired by its limited information about the MNC's cost of production. The commercial policy consists of restrictions on intrafirm transactions. We construct and characterize the optimal commercial policy under imperfect information and find that under imperfect information the optimal policy entails a distorted transfer price and a lower level of intrafirm trade relative to the full information case. Welfare implications of commercial policy under imperfect information are also examined.

1. Introduction

The multinational corporation's (MNC's) decisions regarding intrafirm transactions—transfer pricing and intrafirm trade decisions—have been extensively discussed and analyzed by policy makers, businessmen, and economists since the late 1960s. The issues debated in these discussions center on the MNC's ability to manipulate transfer prices and intrafirm trade to enhance post-tax profits. These manipulations are especially costly for the affected countries since they distort the allocation of resources and production across the MNC's plants located in different countries.

There are many studies documenting transfer price manipulation; some of the most outlandish examples have involved less developed countries (LDCs). For example, Vaitsos's (1974) study of transfer pricing in Colombia documented large over-reports in the pharmaceutical, chemical and rubber industries.[1] Horst (1971) and Copithorne (1971) showed that these findings should have been expected since LDCs heavily regulate MNCs in ways that encourage transfer price abuses. They showed that corporate tax differences, tariffs, and profit remission restrictions all induced manipulative transfer pricing.[2] Katrak (1977) and De Meza (1979) also studied the relationship between host country government (HCG) commercial policies and transfer pricing; Katrak examined the effects of tariffs on imports purchased from a monopoly MNC while De Meza looked at the effects of price controls imposed by host governments on the quantity of imports from MNCs.

Over the years a more general insight concerning transfer price manipulation has emerged: manipulative transfer pricing is made possible not just by restrictive commercial policies but, more importantly, by inadequate monitoring of MNC activities

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welfare. In contrast, the optimal scheme under imperfect information involves information induced production distortions and a reduction in the level of intrafirm trade. It also entails more generous transfer prices which result in a lower level of national welfare than under full information. The key advantage of this policy is that once it is in place, it will be in the MNC's "best interest" to truthfully reveal its costs (i.e., the MNC will no longer misrepresent costs in order to avoid taxes), and the HCG will no longer be faced with the arduous task of monitoring MNC costs.

2. The Model

Consider a horizontally integrated MNC with two operating divisions, each located in a different country. For simplicity, we will refer to the unit located in country $\mathscr{P}$ as the "parent" and the unit in country $\mathscr{A}$ as the "affiliate." Each division produces the same final good. We assume that the host country's market is supplied with a final good imported from the parent and also domestically produced by the affiliate.[3] For simplicity we also assume that all the output produced by the parent's plant is exported to the affiliate.[4] Let X_T denote total sales in $\mathscr{A}$'s market and X_p (X_a) denote output produced by the parent (affiliate); therefore, $X_T = X_p + X_a$.

Regarding the taxation aspect, we assume a tax credit provision as currently in effect in the US. Under this provision the MNC is allowed a tax credit for taxes paid to foreign countries. Let t^P (t^A) denote the corporate tax rate in country $\mathscr{P}$ ($\mathscr{A}$). We assume $t^A > t^P$; it is well known that the tax differential induces the parent unit to overcharge the affiliate on intrafirm transactions and to export too little.[5] Let the parent's costs be denoted by $\theta C_p(X_p)$ and the affiliate's cost be denoted by $C_a(X_a)$, where $C_a'(\cdot) > 0$, $C_a''(\cdot) \geqslant 0$, $C_p'(\cdot) > 0$, $C_p''(\cdot) \geqslant 0$. We relax the full information assumption underlying the conventional approach in the theoretical literature on transfer pricing in order to highlight what we consider the main difficulty regarding transfer pricing: asymmetric information. That is, the MNC has more information about its costs than the host country's regulator does. A simple way to capture the informational asymmetry between the MNC and the HCG is to assume that the distribution of θ is common knowledge but that the actual realization of θ is known only to the MNC. Specifically, both the MNC and the HCG know that θ has support $[\theta_0, \theta_1]$ with density function $f(\theta)$ and cumulative distribution $F(\theta)$.[6] However, the true realization of θ is known only by the MNC. Once θ is realized, the MNC makes its output and pricing decisions.

The HCG uses its commercial policy to affect the quantity of intrafirm trade, X_p, and transfer price, P, given the informational asymmetry about cost.[7] Hence, the HCG selects X_p and P based on the MNC report of the unobservable cost parameter θ. Because of tax differentials, the MNC's would like to report high costs, i.e., high θ, in order to shift profits from the affiliate located in the high-tax country to the parent residing in the low-tax country. Let θ^R be the cost parameter reported by the MNC to the HCG. Since the HCG realizes that the multinational has the incentive to report $\theta^R > \theta$, it must construct a commercial policy which discourages overstating costs. To successfully implement such a scheme, the HCG will have to "penalize" high cost reports and "reward" low cost reports. Although the HCG never observes the true realization of θ, it can construct a scheme such that the parent always reports $\theta^R = \theta$. We focus on commercial policies that entail truth-telling for the following reason. Suppose the HCG designs a policy, $\{\hat{X}_p(\cdot), \hat{P}(\cdot)\}$, which does not induce the MNC to report its true costs. By the revelation mechanism (Dasgupta, Hammond, and Maskin, 1979; Myerson, 1979) it is known that there exists an alternative policy which induces the MNC to report its true costs and this policy guarantees the HCG a level of welfare that is at least as high as the level obtained with $\{\hat{X}_p(\cdot), \hat{P}(\cdot)\}$. Therefore without loss of generality we can restrict ourselves to only those commercial policies that induce truth-telling, i.e., are incentive-compatible.[8] The optimal scheme will induce the MNC to self-select its true costs.

In order to induce self-selection, net global profits with truthful reports have to be at least as large as with misreported costs. If the MNC reports θ^R but has true costs θ, the net (post-tax) profits from the parent's sales to the affiliate are

$$\Pi_p(\theta^R \mid \theta) = (1 - t^P)[P(\theta^R)X_p(\theta^R) - \theta C_p(X_p(\theta^R))], \tag{1}$$

where $P(\cdot)$ and $X_p(\cdot)$ are the regulated transfer price and exports.[9] A cost report of θ^R also implies that the affiliate earns net (post-tax) profits of

$$\Pi_a(\theta^R \mid \theta) = (1 - t^A)[R(X_T(\theta^R)) - C_a(X_a(X_p(\theta^R))) - P(\theta^R)X_p(\theta^R)], \tag{2}$$

where $R(\cdot)$ denotes the revenue earned on sales of $X_T(\cdot)$. We assume that $R'(\cdot) > 0$, $R''(\cdot) < 0$, $R'''(\cdot) \leqslant 0$. It is convenient to think of $X_T(\cdot)$ as being produced in two stages. When the affiliate chooses X_a, it takes the parent's output as given. The affiliate's optimal output is given by $X_a = \text{argmax}\,[R(X_a + X_p) - C_a(X_a)]$, and thus we will write X_a as a function of X_p.

The MNC's global net profits are

$$\Pi(\theta^R \mid \theta) = \Pi_p(\theta^R \mid \theta) + \Pi_a(\theta^R \mid \theta). \tag{3}$$

By the revelation mechanism, we restrict the policy to be incentive-compatible, i.e., when faced with $\{P(\theta), X_p(\theta)\}$ the MNC will prefer to report the true cost rather than to misreport cost.

The incentive-compatibility constraint can be written as

$$\Pi(\theta \mid \theta) \geqslant \Pi(\theta^R \mid \theta), \quad \forall \theta^R, \theta \in [\theta_0, \theta_1]. \tag{4}$$

Finally, if the MNC regards the policy $\{P(\theta), X_p(\theta)\}$ as too onerous it can always set $X_p = 0$ and service the host country with affiliate production alone. This option serves as an "individual rationality" constraint on any potential regulatory scheme. This implies

$$\Pi(\theta \mid \theta) \geqslant (1 - t^A)\Pi_a(\theta; X_p = 0) \equiv (1 - t^A)\bar{\Pi}_a, \quad \forall \theta \in [\theta_0, \theta_1], \tag{5}$$

where $\bar{\Pi}_a$ denotes the monopoly profit level the affiliate would earn in the absence of intrafirm trade, i.e., $\bar{\Pi}_a = \max[R(X_a) - C_a(X_a)]$.

We define the commercial policy as $\{P(\theta^R), X_p(\theta^R)\}$. The challenge for the HCG is to structure $P(\theta^R)$ and $X_p(\theta^R)$ so that the parent reports $\theta^R = \theta$. A policy is "feasible" if it satisfies (4) and (5). Feasible policies imply that the firm will truthfully report costs and export whenever allowed. The HCG devises its feasible policy to maximize expected national welfare. We define national welfare as tax revenue plus an employment effect. A more general host country objective function would include some consideration for consumer surplus as well. We examine this extension in section 3. In order to avoid modelling the labor market directly we assume that employment is positively related to the affiliate's production. Let $\mu \geqslant 0$ reflect this effect. Throughout this paper we will assume that the employment effect does not overwhelm the other components of the HCG's objective function. For notational convenience we define host country tax revenue as

$$T_R(\theta) = t^A[R(X_T(\theta)) - C_a(X_a(X_p(\theta))) - P(\theta)X_p(\theta)].$$

Host country welfare for each θ is defined as

$$W(\theta) = T_R(\theta) + \mu X_a(X_p(\theta)). \tag{6}$$

Thus, the expected national welfare is

$$W = \int_{\theta_0}^{\theta_1} W(\theta)f(\theta)d\theta. \tag{7}$$

Commercial Policy under Full Information

The full information case is when both the HCG and the MNC observe the true realization of θ before the announcement of the policy and is analogous to the approach taken in most of the previous literature on controlling transfer pricing.

Formally, the HCG's problem is to choose $\{P(\theta), X_p(\theta)\}$ to maximize the objective function, $W(\theta)$, subject to the constraint that the firm earns at least its reservation profits, $\Pi(P(\theta), X_p(\theta)) \geq (1 - t^A)\bar{\Pi}_a$.

The optimal commercial policy scheme under full information is described in proposition 1 and characterized by (9) and (10). It serves as a benchmark for comparison with the imperfect information solution to be presented in the following section.

PROPOSITION 1. *The optimal commercial policy scheme under full information, $\{P^F(\theta), X_p^F(\theta)\}$, allows the host country to attain the highest possible level of welfare. This is accomplished by extracting all profits generated by intrafirm trade.*

To solve for the optimal scheme $\{P^F(\theta), X_p^F(\theta)\}$ we substitute the individual rationality constraint stated in (5) into the host country's welfare function stated in (6); this yields:

$$\max_{X(\theta)} W(\theta) = \left[\frac{t^A}{t^A - t^P}\right]\left[(1 - t^P)[R(\cdot) - C_a(\cdot) - \theta C_p(\cdot)] - (1 - t^A)\bar{\Pi}_a \left[\frac{t^A - t^P}{t^A}\right]\mu X_a\right]. \tag{8}$$

Differentiating (8) with respect to $X_p(\theta)$ yields:

$$R'(\cdot) - \theta C_p'(\cdot) = -\mu\left[\frac{t^A - t^P}{(1 - t^P)t^A}\right]\left[\frac{dX_a}{dX_p}\right]. \tag{9}$$

To arrive at (9) we used the fact that $R'(\cdot) - C_a'(\cdot) = 0$. $X_p^F(\theta)$ is the unique solution to (9).[10] The optimal transfer price, $P^F(\theta)$, is found by substituting the solution to (9), $X_p^F(\theta)$, into the individual rationality constraint; this yields:

$$P(\theta)X_p(\theta) = \left[\frac{1}{t^A - t^P}\right]\left[(1 - t^A)[\bar{\Pi}_a - R(\cdot) + C_a(\cdot)] + (1 - t^P)\theta C_p(\cdot)\right]. \tag{10}$$

The solution to the full information problem is very intuitive. First, from (9) and the fact that the affiliate always sets $R'(\cdot) = C_a'(\cdot)$, it follows that $R'(\cdot) = C_a'(\cdot) \geq \theta C_p'(\cdot)$. Since $dX_a/dX_p \leq 0$ (see appendix), the right-hand side of (9) is greater than or equal to zero. Therefore, the output produced by the affiliate exceeds the level of production that would be produced under full efficiency. That is, the optimal scheme does not induce efficient production across divisions in the sense that marginal costs are not equalized across operating units. The production distortion implied by (9) stems purely from the employment considerations in the welfare function. Second, the transfer price as determined by (10) serves only as an allocative device; here it shifts all profits beyond the "no exports" profit level to the HCG. This implies that the MNC always earns net *global* profit equal to $(1 - t^A)\bar{\Pi}_a$. The HCG is able to extract all the surplus created by the intrafirm trade and therefore achieves the highest level of national welfare.

Commercial Policy under Imperfect Information

We now proceed to examine the more realistic asymmetric information case, i.e., when the realization of the cost parameter is known to the MNC but not observable by the HCG. As in the full information case, the HCG confronts the MNC with a price–quantity schedule. In the full information case (θ known), the firm can only choose either to participate and receive $P^F(\theta)$ and provide exactly $X_p^F(\theta)$ or to not transact with its affiliate. In the asymmetric information case, a priori the firm can choose any point on the proposed price–quantity schedule. Here the firm is required to make a cost report, θ^R, to the HCG. Once the cost report has been made the firm is required to provide exactly $X_p(\theta^R)$ and will receive a transfer price of $P(\theta^R)$. The firm is not allowed to offer some $\tilde{X}_p < X_p(\theta^R)$ and still receive $P(\theta^R)$. Put differently, this scheme implies that the import quota, $X_p(\theta^R)$, is binding both from above and below, once the cost report has been made.

When the HCG constructs $\{P(\theta), X_p(\theta)\}$ it must take into account the feasibility constraints (4) and (5). Rather than working with (4) and (5) directly, it is more convenient to use the local representation of feasibility, which we state below in proposition 2 and prove in the appendix.

PROPOSITION 2. *A commercial policy scheme is feasible if and only if it satisfies:*

$$X_p(\theta) \text{ is nonincreasing in } \theta, \tag{11}$$

$$\Pi(\theta_1) \geq (1 - t^A)\bar{\Pi}_a, \text{ and} \tag{12}$$

$$\Pi(\theta) = \Pi(\theta_1) + (1 - t^P) \int_{\theta}^{\theta_1} C_p(X_p(y))dy. \tag{13}$$

Equation (12) merely states that the highest cost type will earn at least the level of profits attained in the absence of intrafirm trade (zero exports). Equation (13) states that net global profit induced by this scheme is higher the lower the realized cost parameter, θ. Moreover, note that the second term in (13) is weighted by $(1 - t^P)$, implying that a feasible solution eliminates the distortions caused by the tax differential. Equation (11) implies that high cost types are not allowed to export more than low cost types. It is noteworthy that feasibility alone does not constrain the transfer price schedule. That is, an incentive compatible policy can imply $P(\theta)$ either increasing or decreasing with θ (depending on the specifics of the problem). More on this issue will be said later.

To derive the optimal scheme we incorporate the local representation of the incentive compatibility conditions into the host country's objective function, (7). After several substitutions and rearrangements (details available upon request) we can write the welfare function as

$$W = \left[\frac{(1-t^P)t^A}{t^A - t^P}\right]\int_{\theta_0}^{\theta_1}\left\{[R(X_T(\theta)) - C_a(X_a(X_p(\theta))) - Z(\theta)C_p(X_p(\theta))] + \frac{\mu(t^A - t^P)}{(1-t^P)t^A} X_a(X_p(\theta))\right\}f(\theta)d\theta - \frac{t^A}{t^A - t^P}\Pi(\theta_1), \tag{14}$$

where $Z(\theta) = \theta + F(\theta)/f(\theta)$. The term $Z(\cdot)C_p(\cdot)$ is interpreted as adjusted parent unit costs; the parent's costs are adjusted upwards to compensate for the informational asymmetry as reflected by the term $F(\theta)/f(\theta)$. From (14) it is clear that the HCG will set $\Pi(\theta_1) = (1 - t^A)\bar{\Pi}_a$.

As stated in (14) the HCG's incentive-compatible objective function consists of (i) tax revenue from the affiliate's profits, where the tax base is determined by the total sales in the affiliate's home market less the sum of the affiliate's cost and parent's adjusted cost, and (ii) the employment effect.

We now proceed to solve for the incentive-compatible policy and compare it with the full information solution. The imperfect information solution, $\{P^*(\theta), X_p^*(\theta)\}$, is derived by pointwise differentiation of (14) with respect to $X_p(\cdot)$. This in conjunction with (13) yields:

$$R'(\cdot) - C_p'(\cdot)Z(\theta) = -\mu\left[\frac{(t^A - t^P)}{(1-t^P)t^A}\right]\left[\frac{dX_a}{dX_p}\right], \tag{15}$$

$$P(\cdot)X_p(\cdot) = \left[\frac{1}{t^A - t^P}\right]\left\{(1-t^A)\bar{\Pi}_a + (1-t^P)\int_{\theta}^{\theta_1} C_p(X_p(y))dy + (1-t^P)\theta C_p(X_p(\theta)) - (1-t^A)[R(X_T(\theta)) - C_a(X_a(X_p(\theta)))]\right\}. \tag{16}$$

To obtain (15) we have once again made use of the fact that $R'(\cdot) = C_a'(\cdot)$. It is straightforward to verify that $\{P^*(\theta), X_p^*(\theta)\}$ is the unique solution to (15) and (16) and satisfies the incentive compatibility constraints, (11)–(13).[11]

The welfare maximizing quantity of intrafirm trade, $X_p^*(\theta)$, is highest for the lowest cost realization and declines with θ. Without further assumptions on demand and technology we cannot characterize how the transfer price, $P^*(\theta)$, varies with θ. However, we do know that the optimal transfer price $P^*(\theta)$ will be distorted relative to its full information counterpart $P^F(\theta)$. This can be seen from comparing (10) with (16); in the latter there is an additional expression, $(1 - t^P)\int_{\theta}^{\theta_1} C_P(X_p(y))dy$, which captures the rents retained by the MNC for all cost realizations that are lower than θ_1. In section 4, we present an example that enables us to fully characterize the transfer pricing schedule. As it turns out, in our example both the transfer price per unit of exports and the level of exports are higher the lower is the realization of θ.

We are now ready to compare the commercial policy schemes under full and imperfect information (proof in appendix):

PROPOSITION 3. *The optimal commercial policy scheme under imperfect information* $\{P^*(\theta), X_p^*(\theta)\}$ *relative to that under full information* $\{P^F(\theta), X_p^F(\theta)\}$ *entails (i)* $X_p^*(\theta) < X_p^F(\theta)$, *for all* $\theta > \theta_0$ *and* $X_p^*(\theta_0) = X_p^F(\theta_0)$; *(ii)* $\Pi(X_p^*(\theta), P^*(\theta)) > \Pi(X_p^F(\theta), P^F(\theta))$, *for all* $\theta > \theta_1$ *and* $\Pi(X_p^*(\theta_1), P^*(\theta_1)) = \Pi(X_p^F(\theta_1), P^F(\theta_1))$; *(iii)* $W^*(\theta) \equiv W(X_p^*(\theta)) \leq W(X_p^F(\theta), P^F(\theta)) \equiv W^F(\theta)$.

In proposition 3 we state that the quantity of intrafirm trade under imperfect information is strictly lower than under full information, for all θ except for the lowest realization of costs, θ_0. Note that (15) states that the optimal policy will set marginal revenue equal to the parent's adjusted marginal costs. The information component of the adjusted marginal cost increases with θ because the higher are the costs, the greater is the range of lower types who could mimic. Since the HCG seeks to discourage misreporting it must exacerbate the quantity distortion for higher types; this implies that the quantity of intrafirm trade allowed for the lower cost realization, $X_p^*(\theta_0)$, is not distorted relative to $X_p^F(\theta_0)$, since there are no other types who would like to mimic θ_0. However, for all $\theta > \theta_0$, the quantity of intrafirm trade under imperfect information is strictly less than the quantity of intrafirm trade under full information.

We also stated that the MNC's net global profits are higher and the HCG's welfare is lower under imperfect information. As discussed above, there is too little intrafirm trade and as a consequence too much affiliate production. Hence, the affiliate's net revenue, $R(\cdot) - C_a(\cdot)$, is lower than under full information. This effect by itself adversely affects MNC profits and the HCG's welfare, due to lower gross profits and therefore a lower tax base.

However, the second policy instrument, the transfer price, has opposing effects on the HCG's welfare and the MNC's profits. Incentive compatibility requires a more favourable transfer price which allows the MNC to shift more profits from the affiliate to the parent. Thus, although the consolidated gross profits are lower under imperfect information, the MNC's net profits are greater.

The decrease in the HCG's welfare is due to a lower tax base. The tax base shrinks for two reasons: first, the affiliate's net revenue, $R(\cdot) - C_a(\cdot)$, falls, and second the transfer price shifts profits from the affiliate to the parent. Note, however, that the level of employment under imperfect information is greater due to expanded production. This, however, cannot fully offset the reduction in welfare due to lower tax revenues.

3. Generalizing the Objective Function

We now extend our analysis by also incorporating consumer surplus into the host country's objective function. Ignoring income effects, we can write the host country's consumer surplus as $V(X_T) - R(X_T)$, where $V(X_T)$ is the total benefit generated by the affiliate's sales of X_T.[12]

We now can write the social welfare function inclusive of consumer surplus, W_α, as

$$W_\alpha = \int_{\theta_0}^{\theta_1} \{(1-\alpha)[V(X_T(\theta)) - R(X_T(\theta))] + \alpha T_R(\theta) + \mu X_a(X_p(\theta))\} f(\theta) d\theta, \tag{17}$$

where α, $0 \leqslant \alpha \leqslant 1$, reflects the relative weight of consumer surplus and tax revenue. As $\alpha \to 0$, the problem becomes one of maximizing just consumer surplus and the employment effect (with no tax revenue considerations), while as $\alpha \to 1$, the objective function collapses to the special case as defined by (7) and analyzed in the previous section.

The approach to solving the generalized welfare function (17) is identical to that in section 2. In fact, it is clear that changing the objective function has no effect on the local implications of incentive compatibility (proposition 2). As before, we incorporate the local representation of the incentive compatibility conditions into (17). After a few steps we can write the welfare function as

$$\begin{aligned} W_a = (1-\alpha) \int_{\theta_0}^{\theta_1} \{V(X_T(\theta)) - R(X_T(\theta))\} f(\theta) d\theta \\ + \alpha \left[\frac{(1-t^P)t^A}{t^A - t^P}\right] \int_{\theta_0}^{\theta_1} \{[R(X_T(\theta)) - C_a(X_a(X_p(\theta))) \\ - Z(\theta) C_p(X_p(\theta))]\} f(\theta) d\theta \\ + \mu \int_{\theta_0}^{\theta_1} X_a(Xp(\theta)) f(\theta) d\theta - \frac{\alpha t^A}{t^A - t^P} \Pi(\theta_1). \end{aligned} \tag{18}$$

It is once again clear that the HCG will set $\Pi(\theta_1) = (1 - t^A)\bar{\Pi}_a$.

We now solve for the optimal incentive-compatible commercial policy with consumer surplus by pointwise differentiating (18) and using (13), yielding

$$\begin{aligned} \alpha\{R'(\cdot) - C_p'(\cdot)Z(\theta)\} + \left[\frac{\mu(t^A - t^P)}{(1-t^P)t^A}\right]\left[\frac{dX_a}{dX_p}\right] \\ - (1-\alpha)X_T(\cdot)P_A'(\cdot)\left[1 + \frac{dX_a}{dX_p}\right] = 0, \end{aligned} \tag{19}$$

$$\begin{aligned} P(\cdot)X_p(\cdot) = \left[\frac{1}{t^A - t^P}\right]\Big\{(1-t^A)\bar{\Pi}_a + (1-t^P)\int_{\theta}^{\theta_1} C_p(X_p(y))dy \\ - (1-t^A)[R(X_T(\theta)) - C_a(X_a(X_p(\theta)))]\Big\}. \end{aligned} \tag{20}$$

Let $\{P^{*\alpha}(\theta), X_p^{*\alpha}(\theta)\}$ denote the optimal commercial policy with the generalized objective function. We are now able to compare the optimal policies with and without consumer surplus. This is stated in the proposition below and proved in the appendix. Note that $X_p^{*\alpha}(\theta; \alpha = 1) = X_p^*(\theta)$ and $P^{*\alpha}(\theta; \alpha = 1) = P^*(\theta)$.

PROPOSITION 4. *For* $0 < \alpha < 1$, *the comparison of the optimal commercial policy with and without consumer surplus yields: (i)* $X_p^{*\alpha}(\theta) \geq X_p^*(\theta)$; *(ii)* $\Pi(X_p^{*\alpha}(\theta), P^{*\alpha}(\theta)) \geq \Pi(X_p^*(\theta), P^*(\theta))$.

From proposition 4 we find that when the HCG values consumer surplus the MNC is allowed to export more. This is very intuitive and has the following interpretation. The optimal policy $\{P^{*\alpha}(\theta), X_p^{*\alpha}(\theta)\}$, in contrast with $\{P^*(\theta), X_p^*(\theta)\}$, entails a trade-off between imports and domestic production. Higher imports enhances consumer surplus but lowers the affiliate's production. As $\alpha \to 1$ (i.e., converges to the "no consumer surplus" case) the valuation of imports decreases and therefore less intrafirm trade is permitted.

Given that imports are higher when consumer surplus enters the welfare function, the second part of the proposition follows directly from equation (13). Note also that the relationship between $\{P^{*\alpha}(\theta), X_p^{*\alpha}(\theta)\}$ and their full information counterparts is similar to the relationship between the imperfect information and the full information policies obtained without consumer surplus. In particular, imports are lower and profits are higher in the imperfect information solution relative to the full information solution.

The analysis in sections 2 and 3 highlights the significant role played by informational asymmetry when an HCG attempts to control imports stemming from intra-MNC transactions. We have shown that the informational asymmetry entails costs borne by both the MNC and the HCG. The analysis in this section has shown that the conclusions derived about the optimal commercial policy under imperfect information are robust to changes in the specification of the welfare function.

4. Example

We now proceed to a specific example that clearly illustrates the effects of the informational asymmetry on the transfer price, imports, profits, and the welfare of the host country. We assume that the parent's and the affiliate's cost functions are quadratic and linear respectively, and the demand for the product is linear. That is, we assume $\theta C_p(X_p) = \theta X_p$, $C_a(X_a) = X_a^2$, $R(X_T) = (a - bX_T)X_T$, $a > b > 0$. We also assume the unobservable cost parameter, θ, is uniformly distributed on $[\theta_0, \theta_1]$. We will compare three alternative schemes: (1) the full information scheme $\{P^F(\theta), X_p^F(\theta)\}$; (2) the imperfect information scheme $\{P^*(\theta), X_p^*(\theta)\}$; and (3) a "naive" scheme $\{P^N(\theta), X_p^N(\theta)\}$. We define the naive policy to be an attempt by the HCG to implement the full information scheme when it is actually in an imperfect information environment. This scheme attempts to describe the behavior of the HCG who ignores the MNC's informational advantage; as we will see, it is not incentive compatible.

Using these functional forms, the optimal schemes under full and imperfect information are presented in Table 1. It is worth noting that the schemes in this table are invariant to whether consumer surplus is incorporated in the objective function because total sales, X_T, are the same under both welfare specifications.

By definition, the transfer pricing and import quota schedules under the naive scheme take the same functional form as under full information. Note, however, that under the naive scheme the HCG attempts to implement the full information scheme despite its informational disadvantage. Since the HCG must rely on the MNC's cost report, the MNC will find it profitable to overstate the parent's costs. Specifically, the MNC will report $\theta^R = \min(2\theta, \theta_1)$, which implies that overstating of costs will occur for all $\theta < \theta_1$.

In Table 1 first note that higher cost reports imply lower exports for both full and imperfect information schemes. Furthermore, for any given θ, $X_p^*(\theta) \leqslant X_p^F(\theta)$; also note that in the imperfect information case, $X_p(\theta)$ declines more rapidly as θ rises relative to the full information case. Second, as depicted in Table 1, the full information transfer price is independent of θ (this will not be the case in general).

	Full Information	*Imperfect Information*
$P(\theta)$	$\left[\frac{1}{t^A - t^P}\right]\left[\frac{(1 - t^P)\beta}{2} - (1 - t^A)\right]$	$\left[\frac{1}{t^A - t^P}\right]\left[\left(\frac{1 - t^P}{2}\right)\left(\frac{\theta\beta}{2\theta - \theta_0} - \frac{\theta_1 - \theta}{2\theta_1 - \theta_0}\right) - (1 - t^A)\right]$
$X_p(\theta)$	$\beta/(2\theta)$	$\beta/[2(2\theta - \theta_0)]$
$\Pi(\theta)$	$(1 - t^A)\bar{\Pi}_a$	$(1 - t^A)\bar{\Pi}_a + \left[\frac{(1 - t^P)\beta^2}{8}\right]\left[\frac{1}{2\theta - \theta_0} - \frac{1}{2\theta_1 - \theta_0}\right]$

Table 1: Optimal Regulatory Schemes

Note: $\beta = 1 - \mu (t^A - t^P)/[(1 - t^P)t^A]$

In contrast, the optimal transfer price under imperfect information decreases in θ. Interestingly, the traditional argument that MNCs need to be compensated for higher marginal costs with a higher transfer price is not necessarily confirmed. Even though higher θ's imply higher costs for any given quantity of exports, the optimal commercial policy involves lower export levels which in turn imply lower marginal cost of production in the parent unit; thus the MNC is entitled to a lower transfer price. Third, the optimal price and quantity of imports under imperfect information converge to their full information counterparts as the MNC's informational advantage dissipates, i.e., as $\theta \rightarrow \theta_1$.

It is useful to graph the relationship summarized in Table 1. To do so we choose the following parameter values: $\theta_0 = 0.5$, $\theta_1 = 1.3$, $a = 2$, $b = 0.5$, $\mu = 0.10$, $t^P = 0.25$, and $t^A = 0.80$. Figure 1 summarizes the relationship between the transfer price and the level of imports under the three regimes. It is worthwhile to make several comments. First, as depicted in the diagram, the quantity of imports under imperfect information for high cost realizations is lower than under either the full information or naive schemes. Under the optimal imperfect information scheme, high cost reports are "penalized" by imposing restrictive import quotas. Second, the variation in the quantity of imports for various cost realizations of θ is smaller with the naive scheme than with the full information scheme. This stems from the misreporting induced by the naive scheme. Thus, while the optimal scheme under imperfect information entails production distortions, the naive scheme will also result in production inefficiencies because it induces cost misreports. Moreover, as we will see, the distortions caused by the misreports have a more deleterious affect on

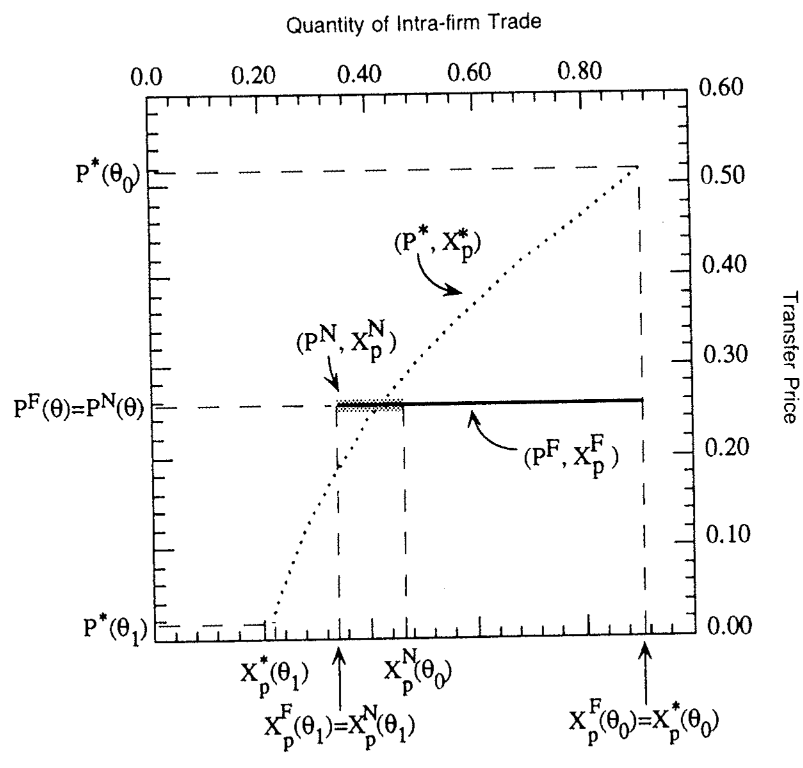

Figure 1. Transfer Price-Quantity Schedules

	Full Information		Imperfect Information		Naive Regulation		
θ	Profit	Welfare	Profit	Welfare	θ^R	Profit	Welfare
0.50	0.10	0.950	0.230	0.761	1.00	0.177	0.725
0.58	0.10	0.888	0.188	0.754	1.16	0.167	0.694
0.66	0.10	0.841	0.163	0.736	1.30	0.159	0.673
0.74	0.10	0.804	0.146	0.718	1.30	0.151	0.673
0.82	0.10	0.774	0.134	0.703	1.30	0.144	0.673
0.90	0.10	0.750	0.125	0.690	1.30	0.137	0.673
0.98	0.10	0.730	0.118	0.679	1.30	0.129	0.673
1.06	0.10	0.712	0.112	0.669	1.30	0.122	0.673
1.14	0.10	0.697	0.107	0.661	1.30	0.115	0.673
1.22	0.10	0.684	0.103	0.654	1.30	0.107	0.673
1.30	0.10	0.673	0.100	0.648	1.30	0.100	0.673

Table 2: MNC Profit and HCG Welfare[a]

a. Table is based on the following parameters: $\theta_0 = 0.50$, $\theta_1 = 1.30$, $a = 2.00$, $b = 0.50$, $t^P = 0.25$, $t^A = 0.80$, $\mu = 0.10$.

welfare than the distortions present under the optimal scheme. Third, the transfer prices under the naive and full imformation schemes are equal and independent of θ. In contrast, the optimal transfer price under imperfect information is positively related with the quantity of exports and both decrease with θ.

Table 2 presents the net global profits and national welfare for different cost realizations. Under full information, the MNC's net global profit is the same for all realizations of θ and is equal to the reservation level of profit earned with no intrafirm trade. As previously mentioned, this is due to the fact that the HCG is able to extract all rents generated via intrafirm trade. The net global profits are higher for low realizations of θ and lower for high realizations of θ under the optimal scheme relative to the naive scheme. On average, the MNC earns greater profit under the naive scheme. For $\theta = \theta_1$ the net global profits are the same in all regimes.

Note that in all regimes welfare falls with θ. The level of welfare under full information always exceeds the level of welfare obtained under the alternative regimes. Under imperfect information, the incentive-compatible scheme entails a higher level of welfare than the naive scheme for low θ and the converse holds for high θ. However, the *expected* welfare is higher under the incentive-compatible scheme than under the naive scheme. In fact, there is a significant welfare gain from implementing the optimal scheme rather than the naive scheme. Using the optimal scheme, rather than the naive scheme, recaptures part of the welfare loss due to asymmetric information. The fraction of the regained loss in welfare in this numerical example is $(W^* - W^N)/(W^F - W^N) = 25\%$. This is a sizeable welfare improvement, reflecting that there is much to be gained by using an optimal commercial policy rather than a naive policy.

5. Concluding Comments

In this paper we examined the role of informational asymmetries in designing commercial policy which governs MNC activity. In particular, we investigated how the HCG can use commercial policy to influence imports resulting from intrafirm transactions. The policy instruments which we considered were import quotas and transfer price controls. We showed that both instruments must be used simultaneously to implement the incentive-compatible commercial policy. The approach used to examine commercial policy towards the MNC is novel not only because it incorporates informational issues but also because the HCG uses both quantity and price restrictions.

The main results are (i) the optimal commercial policy under imperfect information involves information-induced production distortions and a reduction in the level of international trade; (ii) the MNC's informational advantage enables it to retain higher profits than would have been possible in the absence of such an advantage; (iii) the HCG's informational disadvantage leads to a lower level of welfare than it would have enjoyed under full information; (iv) the use of a sophisticated policy scheme which induces truthful cost reports entails less harmful distortions to production when compared to the naive scheme. The latter scheme induces the MNC to misreport costs; the transfer price and import quota associated with these misreports are more distortionary than those associated with the sophisticated scheme.

The broader insight we draw from this paper is that informational asymmetries play a crucial role in designing appropriate trade policies. Governments which fail to recognize that they are limited in their information will find their policies will not achieve their desired objectives.

Appendix

Proof of Proposition 2

First we must show that feasibility implies the proposition. Note that (12) follows directly from (5). From (4) note that for any θ^R, θ

$$\Pi(\theta \mid \theta) \geqslant \Pi(\theta^R \mid \theta) = \Pi(\theta^R \mid \theta^R) + (1 - t^P)[(\theta^R - \theta)C_p(X_p(\theta^R))], \quad \text{(A.1)}$$

$$\Pi(\theta^R \mid \theta^R) \geqslant \Pi(\theta \mid \theta^R) = \Pi(\theta \mid \theta) - (1 - t^P)[(\theta^R - \theta)C_p(X_p(\theta))]. \quad \text{(A.2)}$$

Combining (A.1) and (A.2) yields

$$\begin{aligned}(1 - t^P)(\theta^R - \theta)C_p(X_p(\theta^R)) &\leqslant \Pi(\theta \mid \theta) - \Pi(\theta^R \mid \theta^R) \\ &\leqslant (1 - t^P)(\theta^R - \theta)C_p(X_p(\theta)).\end{aligned} \quad \text{(A.3)}$$

Now (A.3) implies (10). Dividing (A.3) by $(\theta - \theta^R)$ and taking the limit as $\theta^R \to \theta$, we find

$$\Pi'(\theta \mid \theta) = -(1 - t^P)C_p(X_p(\theta)) \quad \text{for almost all } \theta. \quad \text{(A.4)}$$

Integrating (A.4) over $[\theta, \theta_1]$ implies that (13) must hold for any feasible commercial policy.

Now we must show that the proposition implies feasibility. Equation (5) follows from (12) and (13). Using (13) we know that

$$\Pi(\theta^R \mid \theta) = \Pi(\theta \mid \theta) - (1 - t^P) \int_{\theta}^{\theta^R} C_p(X_p(y))dy. \quad \text{(A.5)}$$

Substituting (A.5) into (A.1) implies

$$\Pi(\theta^R \mid \theta) = \Pi(\theta \mid \theta) + (1 - t^P)(\theta^R - \theta)C_p(X_p(\theta^R)) - (1 - t^P)\int_{\theta}^{\theta^R} C_p(X_p(y))dy. \quad (A.6)$$

Rewriting (A.6) we obtain

$$\Pi(\theta^R \mid \theta) = \Pi(\theta \mid \theta) - (1 - t^P)\int_{\theta}^{\theta^R} \{C_p(X_p(y)) - C_p(X_p(\theta^R))\}dy. \quad (A.7)$$

Note that the integrand is nonnegative because $X_p(\cdot)$ is nonincreasing and $\theta^R \geq y$ for all $y \in [\theta, \theta^R]$. Thus, (A.7) implies (4).

Proof of Proposition 3

To show (i) compare (9) with (15), and rewrite as

$$[R'(X_p^F(\theta)) - \theta C_p'(X_p^F(\theta))] - [R'(X_p^*(\theta)) - Z(\theta)C_p'(X_p^*(\theta))] = \mu\left[\frac{t^A - t^P}{(1 - t^P)t^A}\right]\left[\frac{dX_a}{dX_p}\bigg|_{X_p^*} - \frac{dX_a}{dX_p}\bigg|_{X_p^F}\right]. \quad (A.8)$$

Now, suppose to the contrary that $X_p^F(\theta) < X_p^*(\theta)$. Since $Z(\theta) \geq \theta$ for all θ the left-hand side of (A.8) is greater than zero. This implies that the right-hand side of (A.8) must be greater than zero. This in turn implies

$$\left[\frac{dX_a}{dX_p}\bigg|_{X_p^*} - \frac{dX_a}{dX_p}\bigg|_{X_p^F}\right] > 0. \quad (A.9)$$

We now proceed to show that (A.11) cannot hold given that $X_p^F(\theta) < X_p^*(\theta)$. Differentiating the affiliate's first order condition ($R'(\cdot) - C_a'(\cdot) = 0$), we obtain

$$\frac{dX_a}{dX_p} = -\frac{R''(\cdot)}{R''(\cdot) + C_a''(\cdot)} < 0. \quad (A.10)$$

Differentiating (A.12) with respect to X_p yields

$$\frac{d(dX_a/dX_p)}{dX_p} = \frac{R'''(\cdot)C_a''(\cdot)}{[R''(\cdot) + C_a''(\cdot)]^2}. \quad (A.11)$$

Since $R'''(\cdot) \leq 0$ and $C_a''(\cdot) \geq 0$, $d(dX_a/dX_p)/dX_p \leq 0$. Under the supposition that $X_p^F(\theta) < X_p^*(\theta)$ and since $d(dX_a/dX_p)/dX_p \leq 0$ it follows that

$$\left[\frac{dX_a}{dX_p}\bigg|_{X_p^*} - \frac{dX_a}{dX_p}\bigg|_{X_p^F}\right] \leq 0.$$

This is a contradiction. Therefore, $X_p^F(\theta) \geq X_p^*(\theta)$. To show (ii) note that from (13) we know that $\Pi^*(\theta)$ is decreasing in θ and that $\Pi^*(\theta) \geq \Pi^*(\theta_1) = \Pi^F(\theta)$ for all θ; thus we have established that the MNC profits are higher under imperfect information. To show (iii) note that the objective function (6) is the same under both full and imperfect information; however the imperfect information maximization problem involves an additional constraint (i.e., the incentive compatibility constraint (4)). Therefore, by the envelope theorem $W^*(\theta) \leq W^F(\theta)$, for each θ.

Proof of Proposition 4

To show (i) compare (19) with (15) and note that the only difference is the term $(1-\alpha)X_T(\cdot)P'_A(\cdot)[1+dX_a/dX_p] \leqslant 0$. This implies that for $\alpha < 1$, $X_p^{*\alpha} \geqslant X_p^*$. To show (ii) note that (by (13))

$$\Pi^{*\alpha}(\theta) = \Pi(\theta_1) + (1-t^P)\int_\theta^{\theta_1} C_p(X_p^{*\alpha}(y))dy.$$

Using (i), $X_p^{*\alpha}(\theta) \geqslant X_p^*(\theta)$, $\forall\theta$, and thus it follows that $\Pi^{*\alpha}(\theta) \geqslant \Pi^*(\theta)$, $\forall\theta$.

Notes

1. Lall (1973) also documents instances of transfer price manipulation involving LDCs.
2. These authors showed that the profit-maximizing transfer price is set at either the highest or the lowest legally possible price, depending upon the relative tax and tariff rates.
3. We are assuming that trade between operating divisions is in one direction, from the parent to the monopolistic affiliate.
4. Alternatively, our approach can encompass also the case where the parent division produces for additional markets as long as the technology exhibits constant returns to scale.
5. The tax rates, t^P and t^A, are effective tax rates which are inclusive of tax credits to avoid excessive double taxation. For an extensive discussion of tax provisions relating to MNCs see Caves (1982), Chapter 8. Note we are also assuming that the tax rates are exogenous to the agency regulating MNC transfer pricing. The corporate tax rate is set for a broad number of sectors. MNC activity may only be a small part of overall commerce.
6. It is assumed that $F(\theta)/f(\theta)$ is nondecreasing. This is merely a regularity condition that is satisfied by a wide variety of distributions (normal, exponential, uniform).
7. The HCG views X_p as a restriction on imports, but the MNC views X_p as a restriction on exports. Thus, we will refer to X_p both as exports (the parent's viewpoint) and as imports (the HCG's viewpoint) depending upon whom we are describing.
8. See Baron and Myerson (1982) for the seminal contribution to regulation under asymmetric information and Baron (1989) for a more general treatment of the problem.
9. It is natural to restrict the cost and demand functions to those cases that entail $\{P(\cdot), X_p(\cdot)\}$ to be nonnegative.
10. If the unemployment effect, μ, is too large, optimality implies a corner solution, i.e., no intrafirm trade. It is shown in section 4 that there is a wide range of values for μ which generate internal solutions, i.e., $X_p(\theta) > 0$.The concavity of the profit function ensures that the second order conditions are satisfied for all solutions with $X_p(\theta) > 0$.
11. The assumptions made about $R(\cdot)$, $C_a(\cdot)$, and $C_p(\cdot)$ along with the assumption that $F(\theta)/f(\theta)$ is nondecreasing ensures that the welfare function as stated in (14) is strictly concave. This in turn implies that the optimal scheme is unique.
12. $V(X_T) = \int_0^{X_T} P_A(x)dx$ where $P_A(\cdot)$ denotes the host country's inverse demand function. We assume $P_A(\cdot)$ is common knowledge.

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