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Tariffs, licensing and market structure

by

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Abstract: This paper challenges the conventional wisdom that exclusive owners of an advanced technology are always better off when producing as a monopolist than when competing against another firm. Competition against a less efficient firm weakens the power that a host country can exert on the incumbent in the form of its tariff policy. We show that this gives a motive for a monopolist to license its technology to another foreign firm. A host country gains more from increased competition if it can induce the foreign incumbent to transfer technology to the host country firm. We show that the host country can do so by tariff commitment.

JEL Classifications: D43; F13; L13

Key Words: Licensing; Tariff protection; Market structure

Outline

1. *Introduction*
2. *Model*
3. *Licensing*
4. *Host-country policy: commitment or no-commitment?*
5. *Conclusion*

Non-Technical Summary

This paper shows that a monopolist can be better off serving a foreign market through exporting when it competes with a weaker exporting firm. By choosing an appropriate licensee, the monopolist may either reduce the host country's optimal tariff rate or jump the tariff barrier. However, the host country gains more from increased competition if it can induce the foreign incumbent to transfer technology to the host country firm. The host government can only induce technology transfer to the host country when it commits to its tariff rate.

1. Introduction

It is well-known in industrial organization that the aggregate of firms' profits under Cournot competition decreases in the number of firms operating in the marketplace. Therefore, it is not obvious why a monopolist would voluntarily license its technology to other firms. Accordingly, previous literature has only focused on licensing to competing firms in the marketplace with a disadvantage in the marginal cost of production (see, e.g., Katz and Shapiro, 1985 and 1986; Kamien and Tauman, 1986; Fauli-Oller and Sadonis, 2001; Mukherjee, 2001 and Kabiraj and Marjit, 2003) and not on licensing by monopolists to a potential competitor. In a two-country framework with endogenous tariffs, this paper shows that a monopolist may be better off by endogenously creating competition when it wants to serve a foreign market by exporting. The existence of an active tariff policy in the host country is crucial for deriving this result.

The reason for this finding is as follows. If the monopolist licenses its technology to the potential *foreign* entrant, it helps to reduce the host country's optimal tariff rate, if the host country sets its tariff after the licensing agreement. But if the technology is licensed to the potential *host country* entrant, it gives the advantage of 'tariff jumping', irrespective of whether the host country sets its tariff before or after licensing. We find that when the host country sets its tariff after licensing, the benefit to the monopolist is higher if it licenses the technology to the foreign entrant. That is, here the benefit from lower host country tariff rate is greater compared to the benefit from tariff jumping. If the host country sets the tariff before licensing, then licensing to the foreign entrant does not give the benefit of a lower tariff rate but licensing to the host country entrant gives the advantage of tariff jumping. So, in this situation, it is better for the monopolist to license the technology to the host country entrant. Furthermore, we show that the host country's commitment to the tariff rate before the monopolist's decision on licensing improves welfare of the host country by diverting licensing to the host country firm from licensing to the foreign firm.

The idea that a restrictive trade policy may help the local consumers by inducing the foreign firm to transfer its superior technology to a local firm was recently established in Kabiraj and Marjit (2003). Our analysis deviates from theirs in several significant

ways. First, we consider contracts that allow for royalties and fixed fees instead of a fixed fee only. Surveys show that the combination of royalty and fixed fee licensing is far more prevalent than licensing by means of a fixed fee only (Rostoker, 1984).¹

Second, we consider the possibility of licensing to another foreign firm rather than contracts to firms in the host country only. In fact, we show that the foreign firm prefers licensing to a firm from the same country to licensing to a host country firm if the host country cannot commit to its tariff before the firm's licensing decision. So, in contrast to Kabiraj and Marjit (2003), technology transfer to the host country will not take place if the host government does not commit to its tariff, but reacts to the licensing decision by the foreign firm.

Third, we consider the situation of a foreign monopolist where rival firms arise endogenously rather than assuming that they are exogenously given. Finally, the effect of strategic trade policy on the licensing decision is much weaker in Kabiraj and Marjit (2003). In their model the foreign firm would always license its technology (i.e., irrespective of the restrictive trade policy) if the variable cost of the domestic firm were up to 80% of the monopoly price, a condition that is quite likely to hold. In our model, the foreign firm would never license its technology under free trade. Therefore, this paper shows more clearly the effect of an active trade policy.

Finally, our result of a simultaneous choice of exports and licensing gives complementary insight in a recent internalization discussion, which highlights the co-existence of export and foreign investment by the same firm to and in the same host country (Mukherjee, 2003; Rob and Vettas, 2003).

The remainder of the paper is organized as follows. The next section derives the basic models of foreign direct investment and exporting by a monopolist. It also examines the case of exporting by two firms of which one firm (the incumbent) has a lower production cost than the other firm (the entrant). Section 3 endogenizes the market structure and the cost difference by examining the licensing decision of the incumbent firm. Tariffs are imposed after the incumbent's licensing decision. Section 4 shows that a commitment policy by the host country where it fixes tariffs before the incumbent's

¹ Recent research has focused on why royalties are being used so extensively in licensing deals; see Faulí-Oller and Sandonis (2002) for a listing of explanations and references to the relevant papers.

licensing decision alters the equilibrium from licensing to another foreign firm to licensing to a host country firm. Finally, the last section briefly summarizes the main results and gives some directions for further research.

2. Model

We assume that there is a firm, called incumbent, who is the sole owner of a technology. The marginal cost of production is normalized to zero. Demand is linear in price and is written as $q = a - p$ (cf. e.g. Kabiraj and Marjit, 2003; Saggi, 2003) where p denotes price. This section first derives the incumbent's profit and welfare of the host country if the incumbent produces like a monopolist, either by producing locally through a foreign direct investment (FDI) or by exporting from an existing production plant. When undertaking a FDI, the incumbent has to pay a fixed cost for setting up a production plant. Exporting entails the payment of the appropriate tariff to the host government. Next, the section derives the incumbent's optimal profit and the host country's optimal tariff, when the incumbent competes against an entrant that is less efficient than the incumbent.

2.1 Monopoly

2.1.1 Incumbent undertakes FDI

If the incumbent undertakes FDI to the host country, its profit is given by $q^f(a - q^f) - F$, where F stands for the fixed cost of the FDI. The incumbent's profit maximizing output is given by

$$\hat{q}^f = \frac{1}{2}a. \quad (1)$$

By substituting the optimal output in the profit function, the incumbent's maximized profit from FDI is

$$\hat{\pi}^f = \frac{1}{4}a^2 - F. \quad (2)$$

Host country's welfare, when there is no taxation and profits are repatriated, equals the consumer surplus in the host country. It can be derived as

$$\hat{W}^f = \frac{1}{8}a^2. \quad (3)$$

2.1.2 Incumbent exports

Now suppose that the incumbent exports to the host country. Incumbent's profit when the host government imposes a uniform tariff of τ^m equals

$$\pi^m = q^m(a - q^m - \tau^m), \quad (4)$$

where q^m stands for the monopoly output. Host country welfare is equal to the summation of consumer surplus and tariff income. The consumer surplus in the host country equals

$$cs = \frac{1}{2}(q^m)^2, \quad (5)$$

while tariff income for the host government is

$$T = \pi q^m. \quad (6)$$

Consider a two-stage game where in the first stage the host country government sets its tariff rate to maximize host country welfare, and in the second stage the incumbent firm maximizes profit. As usual, the game is solved backwards.

Maximizing (4) with respect to output, we derive the optimal price and output as

$$(\hat{p}^m, \hat{q}^m) = \left(\frac{1}{2}(a + \tau^m), \frac{1}{2}(a - \tau^m)\right) \quad (7)$$

Substituting (7) into the sum of (5) and (6), host country welfare amounts to

$$W^m = \frac{1}{8}(a - \tau^m)^2 + \frac{1}{2}\tau^m(a - \tau^m). \quad (8)$$

Maximizing host country welfare with respect to the tariff yields an optimal tariff of

$$\hat{\tau}^m = \frac{1}{3}a, \quad (9)$$

and maximized host country welfare equals

$$\hat{W}^m = \frac{1}{6}a^2. \quad (10)$$

So both host country welfare and tariff rate are increasing in its own market size (see also Saggi, 2003). The incumbent's optimal output is

$$\hat{q}^m = \frac{1}{3}a, \quad (11)$$

and its optimal profit is

$$\hat{\pi}^m = \frac{1}{9}a^2. \quad (12)$$

So for low enough fixed cost, the incumbent prefers undertaking a FDI into the host country,² while the host government prefers exporting regardless of the fixed cost.

2.2 Duopoly with a uniform tariff

Now consider the case of foreign duopoly, where the incumbent has a technological advantage in production against the foreign rival firm, which is labeled as the entrant. The technological advantage implies that the entrant produces at a marginal cost of c , while the incumbent, as before, has a marginal cost of zero. Both firms and the host government play a two-stage game where both firms compete like Cournot duopolists in the second stage and the host government maximizes welfare in the first stage. The incumbent's profit equals

$$\pi^i = (a - q^i - q^e - \tau^d)q^i, \quad (13)$$

while the entrant's profit reads

$$\pi^e = (a - q^i - q^e - \tau^d - c)q^e, \quad (14)$$

where q^i and q^e denote the output of the incumbent and the entrant, respectively, and τ^d stands for the tariff under the duopoly market structure. The second stage Nash equilibrium output for the firms can be calculated as

$$(\hat{q}^i, \hat{q}^e) = \left(\frac{1}{3}(a - \tau^d + c), \frac{1}{3}(a - \tau^d - 2c) \right). \quad (15)$$

The equilibrium price equals

$$\hat{p}^d = \frac{1}{3}(a + 2\tau^d + c). \quad (16)$$

By substituting the Nash equilibrium output in the host country's welfare function, the latter can be written as

$$W^d = \frac{1}{3}\tau^d(2a - 2\tau^d - c) + \frac{1}{18}(2a - 2\tau^d - c)^2, \quad (17)$$

where the first term on the right-hand side represents tariff revenue and the second term represents consumer surplus. Under the condition that the host country imposes a uniform tariff to both firms, the tariff that maximizes welfare equals

² There may be other reasons than fixed cost of investment that explain why a firm exports instead of doing FDI, for example higher wages in the host country or the risk of expropriation. In order to most clearly convey the effects of the host country's tariff policy and the incumbent's licensing decision we assume that host country and home country are equal in all respects (so same wages, same risk of expropriation etc.)

$$\hat{\tau}^d = \frac{1}{8}(2a - c). \quad (18)$$

Maximized welfare can be written as

$$\hat{W}^d = \frac{1}{16}(2a - c)^2. \quad (19)$$

Incumbent's and entrant's optimal outputs are

$$(\hat{q}^i, \hat{q}^e) = \left(\frac{1}{8}(2a + 3c), \frac{1}{8}(2a - 5c)\right). \quad (20)$$

Note that the entrant will produce positive output provided $c < \frac{2}{5}a$ and we assume that it holds. Maximized profits for the incumbent and the entrant equal

$$(\hat{\pi}^i, \hat{\pi}^e) = \left(\frac{1}{64}(2a + 3c)^2, \frac{1}{64}(2a - 5c)^2\right). \quad (21)$$

Comparing the profits from exporting under foreign monopoly and foreign duopoly, we have the following proposition.

Proposition 1: (i) For $\frac{2}{9}a < c < \frac{2}{5}a$ incumbent's profit from exporting is higher under foreign duopoly than under monopoly and the duopoly is feasible in the sense that the entrant produces positive output.

(ii) Industry profit from exporting is higher under foreign duopoly than under foreign monopoly for all $c \in (0, \frac{2}{5}a)$.

Comparison of (10) and (19) provides the following proposition on host country welfare.

Proposition 2: Suppose $(2 - \frac{2}{3}\sqrt{6})a < c < \frac{2}{5}a$. If only foreign firms serve the host market by exporting, host country welfare is higher under foreign monopoly than under foreign duopoly.

So for a cost range of $\frac{2}{9}a < c < (2 - \frac{2}{3}\sqrt{6})a$ both welfare in the host country and incumbent profit are higher under foreign duopoly as compared to foreign monopoly. The intuition behind this result is the following. When the exporting firm has a monopoly and the incumbent's cost advantage is not too large, the higher tariff revenue of the host country cannot offset the loss in consumer surplus under foreign monopoly, so welfare is higher under duopoly. For the incumbent, competition with a less efficient firm leads to a

lower optimal tariff in the host country. The increase in profit from a lower tariff will more than compensate for the profit loss from competition when the cost advantage is sufficiently high.

Finally, total world welfare, which is the sum of host country welfare and industry profit, equals $\frac{5}{18}a^2$ in the case of monopoly and $\frac{3}{8}a^2 - \frac{3}{8}ac + \frac{35}{64}c^2$ in the case of duopoly. It is easy to check that the duopoly welfare is higher than the monopoly welfare for any feasible cost.

2.3 Duopoly with discriminatory tariffs

Now consider discriminatory tariffs. The host government imposes a tariff τ^i on the incumbent and a tariff τ^e on the entrant. Now, by straightforward algebra, it can be shown that the set of optimal tariffs in the first stage of the game is as follows

$$(\hat{\tau}^i, \hat{\tau}^e) = \left(\frac{1}{8}(2a + c), \frac{1}{8}(2a - 3c)\right). \quad (22)$$

So the host country levies a higher tariff on the more efficient exporter (the incumbent). This result was formerly derived by Gatsios (1991), Hwang and Mai (1995) and Choi (1995). The optimal quantities in the second stage of the game are

$$(\hat{q}^i, \hat{q}^e) = \left(\frac{1}{8}(2a + c), \frac{1}{8}(2a - 3c)\right). \quad (23)$$

Note that the entrant produces positive outputs provided $c < \frac{2}{3}a$.

Maximized profit for the incumbent and entrant equal

$$(\hat{\pi}^i, \hat{\pi}^e) = \left(\frac{1}{64}(2a + c)^2, \frac{1}{64}(2a - 3c)^2\right). \quad (24)$$

The condition for higher profit for the incumbent under duopoly is $c > \frac{2}{3}a$, while the condition for positive output for the entrant is $c < \frac{2}{3}a$. Hence the incumbent cannot be better off under duopoly with discriminatory tariffs. Further, in case of foreign duopoly, industry profit is also higher under uniform tariffs as compared to discriminatory tariffs.

3. Licensing

The results in the previous section suggest that there is an incentive for the incumbent to license its technology to an entrant. By licensing and using output royalty, the incumbent can create competition with an entrant that has a higher cost of production. In this section

we will set up a three-stage game where in the first stage the incumbent decides on the licensing contract. The incumbent can either license to a host country potential entrant or to a foreign potential entrant. We assume that the incumbent has full bargaining power and gives a take-it-or-leave-it licensing contract. The licensee either accepts or rejects the offer. The licensee accepts the offer if it does not make the licensee worse off compared to rejecting the offer. In the second stage the host government chooses the tariff rate and in the third stage both firms set output in the product market. We solve the game through backward induction.

So this section considers the situation where the host government cannot commit to the tariff rate before licensing, but it reacts with the tariff rate to the licensing strategy of the incumbent. This assumption is motivated by the observation that trade policy is often ‘time inconsistent’, meaning that governments have an incentive to reverse its preannounced tariff rate (Staiger and Tabellini, 1987). In section 4, we will consider the situation where host government commits to the tariff rate before the licensing decision.

3.1 Licensing to the host country’s entrant

With the licensing income, the incumbent’s profit equals

$$\pi^{i,lh} = (a - q^{i,lh} - q^{e,lh} - \tau^{lh})q^{i,lh} + c^{lh}q^{e,lh} + l^{lh}, \quad (25)$$

while the host entrant’s profit is

$$\pi^{e,lh} = (a - q^{i,lh} - q^{e,lh} - c^{lh})q^{e,lh} - l^{lh}, \quad (26)$$

where c^{lh} , l^{lh} and τ^{lh} denote the royalty rate charged by the incumbent, the fixed licensing fee and the tariff rate imposed by the host country to the incumbent, respectively.³

The three-stage game is solved backwards as usual. In the third stage, the optimal output of the incumbent and the entrant when competing in the product market are

³ There could be another possibility where the foreign firm can license this technology to the host entrant and does not sell in the host country market. This strategy, if credible, makes the host entrant a monopolist. However, if there is a possibility of re-entry (as in Katz and Shapiro, 1985, Marjit, 1990 and many others, and also implicit in Kabiraj and Marjit, 2003), the foreign firm has always the incentive to enter the market after making the licensing contract. Hence, the host entrant will not accept a relatively expensive licensing contract with a fixed fee that grants a monopoly in the host market. Furthermore, the host government may block any licensing contract that grants monopoly rights to a firm in the host country.

$$(\hat{q}^{i,lh}, \hat{q}^{e,lh}) = \left(\frac{1}{3}(a + c^{lh} - 2\tau^{lh}), \frac{1}{3}(a - 2c^{lh} + \tau^{lh}) \right). \quad (27)$$

For an interior solution where both the incumbent and the entrant produce we need $a + c^{lh} - 2\tau^{lh} > 0$ and $a - 2c^{lh} + \tau^{lh} > 0$. Host country's welfare is equal to

$$W^{lh} = \frac{1}{3}\tau^{lh}(a + c^{lh} - 2\tau^{lh}) + \frac{1}{18}(2a - c^{lh} - \tau^{lh})^2, \quad (28)$$

which is the sum of tariff income and consumer surplus. Entrant's profit does not come into the host country's welfare as the incumbent will set the fixed fee such that the entrant is indifferent between accepting and rejecting the licensing offer. Hence, entrant's profit is zero.

In the second stage, the tariff that maximizes host country welfare equals

$$\hat{\tau}^{lh} = \frac{1}{3}a. \quad (29)$$

Substituting the optimal tariff and optimal outputs into (25) gives incumbent's profit as

$$\pi^{i,lh} = \left(\frac{1}{9}a + \frac{1}{3}c^{lh} \right)^2 + \frac{4}{9}ac^{lh} - \frac{2}{3}(c^{lh})^2 + l^{lh}. \quad (30)$$

In the first stage of the game, the royalty rate that maximizes the incumbent's profit equals

$$\hat{c}^{lh} = \frac{7}{15}a. \quad (31)$$

Therefore, from (27), (29) and (31) we get the optimal outputs of the firms as

$$(\hat{q}^{i,lh}, \hat{q}^{e,lh}) = \left(\frac{12}{45}a, \frac{6}{45}a \right). \quad (32)$$

The optimal fixed fee in the licensing contract is such that the entrant is indifferent between accepting and rejecting the licensing contract. Hence \hat{l}^{lh} solves $\pi^{e,lh} = 0$. By substituting (29), (31) and (32) into (26), we derive

$$\hat{l}^{lh} = \frac{4}{225}a^2 \quad (33)$$

Host country's welfare and the incumbent's profit can now be calculated respectively as

$$\hat{W}^{lh} = \frac{38}{225}a^2, \quad (34)$$

$$\hat{\pi}^{i,lh} = \frac{34}{225}a^2. \quad (35)$$

3.2 Licensing to the foreign country's entrant

The results in section 2.3 show that the incumbent can only achieve a lower tariff when licensing to an entrant from the same country.⁴ If the incumbent would license to an entrant of another nation, the host country would discriminate tariffs and would not reduce the tariff imposed on the incumbent competing with a firm with higher marginal cost.

Now, we consider licensing to a host country firm. Here, the incumbent's profit equals

$$\pi^{i,lf} = (a - q^{i,lf} - q^{e,lf} - \tau^{lf})q^{i,lf} + c^{lf}q^{e,lf} + l^{lf}, \quad (36)$$

while the entrant's profit is

$$\pi^{e,lf} = (a - q^{i,lf} - q^{e,lf} - \tau^{lf} - c^f)q^{e,lf} - l^{lf}, \quad (37)$$

where c^{lf} , l^{lf} and τ^{lf} denote the royalty rate charged by the incumbent, the fixed licensing fee and the tariff rate imposed by the host country, respectively.

In the third stage, the optimal outputs of the incumbent and the entrant are as in equation (15). Host country's welfare is given in equation (17). From (15), the conditions for an interior solution are $a - \tau^{lf} + c^{lf} > 0$ and $a - \tau^{lf} - 2c^{lf} > 0$.

In the second stage, the tariff that maximizes host country welfare is as expressed in equation (18). Substituting the optimal tariff into (36) gives the incumbent's profit as

$$\pi^{i,lf} = \frac{1}{64}(2a + 3c^{lf})^2 + \frac{1}{8}c^{lf}(2a - 5c^{lf}) + l^{lf}, \quad (38)$$

provided that $2a - 5c^{lf} > 0$.

In the first stage of the game, the royalty rate that maximizes the incumbent's profit equals $\hat{c}^f = \frac{14}{31}a$. However, for this fee the entrant's output is negative. Since incumbent's profit is increasing in c^{lf} for $0 < c^{lf} < \frac{2}{5}a$, the royalty rate that maximizes the incumbent's profit is

$$\hat{c}^{lf} = \frac{2}{5}a. \quad (39)$$

Since the profit of the entrant is zero, the incumbent licenses its technology by means of a royalty only, so $\hat{l}^{lf} = 0$. Host country's welfare and the incumbent's profit can now be calculated as

⁴ Or to an entrant of a country that is in the same customs union as the incumbent's country of origin.

$$\hat{W}^{lf} = \hat{\pi}^{i,lf} = \frac{4}{25}a^2. \quad (40)$$

3.3 Equilibrium

Since the profit of the incumbent in either licensing regime is higher than the monopoly profit obtained in equation (12), the incumbent is better off by licensing its technology and exporting in a duopoly than exporting as a monopolist. So exporting and licensing co-exist when the fixed cost of FDI is sufficiently high. Alternatively, they can co-exist when the host country puts significant constraints on foreign inward investments. For example, Belderbos (1998) illustrates that FDI by Dutch multinationals into Japan is surprisingly low but licensing agreements with Japanese firms are widespread. At the same time these multinational firms export their goods to Japan. Our result complements recent research on the internalization motive for the multinationals where it is shown that there are circumstances under which it is optimal for a firm to undertake FDI in a host country while exporting the same good to the host country (Mukherjee, 2003; Rob and Vettas, 2003).

When considering the decision to whom to license, we find that the incumbent prefers to license by royalty only to another foreign firm. By licensing to another foreign firm the incumbent gains a tariff reduction whereas licensing to a host country firm gives the advantage of ‘tariff jumping’. In case of licensing to the foreign entrant, the incumbent imposes the royalty rate in a way so that the entrant’s output approaches zero and hence the incumbent has a virtual monopoly. Proposition 3 summarizes the findings.

Proposition 3: *When the host country does not commit to a tariff and when the fixed cost of FDI is sufficiently high, the exclusive owner of an advanced technology will transfer its technology to another foreign firm rather than transferring its technology to a host country firm.*

4. Host country policy: commitment or no-commitment?

The previous analysis shows that not only the incumbent is better off under ‘exporting and licensing’ than ‘exporting as a monopolist’, host country’s welfare also increases when the incumbent issues a license to another firm. However, it is clear from

subsections 3.1 and 3.2 that host country welfare increases more if the license is issued to a host country firm instead of a foreign entrant. Hence, the optimal policy for the host country seems compulsory licensing to the host country firm. Nevertheless, such a policy is hard to enforce internationally. An intuitive way for the host government to achieve licensing to the host country firm is not to lower the tariff in response to competition between the incumbent and the foreign entrant. In other words, the host government can induce licensing to the host country firm if it commits to the tariff before licensing. We formally demonstrate the effectiveness of such a commitment policy⁵ in a three-stage game where the host country fixes the tariff before licensing.

4.1 Licensing to a host country's entrant

If the foreign firm licenses its technology to the host country firm then the analysis of the product market competition in the third stage is similar to subsection 3.1. The optimal royalty in the second stage now equals

$$\hat{c}^{lh} = \frac{1}{2}a - \tau^{lh}, \quad (41)$$

while the optimal fixed fee can be derived as

$$l^{lh} = (\tau^{lh})^2 \quad (42)$$

In the first stage the host government maximizes host country welfare with respect to the tariff. The optimal tariff equals

$$\hat{\tau}^{lh} = \frac{1}{4}a. \quad (43)$$

The solution yields an interior solution for the outputs, which equal

$$(\hat{q}^{i,lh}, \hat{q}^{e,lh}) = \left(\frac{1}{4}a, \frac{1}{4}a\right). \quad (44)$$

The optimal licensing contract is characterized by

$$(\hat{c}^{lh}, \hat{l}^{lh}) = \left(\frac{1}{4}a, \frac{1}{16}a^2\right).^6 \quad (45)$$

Home country's welfare is equal to

⁵ Mukherjee (2000) shows the domestic country's preference for a commitment policy towards the taxation of foreign multinational firms while Al-Saadon and Das (1996) demonstrate the host government's preference for a no-commitment strategy with respect to the taxation of joint ventures between a foreign multinational firm and a domestic firm.

$$\hat{W}^{lh} = \frac{3}{16}a^2, \quad (46)$$

which is the sum of tariff income and consumer surplus. The profit of the incumbent can be calculated as

$$\hat{\pi}^{i,lh} = \frac{3}{16}a^2. \quad (47)$$

4.2 Licensing to a foreign country's entrant

If the host government commits to a tariff rate before licensing, it is clear that the foreign incumbent has no incentive to license its technology to the foreign entrant⁷. If the host government commits to a tariff rate τ^{lf} , licensing to a foreign entrant will create competition in the industry without affecting the tariff rate. As the foreign incumbent has no incentive to license to the foreign entrant⁸, the foreign firm remains a monopoly and the analysis is similar to subsection 2.1.2. So the optimal tariff rate equals

$$\hat{\tau}^{lf} = \frac{1}{3}a. \quad (48)$$

The solution yields a monopoly for the incumbent as the output of the entrant is zero. Hence, the fixed fee is zero and home country's welfare and incumbent's profit are as in equation (10) and (12), respectively.

4.3 Equilibrium outcome

With the payoffs corresponding to the host government's strategy either to commit or not to commit to the tariff and the incumbent's strategy to license either to a home country firm or to another foreign firm, we are in a position to see whether the host government prefers commitment or no-commitment. Table 1 summarizes host country's welfare and foreign incumbent's profit from licensing to a firm in the home and host country.

⁶ The optimal royalty rate $\frac{1}{4}a (< \frac{1}{2}a)$ implies that the incumbent is better off under licensing with this royalty rate compared to no licensing. Because, otherwise the optimal royalty rate will be $\frac{1}{2}a$, which makes the optimal output of the host country firm equal to zero.

⁷ It is easy to check that given τ^{lf} , the foreign incumbent's monopoly profit $\frac{1}{4}(a - \tau^{lf})^2$ is always greater than the industry profit under foreign duopoly, which is $\frac{1}{9}[(a - \tau^{lf} + c)^2 + (a - 2c - \tau^{lf})^2]$, where c is the marginal cost of the foreign entrant and $c \in [0, \frac{1}{2}(a - \tau)]$.

⁸ So the optimal royalty and fixed-fee are such that the optimal output of the entrant is zero.

Table 1: Incumbent's profit and welfare in the host country

		Host country's strategy	
		Commitment	No-Commitment
Incumbent's strategy	Licensing to the host country firm	$\hat{\pi}^{i,lh} = \frac{3}{16} a^2$ $\hat{W}^{lh} = \frac{3}{16} a^2$	$\hat{\pi}^{i,lh} = \frac{34}{225} a^2$ $\hat{W}^{lh} = \frac{38}{225} a^2$
	Licensing to the firm from same foreign country	$\hat{\pi}^{i,lf} = \frac{1}{9} a^2$ $\hat{W}^{lf} = \frac{1}{6} a^2$	$\hat{\pi}^{i,lf} = \frac{4}{25} a^2$ $\hat{W}^{lf} = \frac{4}{25} a^2$

The host government has a dominant strategy of commitment to its tariffs. Given this commitment, the incumbent's optimal strategy is to license its technology to the host country firm. The equilibrium payoff for the incumbent is higher than the payoff from maintaining a monopoly and serving the host country by exporting. The host country significantly gains from commitment, as host country welfare under commitment strategy, given in (46), is greater than the host country welfare under no-commitment strategy, given in (40). Commitment not only induces technology transfer to the host country, which would not be achieved without commitment, it also raises host country welfare as compared to the no-commitment case and technology transfer to the foreign entrant. Proposition 4 summarizes the main findings.

Proposition 4: *Assume that the cost of foreign investment is sufficiently high so that foreign investment does not occur.*

- (i) *Host country's commitment to the tariff rate induces the foreign firm to transfer its technology to the host country firm, whereas no-commitment to the host country tariff rate induces the foreign firm to transfer its technology to another foreign firm.*
- (ii) *Host country welfare is higher under commitment to the tariff rate compared to no-commitment to the tariff rate.*

5. Conclusion

This paper shows that a monopolist can be better off serving a foreign market through exporting when it competes with a weaker exporting firm. By licensing, the monopolist can endogenously create the desired duopolistic market structure. The host government can only induce technology transfer to the host country when it commits to its tariff rate. Though we have not explicitly shown that licensing to a single firm is the optimal strategy for the incumbent, initial calculations show that there is no gain for the incumbent from creating competition with more than one firm. We leave a formal analysis of multiple licenses for future research.

Empirical tests of the implications from the model, such as (i) the incumbent's decision to both export and license when it has high market power and faces high fixed cost of investment (or restrictions to foreign investment), and (ii) the positive relationship between technology transfer to the host country and the host country's commitment to a tariff, provide other interesting directions for further research. Building blocks for such empirical tests may be Ferrantino (1993) and Maskus (1998) who show a positive relationship between relatively strong patent protection and the MNE's decision to transfer knowledge through licensing. In a simultaneous model of licensing and exporting, Smith (2001) finds that strong patent protection in a host country simultaneously stimulates both exports and licenses into the host country.

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