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Trade Cost, Technology Licensing and Foreign Direct Investment

by

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Abstract

Recent evidences show the co-existence of lower trade cost and higher amount of foreign direct investment (FDI), which cannot be explained by the traditional "proximity-concentration trade-off". We show that if both the home and the host country markets are important to the foreign firm, lower trade cost may increase FDI if the foreign and the host country firms differ in technologies. Whether lower trade cost increases welfare is ambiguous, and depends on its effects on FDI. We also show the impacts of technology licensing on FDI and welfare. Licensing substitutes FDI, and the effects of lower trade cost are ambiguous on the home country welfare and the host country welfare in presence of licensing. Whether, for a given trade cost, licensing (compared to no licensing) increases welfare is also ambiguous.

Outline

1. *Introduction*
2. *The basic model*
3. *Technology licensing*
4. *Conclusion*

Non-Technical Summary

The effect of trade cost reduction on foreign direct investment (FDI) has always been in question to the trade economists. The well-established theory of "proximity-concentration trade-off" suggests a positive relationship between trade cost and FDI. That is, a lower trade cost, which is the result of better transportation technology, higher economic integration, or trade liberalization, should lower FDI. However, recent evidences show that technological and policy induced trade cost are falling dramatically while, at the same time, FDI is gaining importance in the world economies. The "proximity-concentration trade-off" may not be useful in explaining the recent evidences. The usual explanation for this apparent puzzle argues that along with the reduction in trade cost, the host country governments often induce FDI by reducing the cost of doing FDI, creating more congenial environment for the investment. However, we show that, even if the cost of FDI remains unaffected, FDI increases with lower trade cost in presence of technological difference between the foreign and the host country firms.

We consider the effect of trade cost reduction on FDI by using a simple model where a foreign firm sells its product both in the home country and in the host country markets. We show that when the foreign firm is sufficiently technologically superior to that of the host country firm, the foreign firm prefers to conduct FDI. Moreover, we show that lower trade cost may increase the incentives for FDI, and the effect depends on market size and the cost difference between the firms. We also show that the effects of lower trade cost on welfare of these countries and world welfare are ambiguous. This paper also determines the implications of licensing on FDI incentive. We suggest that licensing can substitutes FDI and, in presence of licensing, the effects of lower trade cost on these countries welfare are ambiguous and depend on the relationship between trade cost and FDI. Whether, for a given trade cost, licensing (compared to no licensing) increases welfare is ambiguous.

In summary, this paper provides an explanation for the negative relationship between trade cost and FDI, which can be found in the contemporary world and may not be well explained by the traditional theory of "proximity-concentration trade-off". The effect of lower trade cost on welfare and the implications of licensing are also investigated.

1. Introduction

What is the effect of trade cost reduction on foreign direct investment (FDI)? The well-established theory of "proximity-concentration trade-off" suggests a positive relationship between trade cost and FDI (see, e.g., Smith, 1987 (section 2) and Markusen, 2002 (chapter 2)). That is, ceteris paribus, a lower trade cost (which may be the outcome of better transportation technology, higher economic integration or trade liberalization) should lower FDI. However, this theory may not be very useful to explain recent observations in the world economy where technological and policy-induced trade costs are falling dramatically in recent decades, but, at the same time, FDIs are gaining importance in the world economies.

Feinberg et al. (1998) tests the relationship between trade cost and FDI at a disaggregate level by looking at the effects of US-Canada tariff reduction on the behaviour of the multinationals and their affiliates. They do not support the prediction of the proximity-concentration trade-off and show the negative relationship between tariff reduction and FDI. The relocation of firms in response to a lower trade cost is also supported by a survey on the effect of NAFTA on industry location (Hanson, 1988).

There are several other evidences showing the negative relationship between trade cost and FDI. For example, on the one hand, UNCTAD (2004) reports "Trade reforms in developing countries over the past 10-to-15 years are reflected in the general decline in protection in these countries, often under World Bank/IMF programs. Chinese import tariffs, for example, dropped from 34.8% to 12.4% in year 1992 to 2001; Indian tariffs fell from 70.5% to 28.0% in year 1990 to 2001". On the other hand, World Investment Report (2002) shows that FDI inflows (in million of dollars) to China and India have increased respectively by almost double and four times between 1990 (annual average between 1990 – 1995) and 2001. The enormous increase in FDI in the 1990s into the European Union even after the dramatic fall in trade costs provide further evidence of this negative relationship between trade costs and FDI.

The usual explanation for this apparent puzzle of lowering trade cost and increasing FDI argues that along with the lower trade costs, the host country policies are facilitating investments from abroad by reducing the cost of doing FDI (see, e.g., Markusen and Venables, 1998). Though the host country policies are creating more congenial environment for investment, which reduces the cost of FDI, significant cost of FDI still remains. These costs may arise simply because the foreign firms need to set up their plants

and the distribution channels in the host countries. We show that even if the cost of doing FDI is unaffected, lower trade cost may increase FDI in presence of technological[1] difference between the foreign and the host country firms.

In a simple model where a foreign firm sells its product both in the home country and in the host country markets, we show that the foreign firm prefers to conduct FDI if it is sufficiently technologically superior to that of the host country firm. Given that the trade cost is symmetric for exporting to and from the host country, we show that lower trade cost may increase the foreign firm's incentive for FDI. Since the fall in the trade cost makes exporting to the home country less expensive, it provides the foreign firm higher incentive for exploiting its competitive advantage through FDI. Whether lower trade cost increases the incentive for FDI depends on the market size and the cost difference between the firms. We also show that the effects of lower trade cost on welfare of these countries and world welfare are ambiguous.

If technological difference between the firms creates the possibility for technology licensing, which is an important element of conduct in today's world,[2] we show that licensing substitutes FDI. In presence of licensing, the effects of lower trade cost on the host country welfare and the home country welfare are ambiguous, and depend on the relationship between trade cost and FDI. Whether, for a given trade cost, licensing (compared to no licensing) increases welfare is also ambiguous.

The present paper is related to several strands of literature. First, it contributes to the theoretical literature explaining the negative relationship between trade cost and FDI (Motta, 1992, Norman and Motta, 1993, Motta and Norman, 1996, Lommerud et al., 2003 and Neary, 2002 and 2006).[3] Motta (1992) shows that if a host country firm's entry decision is endogenous and is affected by the foreign firm's decision on FDI and export, lower trade cost may increase FDI. However, in his analysis, if the entry cost for the host country firm is such that the host country firm enters the market irrespective of the investment decision of the foreign firm, lower trade cost always reduces entry like the

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[1] In this paper we define a technology according to the marginal cost of production. Lower marginal cost implies better technology.

[2] There is a vast empirical and theoretical literature on technology licensing. We do not attempt to review the licensing literature here. Instead, we refer to Calvert (1964), Taylor and Silberston (1973), Rostoker (1984), Kamien (1992), Pack and Saggi (1997) and Saggi (2002) for overviews on this issue.

[3] There is a literature with a competitive general equilibrium framework that suggests trade liberalisation can increase FDI if the induced capital flow increases production of the export sector (see, e.g., Markusen, 1983, Jones and Neary, 1984 and Neary, 1995). However, as nicely pointed out by Neary (2006) "This literature has fallen out of fashion, as its view of FDI as physical flows of a productive factor has given way to an industrial-organisation inspired view of FDI as an intra-firm transfer of intangible assets by multinational corporations". The present paper also considers this latter view of FDI.

proximity-concentration trade-off. Norman and Motta (1993), Motta and Norman (1006) and Neray (2002) show that the relationship between lower trade cost and FDI can be negative in case of "third country export-platform FDI"[4]. Neary (2006) show three reasons, such as vertical FDI, third country export-platform FDI and cross-border merger, which can explain the negative relationship between lower trade cost and FDI.[5] Lommerud et al. (2003) show that a lower trade cost can increase FDI if a firm's home labour market is unionised. We provide a new reason for this negative relationship. We show that even if the labour markets are perfectly competitive in both the home and host countries, lower trade cost can increase horizontal FDI if both the home country market and the host country market are important to the foreign firm and the technological difference between the firms creates the incentive for (almost) monopolizing the host country market through FDI.

Second, the present paper extends the literature on "welfare reducing licensing", which shows that licensing reduces welfare by facilitating collusive behaviour in the industry (Eswaran, 1994, Lin, 1996, Erutku and Richelle, 2000, Faulí-Oller and Sandonis, 2002), affecting the incentive for cooperative R&D (Mukherjee, 2005), or by affecting the incentive for market entry (Mukherjee and Mukherjee, 2005). Unlike these previous works, the present paper considers an open economy and shows that licensing may reduce welfare by eliminating FDI.

The present paper can also be related to Kabiraj and Marjit (2003), which shows that consumers of a host country may be better off from higher trade barrier since higher trade barrier induces the foreign firm to license its superior technology to the domestic firm, thus reducing the cost of production and the output prices in the domestic country.[6] However, they do not consider FDI by the foreign firm and assume that both the foreign and the domestic firms compete in the product market after licensing, thus ignoring the creation of exclusive territory for the foreign technology,[7] as considered in the present

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[4] By third country export-platform FDI, we refer to the situation where a firm invests in a host country for selling its products in that country and in another country different from its home country.

[5] In a multi-region general equilibrium model where marginal cost of production increases with higher outputs, Markusen and Rutherford (1994) show the effect of trade cost reduction on the plant location choice of a firm. Following the calibration procedure and starting with an initially diversified plant location by a multinational, they show that trade cost reduction reduces the number of plants. Their result is consistent with the proximity-concentration trade-off in the sense that lower trade cost induces the multinational to close its foreign plant (i.e., FDI reduces with trade cost reduction).

[6] Mukherjee and Pennings (2006) extend this line of research and show the incentive for licensing by a monopolist foreign producer in presence of strategic trade policy. They also show the incentive for committed and non-committed trade policies by the importing country.

[7] The exclusive territory clause guarantees to a licensee that no other firm using the innovation can sale its product in the licensee's market. In reality, licensing contract often includes an exclusive territory clause in addition to a specified payment scheme (Anand and Khanna, 2000). Caves et al. (1983) find that 34% of the

paper. In presence of licensing, though host country welfare may increase with higher trade cost in our analysis, it is due to higher profit extraction by the host country firm while consumer surplus is unaffected by the change in trade cost. Moreover, unlike them, we show that licensing may reduce both host country welfare and world welfare.

The remainder of the paper is organized as follows. In section 2, we set up the basic model without technology licensing, and show the implications of lower trade cost on FDI. We show the implications of technology licensing in section 3. Section 4 concludes.

2. The basic model

Assume that there are two countries, called home country and host country. There is a firm in the home country, called firm 1, who has already established its business in the home country and wants to serve the demand for both the countries. The markets for these countries are segmented. Firm 1 has two production strategies available: (i) it can produce in the home country and sell to both markets, or (ii) it can relocate its plant to the host country and sell to both markets from the host country. We assume that it is not profitable for firm 1 to use two plants in each country to serve the respective demand in those countries (see, e.g., Barros and Cabral, 2000 and Fumagalli, 2003 for similar assumptions in different contexts). This may be due to the diseconomies created by the higher cost of managing and operating two plants. If firm 1 wants to re-locate its plant to the host country, it needs to incur a fixed cost, F, for setting up its business in the host country. We further assume that exporting to and from the home country involves the same and constant per-unit trade cost, t. The constant marginal cost of production for firm 1 is c_1, and it is assumed to be 0, for simplicity. We assume that the constant marginal cost of production for firm 2 is $c_2 > 0$.[8] For simplicity, we assume that there are no other fixed costs of production for these firms.

Though we use the term trade cost in our analysis, appealing to the empirical evidences, we consider transportation cost as the trade cost and assume away tariff barrier.

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licensing contracts in their survey include a market restriction clause while another 34% include a production location restriction scheme. Such restrictions generally prohibit the licensees from selling the products flowing from the licensing agreement outside certain specified markets. Though exclusive territory clause is commonly used in the licensing contracts, theoretical literature did not pay much attention to this phenomenon. Recently, Freire et al. (2005) show the effect of exclusive territory clause on the revenue generation from licensing when the licenser and the licensees do not compete in the product market.

[8] Our assumptions of constant marginal costs of production implicitly assume that the factor prices are given in our analysis. In other words, the labour or input market is perfectly competitive in both the countries, which is in contrast to Lommerud et al. (2003).

Milner (2005) shows that even if tariff barriers have been reduced in recent years, international transportation costs are still significant and create sufficiently large trade costs. Similar conclusion can be found in Hummels (1991), according to whom transport costs often represent a greater barrier to trade than tariffs. The inclusion of exogenous tariff barrier will not affect our qualitative results for plant location decision, but it will change the welfare expressions by including the tariff revenue in the welfare functions. This can be extended easily from our analysis.

While firm 1 is a monopolist in the home country, we assume that it faces competition in the host country from an established host country firm, called firm 2. Different patent systems in these countries may provide a justification why firm 2 is selling its product only in the host country market. Assuming firm 1 as the innovator of this product, while product patent (or a strong process patent)[9] in the home country can ensure firm 1's monopoly in that country, the lack of product patent (or a strong process patent) in the host country can create the threat of competition in the host country.[10] We assume that the firms compete like Cournot duopolists with homogeneous products in the host country.

To eliminate the effect of different market size in different countries, we assume that the inverse demand function in both the markets are same, and, in each market, it is given by

$$P = a - q , \qquad\qquad (1)$$

where the notations have usual meanings.

We consider the following game. At stage 1, firm 1 decides whether to re-locate its plant to the host country or not, i.e., whether to do FDI or not. At stage 2, the firms take their production decisions and the profits are realized. We solve the game through backward induction.

2.1. Selling to both markets from the home country

Let us first consider the profit of firm 1 when it decides to produce in the home country and serve the host country through export. In this situation, firm1's profit is

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[9] Product patent implies that no other firm except the original innovator can produce similar products through imitation, thus ensures monopoly to the original innovator. Though process patent allows non-infringing imitation, the novelty requirement for the imitated product or large patent breadth helps to prevent imitation and allows the innovator the monopoly power. We refer to Mazzoleni and Nelson (1998) for an overview on the benefits and costs of patent protection.

[10] There may be other reasons to justify why firm 2 is selling its product only in the host country. For example, financial constraint or lack of reputation of firm 2 may prevent it from selling its product in the home country. Further, the transportation technology available to the firms may be different, and may create prohibitive trade cost for firm 2, thus restricts firm 2 to sell in the host country only.

$$\pi_1^1 = (a - q_1^1)q_1^1 + (a - q_1^2 - q_2 - t)q_1^2, \tag{2}$$

where q_1^1 and q_1^2 denote the outputs of firm 1 in countries 1 and 2 respectively, and q_2 is the output of firm 2.

If firm 1 produces in the home country, the profit of firm 2 is

$$\pi_2^1 = (a - q_1^2 - q_2 - c_2)q_2. \tag{3}$$

The equilibrium outputs are

$$q_1^1 = \frac{a}{2}, \ q_1^2 = \frac{a - 2t + c_2}{3} \ \text{and} \ q_2 = \frac{a - 2c_2 + t}{3}. \tag{4}$$

The second order conditions for profit maximization are satisfied. It should be noted that the equilibrium output of firm 2 is positive if and only if $c_2 < \dfrac{a + t}{2}$, and the equilibrium output of firm 1 under export is positive even for the lowest cost of firm 2 (i.e., even for $c_2 = 0$) provided $a > 2t$.

Assuming all the outputs in (4) are positive, we get the respective equilibrium profits for firms 1 and 2 as

$$\pi_1^1 = \left(\frac{a}{2}\right)^2 + \left(\frac{a - 2t + c_2}{3}\right)^2 \tag{5}$$

$$\pi_2^1 = \left(\frac{a - 2c_2 + t}{3}\right)^2. \tag{6}$$

2.2. Selling to both markets from the host country

Next, consider the situation where firm 1 relocates its plant to the host country (i.e., does FDI) and sells its product to both markets from the host country. In this situation, the profit of firm 1 is given by:

$$\pi_1^2 = (a - q_1^1 - t)q_1^1 - F + (a - q_1^2 - q_2)q_1^2. \tag{7}$$

If firm 1 relocates its plant in the host country, the profit of firm 2 is

$$\pi_2^2 = (a - q_1^2 - q_2 - c_2)q_2. \tag{8}$$

The equilibrium outputs are

$$q_1^1 = \frac{a - t}{2}, \ q_1^2 = \frac{a + c_2}{3} \ \text{and} \ q_2 = \frac{a - 2c_2}{3}. \tag{9}$$

The second order conditions for profit maximization are satisfied. The equilibrium output of firm 2 is positive if and only if $c_2 < \dfrac{a}{2}$, and firm 1's export to the home country is positive provided $a > t$.

Assuming all the outputs in (9) are positive, we get the respective equilibrium profits for firms 1 and 2 as

$$\pi_1^2 = \left(\frac{a-t}{2}\right)^2 + \left(\frac{a+c_2}{3}\right)^2 - F \tag{10}$$

$$\pi_2^2 = \left(\frac{a-2c_2}{3}\right)^2. \tag{11}$$

In the following analysis we will consider those parameter values that always ensure positive outputs for both firms. This assumption helps us to show our results in the simplest way by avoiding corner solutions, where outputs of a firm or in a particular market are not positive. Relaxing this assumption will not add new insight to the main purpose of this paper. Hence, in order to ensure positive outputs always for both firms and for both markets, we assume that $c_2 < \dfrac{a}{2}$ and $a > 2t$.

2.3. Plant location decision of firm 1

Now, we are in a position to consider the pant location decision of firm 1. Comparison of (5) and (10) shows that $\pi_1^1 \underset{<}{\overset{\geq}{=}} \pi_1^2$ provided

$$\left(\frac{a}{2}\right)^2 + \left(\frac{a-2t+c_2}{3}\right)^2 \underset{<}{\overset{\geq}{=}} \left(\frac{a-t}{2}\right)^2 + \left(\frac{a+c_2}{3}\right)^2 - F, \tag{12}$$

which boils down to

$$F \underset{<}{\overset{\geq}{=}} \frac{t(-2a-7t+16c_2)}{36} \equiv F^*. \tag{13}$$

We find that $F^* > 0$ provided $t > 0$ and $c_2 > \dfrac{2a+7t}{16}$.

Hence, the following result is immediate.

Proposition 1: *Assume that* $c_2 \in (0, \frac{a}{2})$, $t > 0$ *and* $a > 2t$. *Firm 1 does FDI (i.e., invests in the host country) provided* $c_2 > \frac{2a + 7t}{16} \equiv \bar{c}_2$ *and* $F < F^*$.

Proposition 1 shows that FDI occurs only if the cost difference between firm 1 and 2 are large enough (i.e. $c_2 > \frac{2a + 7t}{16}$). Otherwise, firm 1 has no incentive to relocate its plant to the host country.

The above result can be explained as follows. Let us consider the case where $c_2 = \frac{a}{2}$. In this situation, if firm 1 invests in the host country, it gets monopoly profits in both markets, whereas if it produces in the home country, it gets a monopoly profit in the home country and a duopoly profit in the host country. Since both markets are of the same size, firm 1's monopoly profit in the host country when it invests in the host country and its monopoly profit in the home country when it produces in the home country are equal. However, firm 1's monopoly profit in the home country when it invests in the host country is greater than its duopoly profit in the host country when it produces in the home country. So, if $c_2 = \frac{a}{2}$ and the cost of plant relocation (i.e., F) is not large enough, firm 1's total net profit is higher from investing in the host country than that of from producing in the home country. Although a slightly lower value of c_2 would create competition in the host country irrespective of firm 1's plant location decision, firm 1 would get a near monopoly profit in the host country, and the above logic implies that FDI would be the preferable strategy for firm 1. So, if the technological asymmetry is sufficiently large, investing in the host country helps firm 1 to monopolise (or almost monopolise) both the markets, and induces firm 1 to do FDI.

If the technology difference between firms 1 and 2 is sufficiently small, investment in the host country does not allow firm 1 to (almost) monopolise the host country market. In this situation, firm 1 prefers to avoid the distortion on its monopoly profit in the home country created by the trade cost while exporting from the host country. Hence, firm 1 does not do FDI and produces in the home country for small technological differences between firms 1 and 2.

2.4. The effects of trade cost reduction on FDI incentive

Let us now consider how trade cost reduction affects the incentive for FDI.

Proposition 2: *Assume that $t > 0$ and $a > 2t$.*

(i) If $c_2 < \bar{c}_2$, lower trade cost increases the possibility for FDI.

(ii) Assume that $c_2 \in (\bar{c}_2, \dfrac{a}{2})$.

(a) If $a \in (2t, \dfrac{7t}{3})$, lower trade cost always increases the incentive for FDI.

(b) If $a > \dfrac{7t}{3}$, lower trade cost increases the incentive for FDI provided $c_2 \in (\bar{c}_2, \dfrac{a + 7t}{8})$.

Proof: (i) Proposition 1 shows that FDI occurs only if $c_2 > \bar{c}_2$, and lower trade cost relaxes this constraint, thus increases the possibility for FDI.

(ii) Consider the situation where $c_2 \in (\bar{c}_2, \dfrac{a}{2})$, i.e., FDI occurs even with a relatively higher trade cost. Differentiating F^* with respect to t, we find that $\dfrac{\partial F^*}{\partial t} < 0$ provided

$$c_2 < \frac{a + 7t}{8}. \tag{14}$$

(a) If $a \in (2t, \dfrac{7t}{3})$, we find that $\dfrac{a}{2} < \dfrac{a + 7t}{8}$, which implies that condition (14) always holds in this situation.

(b) If $a > \dfrac{7t}{3}$, we have $\dfrac{a}{2} > \dfrac{a + 7t}{8} > \dfrac{2a + 7t}{16}$. The rest of the proof is trivial.   Q.E.D.

In contrast to the proximity-concentration trade-off where lower trade cost reduces the incentive for FDI, Proposition 2 shows the conditions for the negative relationship between trade cost and FDI.

The results in Proposition 2 can be explained as follows. FDI helps firm 1 to monopolise (or almost monopolise) the host country market but distorts its monopoly output for the home country, since exporting to the home country involves trade cost. A lower trade cost reduces firm 1's cost of exporting to and from the home country. If the initial profit of firm 1 is relatively low, either for relatively small market size or for relatively low cost of firm 2 (the host country firm), a lower trade cost increases firm 1's

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incentive for monopolising the host country market by reducing the cost of exporting to the home country, thus increases its incentive for FDI. But, if the market is very large and the cost of firm 2 is very high, firm 1 earns sufficiently large profit even under relatively high trade cost. Hence, a reduction in the trade cost does not increase its profit significantly from exporting to the home country, but the lower cost of exporting to the home country induces firm 1 to save the cost of FDI by not doing FDI. So, in this situation, lower trade cost reduces firm 1's incentive for FDI. Hence, the factors such as the incentive to monopolise the host country market, the cost of FDI and the relative output distortion for exporting to the home country compared to exporting to the host country determine the relationship between lower trade cost and FDI. The net effect of these factors depends on the market size and the cost differences between the firms.

2.5. *Welfare implications for the trade cost reduction*

Let us now consider welfare of each country conditional on the plant location decision of firm 1. Social welfare of a country is the summation of profit of the firm of that country and consumer surplus for that country.

Referring to our above results, firm 1 does not relocate its plant to the host country (i.e., does not do FDI) if $F > F^*$. In this situation, welfare of the home country and the host country are respectively

$$W_1^1 = \left(\frac{a}{2}\right)^2 + \left(\frac{a - 2t + c_2}{3}\right)^2 + \frac{1}{2}\left(\frac{a}{2}\right)^2 \tag{15}$$

$$W_2^1 = \left(\frac{a - 2c_2 + t}{3}\right)^2 + \frac{1}{2}\left(\frac{2a - c_2 - t}{3}\right)^2. \tag{16}$$

Firm 1 does FDI for $F < F^*$. In this situation, welfare of the home country and the host country are respectively

$$W_1^2 = \left(\frac{a - t}{2}\right)^2 + \left(\frac{a + c_2}{3}\right)^2 + \frac{1}{2}\left(\frac{a - t}{2}\right)^2 - F \tag{17}$$

$$W_2^2 = \left(\frac{a - 2c_2}{3}\right)^2 + \frac{1}{2}\left(\frac{2a - c_2}{3}\right)^2. \tag{18}$$

Now, consider the effect of lower trade cost on welfare of these countries. Assume that the trade cost reduces from t_0 to t_1 where $t_1 < t_0$. Note that there are four possible situations regarding firm 1's investment decisions. They are (FDI, FDI), (exporting,

exporting), (exporting, FDI) and (FDI, exporting), where the first (second) term for each case refers to firm 1's production decision for the high (low) trade cost.

2.5.1. Host country welfare

It is trivial that if firm 1's choice is (FDI, FDI), lower trade cost does not affect the host country welfare.

Next, consider the opposite situation where firm 1's choice is (exporting, exporting). Hence, the relevant expression for the host country welfare is given by (16), and lower trade cost increases the host country welfare provided

$$t_0 < 2c_2 - t_1. \tag{19}$$

While lower trade cost increases consumer surplus, it reduces profit of the host country firm by reducing firm 1's marginal cost of production. Therefore, whether lower trade cost increases the host country welfare depends on the relative strengths of these effects. If condition (19) is not satisfied, the host country welfare reduces with lower trade cost.

Now, consider the case of (exporting, FDI). In this situation, the relevant welfare expressions for the host country are (16) and (18) for t_0 to t_1 respectively. Therefore, while lower trade cost reduces profit of the host country firm (compare the first terms in (16) and (18)), it increases consumer surplus in the host country (compare the second terms in (16) and (18))). It turns out that lower trade cost increases welfare of the host country provided

$$t_0 < 2c_2. \tag{20}$$

If condition (20) is not satisfied, lower trade cost reduces welfare of the host country. Therefore, compared to the situation where firm 1 always chooses to serve the host country market through export, the FDI attracting role of lower trade cost increases the possibility of higher host country welfare due to the trade cost reduction (compare (19) and (20)).

If lower trade cost reduces the incentive for FDI, i.e., the choice of firm 1 is (FDI, exporting), the relevant welfare expressions for the host country are (18) and (16) for t_0 to t_1 respectively. So, while lower trade cost increases profit of the host country firm, it reduces consumer surplus in the host country. It turns out that lower trade cost increases welfare of the host country provided

$$t_1 > 2c_2. \tag{21}$$

If condition (21) is not satisfied, lower trade cost reduces welfare of the host country. Comparison of (19) and (21) shows that if lower trade cost reduces FDI, whether the

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possibility of FDI by the foreign firm (compared to no possibility of FDI by the foreign firm) increases or reduces the possibility of higher host country welfare due to the trade cost reduction is ambiguous.

2.5.2. Home country welfare

The effect of lower trade cost on home country welfare is also ambiguous. It is trivial that if firm 1's choice is either (exporting, exporting) or (FDI, FDI), lower trade cost always increases the home country welfare.

It is also easy to see that if lower trade cost reduces FDI, i.e., the choice of firm 1 is (FDI, exporting), lower trade cost increases home welfare. Since, firm 1 produces in the home country under lower trade cost, lower trade cost definitely increases consumer surplus in the home country by eliminating the distortion created under high trade cost, since, under high trade cost firm 1 serves the home country by exporting from the host country. It should also be clear that lower trade cost increases profit of firm 1. Note that if firm 1 had decided to do FDI even under lower trade cost, lower trade cost should benefit firm 1 by reducing its cost. Since, under lower trade cost, firm 1 prefers exporting than FDI, exporting (compared to FDI) should make firm 1 further better off, because, otherwise, firm 1 could continue to serve the host country through FDI. Hence, if firm 1's choice is given by (FDI, exporting), home welfare increases with lower trade cost.

Now, consider the situation where lower trade cost attracts FDI, i.e., the choice of firm is (exporting, FDI), it can be shown that, in this situation, the effect of lower trade cost on the home country welfare is ambiguous. For example, assume that $F = 0$. Hence, it follows from Proposition 1 that $\frac{2a + 7t_1}{16} < c_2 < \frac{2a + 7t_0}{16}$, and the relevant welfare expressions are given by (15) for t_0 and (17) for t_1. We find that lower trade cost increases the home country welfare (i.e., (15) < (17)) provided

$$27t_1(2a - t_1) < 32t_0(a - t_0 + c_2),\tag{22}$$

which clearly holds for $t_1 \to 0$. But, if $t_1 \to t_0$, we get that condition (22) does not hold

since $c_2 < \frac{a}{2}$, by assumption. While lower trade cost increases profit of firm 1 by inducing

FDI,[11] it reduces consumer surplus in the home country by reducing the output sold in the

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[11] Recall that if firm 1 always does export, lower trade cost increases its profit. Since, firm 1 prefers FDI than export under lower trade cost, it implies that FDI further increases the profit of firm 1.

home country. Hence, the welfare effect of lower trade cost for the home country depends on the relative strengths of these factors.

2.5.3. World welfare

The possible violation of both (20) and (22) immediately implies that, in general, the effect of lower trade cost on world welfare is ambiguous.

The following proposition summarizes the discussion of this section about the welfare implications of trade cost reduction.

Proposition 3: *Whether trade cost reduction increases the host country welfare, the home country welfare and world welfare is ambiguous.*

3. Technology licensing

If the difference in technologies is responsible for the cost difference between the firms, one natural strategy of the cost efficient firm may be to license its technology to the relatively cost inefficient firm, and leave the product market.[12] Thus, the firms can increase the industry profit by creating monopoly in the product market, and the licenser can use the licensing fee to extract the benefit from this strategy. However, often technology licensing involves significant amount of "resource cost" (see e.g., Teece, 1977 and 1981), and it was implicit in our above analysis that the prohibitive cost of technology licensing was making licensing unprofitable.

In this section we relax this assumption of the prohibitive cost of technology licensing and consider another extreme situation of no cost of technology licensing. We consider the following game. At stage 1, firm 1 decides whether to license its technology to firm 2. In case of licensing, we assume that firm 1 gives a take-it-or-leave-it offer to firm 2, who accepts the offer if the licensing does not make firm 2 worse off compared to no licensing. At stage 2, firm 1 decides whether to relocate its plant to the host country. At stage 3, the firms take their production decisions conditional on the decision on licensing and plant relocation. We solve the game through backward induction.

It is easy to understand that, in our framework, it is always optimal for firm 1 (the licenser) to license its technology to firm 2 against an up-front fixed-fee with a exclusive territory clause[13] that allows firm 2 to sell the product in the host country only by using the

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[12] It is often found that the foreign firms consider technology licensing as a substitute for FDI. See, e.g., Saggi (2002) for a survey on FDI and technology licensing.

[13] See footnote 6 for evidences on licensing with exclusive territory clause.

technology of firm 1, thus creating monopoly in the host country market.[14] In other words, firm 1 licenses its technology to firm 2 against an up-front licensing fee, and does not compete in the host country market after licensing. Though, in principal the licensing contract can consist of an up-front fixed-fee and per-unit output royalty, it is trivial that, firm 1 will license the technology against an up-front fixed-fee only if it does not compete in the host country market after licensing and therefore, firm 2 becomes a monopolist producer in the host country market. Since, under licensing, firm 2 will be the monopolist producer in the host country market, there is no reason for firm 1 to charge a positive output royalty that distorts the output decision of firm 2. It is also trivial that, since, under licensing, firm 1 sells its product only in the home country, it has no incentive to relocate its plant to the host country due to the cost of FDI and the cost of exporting to the home country.

If there is no licensing at stage 1, the analysis is similar to section 2. Since, in our analysis, licensing always increases industry profit, it occurs always. However, the game under no licensing is important to determine firm 2's reservation payoff, which it should get under the licensing agreement. This is because firm 2 has no incentive to accept the licensing offer if its payoff under licensing is lower than that of under no licensing. On the other hand, given that firm 1 offers a take-it-or-leave-it licensing contract, it will charge the fixed-fee in a way that makes firm 2 indifferent between licensing and no licensing.

Therefore, if there is licensing at stage 1, the profit of firm 1 is

$$\pi_{1,l}^1 = \left(\frac{a}{2}\right)^2 + L, \tag{23}$$

where L is the up-front fixed-fee. The amount of up-front fixed-fee will be

$$L = \left(\frac{a}{2}\right)^2 - \left(\frac{a - 2c_2 + t}{3}\right)^2, \quad \text{when} \quad F > F^* \tag{24}$$

$$L = \left(\frac{a}{2}\right)^2 - \left(\frac{a - 2c_2}{3}\right)^2, \qquad \text{when} \quad F < F^*. \tag{25}$$

If $F > F^*$, firm 1 does not do FDI under no licensing and the profit of firm 2 is $\left(\frac{a - 2c_2 + t}{3}\right)^2$. But, if $F < F^*$, firm 1 does FDI without licensing and the profit of firm 2

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[14] Even if antitrust-authority in the host country may prevent a contract under no licensing that induces firm 2 to bribe firm 1 for leaving the host country market, a licensing contract that gives firm 2 the exclusive right for producing a product with firm 1's technology for the host country market only may be acceptable under the patent laws of the host country market.

is $\left(\dfrac{a-2c_2}{3}\right)^2$. Hence, it explains the licensing fees shown in (24) and (25). Therefore, the

profits of firm 2 are $\left(\dfrac{a-2c_2+t}{3}\right)^2$ and $\left(\dfrac{a-2c_2}{3}\right)^2$ for $F > F^*$ and $F < F^*$ respectively.

Let us now consider the welfare effects of trade cost reduction in presence of licensing. Under licensing, welfare of the home and the host countries are respectively

$$W_{1,l}^1 = \left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2 - \left(\frac{a-2c_2+t}{3}\right)^2 + \frac{1}{2}\left(\frac{a}{2}\right)^2 \tag{26}$$

$$W_{2,l}^1 = \left(\frac{a-2c_2+t}{3}\right)^2 + \frac{1}{2}\left(\frac{a}{2}\right)^2, \tag{27}$$

for $F > F^*$, and

$$W_{1,l}^1 = \left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2 - \left(\frac{a-2c_2}{3}\right)^2 + \frac{1}{2}\left(\frac{a}{2}\right)^2 \tag{28}$$

$$W_{2,l}^1 = \left(\frac{a-2c_2}{3}\right)^2 + \frac{1}{2}\left(\frac{a}{2}\right)^2, \tag{29}$$

for $F < F^*$.

It is immediate that if, under no licensing, firm 1 always serves the host country through exporting or lower trade cost induces FDI, lower trade cost always reduces the host country welfare if licensing is an option, since lower trade cost reduces firm 2's reservation payoff that it gets under the licensing contract, and it increases the home country welfare by increasing profit extraction by firm 1 under licensing. But, if lower trade cost reduces FDI under no licensing, it, in presence of licensing, always increases the host country welfare and reduces the home country welfare. Lastly, if firm 1 always serves the host country through FDI, lower trade cost does not affect the welfare of these countries.

Since, under licensing, the firm 1 and firm 2 sell only in the home country and in the host country respectively, world welfare is independent of trade cost. Therefore, in this situation, lower trade cost does not affect world welfare but only affects the composition of total welfare between these two countries.

Hence, the following proposition is immediate.

Proposition 4: *If there is a possibility of technology licensing with the exclusive territory clause, technology licensing is always profitable for sufficiently low cost of technology transfer. In presence of licensing, the effects of lower trade cost on the host country welfare and the home country welfare are ambiguous and depend on the effects of trade cost reduction on FDI. World welfare is independent of trade cost under licensing.*

The above proposition shows how lower trade cost affects welfare of these countries when there is a possibility of licensing. Now, we will see whether, for a given trade cost, licensing increases welfare of these countries.

Proposition 5: *Consider a given trade cost and assume that $c_2 \in (0, \frac{a}{2})$, $t > 0$ and $a > 2t$.*

(i) If $F > F^*$, the host country welfare is lower (higher) under licensing than no licensing for $a > 2t + 2c_2$ ($a \in (2t, 2t + 2c_2)$). But, for $F < F^*$, the host country welfare is always lower under licensing than no licensing.

(ii) Licensing always increases welfare of the home country.

(ii) Given t and c_2, licensing (compared to no licensing) reduces world welfare if the markets are sufficiently large (i.e., a is sufficiently large). If the markets are not very large, licensing can increase world welfare.

Proof: (i) (a) Suppose, $F > F^*$. Comparison of (16) and (27) shows that welfare of the host country is lower (higher) under licensing provided

$$a > (<)2t + 2c_2. \tag{30}$$

Therefore, licensing reduces (increases) the host country welfare for $a > 2t + 2c_2$ ($a \in (2t, 2t + 2c_2)$).

Suppose, $F < F^*$.[15] Comparison of (18) and (29) shows that (18) is always greater than (29). Therefore, licensing reduces the host country welfare in this situation.

(b) Comparison of (15) and (26), (17) and (28) proves the result.   Q.E.D.

The reason for higher welfare of the home country due to licensing is straightforward. Licensing increases market concentration and the industry profit in the host country, thus increasing firm 1's profit from the host country through licensing. Further,

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[15] This immediately implies that c_2 must be greater than $\frac{2a + 7t}{16}$.

licensing prevents firm 1 from doing FDI, and therefore, saves the cost of FDI and the distortion created by the trade cost while exporting back to the home country. All these benefits increase home country welfare under licensing than no licensing.

However, the effect on the host country welfare depends on firm 1's production strategy under no licensing. If firm 1 does FDI under no licensing, it is trivial that licensing reduces the host country welfare by increasing market concentration in the host country. But, if firm 1 does exporting without licensing, there is a positive effect of licensing on the host country welfare. This is because licensing improves cost efficiency in the host country. Without licensing, the total marginal cost of production for the host country output is $(t + c_2)$, which determines the total supply of output in the host country,[16] whereas, under licensing, the total marginal cost of production for the host country output is 0. Therefore, if the cost efficiency created by licensing dominates the negative impact of licensing due to higher market concentration, the host country welfare is higher under licensing than no licensing. We find that the cost efficiency effect dominates the market concentration effect in small markets. But, in large markets, the market concentration effect dominates the cost efficiency effect, and the host country welfare reduces with licensing.

The above discussion suggests that the effect of licensing on world welfare may be ambiguous. Consider the following example with $a = 1$ and $t = 0$. This immediately tells us that firm 1 does exporting without licensing. Therefore, licensing reduces (increases) world welfare provided

$$8(1 + c_2)^2 + 8(1 - 2c_2)^2 + 4(2 - c_2)^2 - 27 > (<)0. \tag{31}$$

We find that LHS of (31) is positive (negative) for $c < (>)\dfrac{5}{22}$. The trade-off between cost efficiency and higher market concentration is responsible for this result. It should be noted that even if we consider a situation where firm 1 does FDI without licensing, the effect of licensing on world welfare could also be ambiguous.

Hence, the following proposition is immediate.

Proposition 6: *For a given trade cost, whether licensing (compared to no licensing) increases world welfare is ambiguous.*

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[16] In case of Cournot oligopoly with constant marginal costs of production, the total output produced is determined by the sum of the marginal costs of production for all firms (see, Varian, 1992, pp. 290).

3.1. Licensing without commitment

So far we have assumed that firm 1 can make a credible commitment through the exclusive territory clause that it will not sell its product in the host country after licensing. However, there may be situations when firm 1 is not able to make such a credible commitment. This may be due to the lack of enforcement in the world economy or it may be easy for the licenser to enter the market with almost similar technologies, and thus preventing monopoly in the host country.[17] Even if the legal system may not help firm 1 to make a credible commitment for not entering the host country market, a relatively higher cost of FDI can ensure that it will not serve the host country through FDI, though it can still serve the host country through export. If the cost of FDI is very small, firm 1 may have the incentive to serve the host country even by FDI.

However, it easily follows from Rockett (1990) that, even if the market structure in the host country becomes a duopoly, licensing can occur always. This is because, firm 1 can always charge a royalty rate to make the effective marginal cost of firm 2 equal under licensing and no licensing, thus creates the same equilibrium outputs for the firms and the profit of firm 2, while the royalty income increases the profit of firm 1. Since, licensing without commitment by firm 1 reduces market concentration in the host country compared to the situation with an effective exclusive territory clause, it should be clear that licensing would be more likely to increase welfare under the former situation than the latter.

4. Conclusion

Recent evidences show a negative relationship between trade cost and FDI. This apparent puzzle cannot be explained by the well-established theory of proximity-concentration trade-off, and is getting attention from the researchers. We provide a theoretical explanation for this phenomenon.

We show that if both the home and the host country markets are important to the foreign firm, lower trade cost may increase FDI in presence of technological difference between the firms. We further show that the welfare effects of lower trade cost are ambiguous and depend on the effects of lower trade cost on FDI.

If the cost differences between the firms are due to the technological difference, it may create the possibility for technology licensing, which can substitute FDI. Even in

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[17] See, e.g., Katz and Shapiro (1985), Marjit (1990), Kabiraj and Marjit (2003) and Mukherjee and Pennings (2006) for the works where the licenser can enter the product market after licensing, and both the licenser and the licensee compete in the product market with and without licensing.

presence of licensing, the effects of lower trade cost on the home country welfare and the host country welfare are ambiguous and depend on the relationship between trade cost and FDI. Further, given the trade cost, whether licensing (compared to no licensing) increases welfare is also ambiguous.

References

Anand, B. N. and T. Khanna, 2000, 'The structure of licensing contracts', *Journal of Industrial Economics*, **48**: 103 – 35.

Barros, P. P. and L. Cabral, 2000, 'Competing for foreign direct investment', *Review of International Economics*, **8**: 360 – 71.

Calvert, R., 1964, *The encyclopedia of patent practice and invention management*, Reinhold, New York.

Caves, R. E., H. Crookell and J. P. Killing, 1983, 'The imperfect market for technology licenses', *Oxford Bulletin of Economics and Statistics*, **45**: 249 – 67.

Erutku, C. and Y. Richelle, 2000, 'Optimal licensing contracts and the value of a patent', *Journal of Economics and Management Strategy*, Forthcoming..

Freire, A. P., Y. Richelle and C. Erutku, 2005, 'Licensing innovations with exclusive contracts', *Mimeo*, Competition policy branch, Competition Bureau, Canada.

Eswaran, M., 1994, 'Cross-licensing of competing patents as a facilitating device', *Canadian Journal of Economics*, **XXVII**: 689 – 708.

Faulí-Oller, R. and J. Sandonis, 2002, 'Welfare reducing licensing', *Games and Economic Behavior*, **41**: 192 – 205.

Feinberg, S. E., M. P. Keane and M. F. Bognanno, 1998, 'Trade liberalization and "delocalisation": new evidence from firm-level panel data', *Canadian Journal of Economics*, **31**: 749 – 77.

Fumagalli, C., 2003, 'On the welfare effects of competition for foreign direct investments', *European Economic Review*, **47**: 963 – 83.

Hanson, G. D., 1998, 'North American economic integration and industry location', *Oxford Review of Economic Policy*, **14**: 30 – 44.

Hummels, D., 1991, 'Have international transaction costs declined?' *Mimeo,* University of Chicago.

Jones, R. and J. P. Neary, 1984, 'The positive theory of international trade', in R. W. Jones and P. B. Kenen (Eds.), *Handbook on international economics*, vol. 1: 1 – 62, North-Holland, Amsterdam.

Kabiraj, T. and S. Marjit, 2003, 'Protecting consumers through protection: the role of tariff induced technology transfer', *European Economic Review*, **47**: 113 – 24.

Kamien, M., 1992, 'Patent licensing', in R. J. Aumann and S. Hart (Eds.), *Handbook of game theory*, Ch. 11.

Katz, M. L. and C. Shapiro, 1985, 'On the licensing of innovations', *Rand Journal of Economics*, **16**: 504 – 20.

Lommerud, K. E., F. Meland and L. Sørgard, 2003, 'Unionised oligopoly, trade liberalization and location choice', *The Economic Journal*, **113**: 782 – 80.

Marjit, S., 1990, 'On a non-cooperative theory of technology transfer', *Economics Letters*, **33**: 293 – 98.

Markusen, J. R., 1983, 'Factor movements and commodity trade as complements', *Journal of International Economics*, **14**: 341 – 56.

Markusen, J. R., 2002, *Multinational firms and the theory of international trade*, Cambridge, Massachusetts, MIT Press.

Markusen, J. R. and T. F. Rutherford, 1996, 'Discrete plant-location decisions in an applied general-equilibrium model of trade liberalization', *Weltwirtschaftliches Archiv (Review of World Economics)*, **1**: 133 – 51.

Mazzoleni, R. and R. Nelson, 1998, 'The benefits and costs of strong patent protection. a contribution to the current debate', *Research Policy*, **27**: 273 – 84.

Milner, C., 2005, 'Protection by tariff barriers and international transaction costs', *Scottish Journal of Political Economy*, **52**: 105 – 21.

Motta, M., 1992, 'Multinational firms and the tariff-jumping argument', *European Economic Review*, **36**: 1557 – 71.

Motta, M. and G. Norman, 1996, 'Does economic integration cause foreign direct investment?', *International Economic Review*, **37**: 757 – 83.

Mukherjee, A., 2005, "Innovation, licensing and welfare", *The Manchester School*, **73**: 29 – 39.

Mukherjee, A. and E. Pennings, 2006, 'Tariffs, licensing and market structure', *European Economic Review*, **50**: 1699 – 1707.

Mukherjee, A. and S. Mukherjee, 2005, 'Entry, licensing and welfare", *Discussion Paper, 05/02*, School of Economics, University of Nottingham.

Neary, J. P., 1995, 'Factor mobility and international trade', *Canadian Journal of Economics*, **28**: S4 – S23.

Neary, J. P., 2002, 'Foreign direct investment and the single market', *The Manchester School*, **70**: 291 – 314.

Neary. J. P., 2006, 'Trade costs and foreign direct investment', *Mimeo*, UCD School of Economics, University College Dublin.

Norman, G. and M. Motta, 1993, Eastern European economic integration and foreign direct investment', *Journal of Economics and Management Strategy*, **2**: 483 – 508.

Pack, H. and K. Saggi, 1997, 'Inflows of foreign technology and indigenous technological development', *Review of Development Economics*, **1**: 81 – 98.

Rockett, K., 1990, 'The quality of licensed technology,' *International Journal of Industrial Organization*, **8**: 559 – 574.

Rostoker, M., 1984, *A survey of corporate licensing*, IDEA, **24**: 59 – 92.

Saggi, K., 2002, 'Trade, Foreign Direct Investment, and International Technology Transfer: A Survey', *World Bank Research Observer*, **17**: 191 – 235.

Smith, A., 1987, 'Strategic investment, multinational corporations and trade policy', *European Economic Review*, **31**: 89 – 96.

Taylor, C. and Z. Silberston, 1973, *The economic impact of the patent system*, Cambridge University Press, Cambridge.

Teece, D. J., 1977, 'technology transfer by multinational firms: the resource cost of transferring technological know-how', *The Economic Journal*, **87**: 242 – 61.

Teece, D. J., 1981, 'The market for know-how and the efficient international transfer of technology', *ANNALS, AAPSS*, **November**, 81 – 95.

UNCTAD handbook of statistics, 2004, *China set to stay growth course*, UNCTAD, Switzerland.

Varian, H. R., 1992, *Microeconomic analysis*, 3rd ed., W. W. Norton & Company, New York.

World development report, 2002, *Transnational corporations and export competitiveness*, United Nations, New York and Geneva.