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Domestic entry, international trade cost reduction and welfare

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Abstract:

We show the welfare effects of international trade cost reduction under endogenous domestic market structure. If the domestic labour market is competitive, there is no integer constraint and the trade cost represents transportation cost, a reduction in the transportation cost does not affect (may reduce) domestic welfare if the products are perfect (imperfect) substitutes. If the trade cost represents tariff, domestic welfare is higher under a positive non-prohibitive tariff compared to both free trade and no trade. In the presence of an integer constraint, a lower transportation cost may reduce consumer surplus and increase the profits of the active domestic firms and domestic welfare, even if the products are homogeneous. If there is no integer (integer) constraint and the products are perfect substitutes, transportation cost reduction reduces (may increase) domestic welfare in the presence of a domestic labour union. We also show that entry for the domestic country may be socially excessive or insufficient under a competitive domestic labour market, while it is always socially insufficient in the presence of a domestic labour union.

Key Words: Free entry; Transportation cost; Tariff; Labour union; Welfare

JEL Classification: F12; L13; L40

Outline:

Non-Technical Summary

The purpose of this paper is two-fold. First, it shows the effects of trade cost reduction on domestic welfare under free entry of domestic firms. Second, it shows social efficiency of entry in the domestic country. In other words, it shows whether domestic anti-competitive entry regulation policy is justified in the presence of foreign competition.

The first motivation of this paper comes from the observation that international trade costs are falling significantly in recent years, either due to policy decisions or technological improvements. Although it is intuitive that a trade cost reduction creates important welfare implications, the existing literature is restrictive in addressing this issue due to its focus on a given market structure and competitive labour market. Hence, the literature so far mainly shows the short-run effects of trade cost reduction by ignoring market entry. In contrast, we show a more long-run effect of trade cost reduction by considering the effects of trade cost on the entry of domestic firms. We analyze this issue under perfectly competitive and imperfectly competitive domestic labour markets, where imperfection in the input market is due to the presence of a domestic labour union.

The consideration of free entry of domestic firms gives us the second motivation of the paper. It is well-known that free entry with scale economies is socially excessive in the oligopolistic markets, and this result is often referred as the “excess-entry” theorem. Although the literature examining social efficiency of free entry is quite large and has provided several important insights, the literature has mainly focused on closed economies. However, in this era of globalization, it is fair to say that the policy makers should also take into account the effect of foreign competition while designing competition policies. This limitation of the excess-entry literature motivates us to examine social efficiency of domestic entry in the presence of foreign competition, under both competitive and imperfectly competitive domestic input markets.

1. Introduction

The purpose of this paper is two-fold. First, it shows the effects of trade cost reduction on domestic welfare under free entry of domestic firms. Second, it shows social efficiency of entry in the domestic country. In other words, it shows whether domestic anti-competitive entry regulation policy is justified in the presence of foreign competition. We analyze these issues under perfectly competitive and imperfectly competitive domestic labour markets, where imperfection in the input market is due to the presence of a domestic labour union.

The first motivation of this paper comes from the observation that international trade costs are falling significantly in recent years, either due to policy decisions or technological improvements. Although it is intuitive that a trade cost reduction creates important welfare implications, the existing literature is restrictive in addressing this issue due to its focus on a given market structure and competitive labour market.[1] Hence, the literature so far mainly shows the short-run effects of trade cost reduction by ignoring market entry. In contrast, we show a more long-run effect of trade cost reduction by considering the effects of trade cost on the entry of domestic firms. Moreover, we address this issue under both perfectly competitive and imperfectly competitive domestic labour markets, thus showing the importance of the labour market structure.

The possibility of welfare loss from international trade in a Cournot oligopoly has been pointed out by Brander (1981) and Brander and Krugman (1983) in the segmented markets, and by Markusen (1981) in the case of integrated markets. Brander (1981) shows that there are welfare gains from bilateral transportation cost reduction if the transport costs are sufficiently low, but there are welfare losses from transportation cost reduction if the transport costs are close to the prohibitive level. Brander and Krugman (1983) confirm the result of Brander (1981) with general demand functions, and also show that bilateral transportation cost reduction always increases welfare compared to no trade in the presence of free entry of firms. For the case of integrated

[1] Although Brander and Krugman (1983) discuss the implications of free entry under a competitive labour market, as we will discuss below, our structure and also the results differ significantly from theirs.

markets, Markusen (1981) shows that bilateral free trade may affect the countries differently – the country with the small market gains from trade, but the country with the large market may lose from trade. While these papers consider the effects of bilateral trade, Cordella (1993) and Collie (1996) show welfare loss from unilateral trade cost reduction. Mukherjee and Mukherjee (2005) extend Collie (1996) and show that welfare losses from unilateral trade cost reduction may reduce in the presence of technology licensing. Clarke and Collie (2003) show that unilateral trade (compared to no trade) is beneficial under Bertrand competition.

Except Brander and Krugman (1983), a common feature of these works is to consider a given market structure, thus ignoring the effects of the trade cost on the market structure. Although Brander and Krugman (1983) show the implications of free entry, they consider a situation of reciprocal dumping and symmetric bilateral transportation cost reduction, thus ignoring the effects of asymmetric transportation cost reduction. Moreover, they ignore the implications of integer constraint on the free entry equilibrium and the effects of the input market distortion.

The consideration of reciprocal dumping considered in Brander and Krugman (1983) may be more appropriate for trade between the similar countries, where the firms in both countries have reputation and the capability to sell their products in both the domestic and the foreign markets. However, the firms from developing countries are often not capable of selling their products to the developed countries – due to high network costs[2] and/or legal restrictions[3]. The consideration of unilateral trade cost reduction may then be more important when we consider trade between developed and developing countries such as USA and India, where the latter country is improving economic governance to reduce the foreign firm's international trade costs. Often the policies of many developing countries are also influenced by the suggestion of WTO for reducing the

[2] As pointed out by Greaney (2003) and Helpman et al. (2004), buyer-seller networks may be important for both international trade and investment. A favourable network effects may allow only the developed-country firms to penetrate the foreign markets.

[3] It is well documented that often the firms from developing countries imitate the technologies of the developed-country firms, and a weak patent regime in the developing countries allow the developing-country firms to produce and sell their products in the developing countries with the imitated technologies, while the strong patent regimes in the

international trade costs. We show that the welfare effects of a unilateral trade cost reduction differ significantly from Brander and Krugman (1983), and the integer constraint on the free entry equilibrium and the input market structure also play important roles.

The consideration of free entry of domestic firms gives us the second motivation of the paper. In an influential paper, Mankiw and Whinston (1986) show that free entry with scale economies is socially excessive in the oligopolistic markets, and this result is often referred as the "excess-entry" theorem.[4] Vickrey (1964), von Weizsäcker (1980), Perry (1984), and Suzumura and Kiyono (1987), to name a few, are other important works showing socially excessive entry in oligopolistic markets.[5] As Vives (1988) suggests, whether entry is excessive or insufficient is not of purely academic interest. In many countries, governments take actions to foster or deter entry into particular industries. For example, in the post-war period, preventing excessive entry was a guiding principle in the Japanese industrial policy (see, for example, Suzumura and Kiyono, 1987; Suzumura, 1995). Komiya (1975) pointed out the industries such as petrochemicals and certain other chemical industries with a tendency to develop excessive competition, and it appears that the excessive-entry theorem can justify this phenomenon.

More recent works are concerned about the "excess-entry" theorem and show that entry can be insufficient in oligopolistic markets with scale economies in the presence of vertical relationships (Ghosh and Morita, 2007a, b)[6], technology licensing (Mukherjee and Mukherjee, 2008), spatial competition (Matsumura and Okamura, 2006) and external economies of scale (Mukherjee, 2010).

Although the literature examining social efficiency of free entry is quite large and has provided several important insights, the literature has mainly focused on closed economies.

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developed countries do not allow the developing-country firms to enter the developed countries with the imitated technologies. See, e.g., Yang and Maskus (2009) and the references therein on this issue.

[4] Mankiw and Whinston (1986) also show the possibility of insufficient entry in the presence of integer constraint.

[5] Spence (1976), Dixit and Stiglitz (1977) and Salop (1979) show that entry can be either excessive or insufficient if there is monopolistic competition.

However, in this era of globalization, it is fair to say that the policy makers should also take into account the effect of foreign competition while designing competition policies. This limitation of the excess-entry literature motivates us to examine social efficiency of domestic entry in the presence of foreign competition, under both competitive and imperfectly competitive domestic input markets.

In what follows, Section 2 considers a situation where a foreign firm competes with symmetric domestic firms in the domestic country. The number of domestic firms is determined by the zero profit condition. We consider perfectly competitive labour markets in this section. The foreign firm's marginal cost of production is lower than the domestic firm's marginal costs. However, export by the foreign firm requires a per-unit transportation cost. Following the previous works (see, e.g., Brander, 1981, Brander and Krugman, 1981 and Collie, 2003), we mainly consider the international trade cost as a transportation cost. The consideration of transportation cost can also get support from the works by Hummels (1991) and Milner (2005). 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. This conclusion is echoed in Hummels (1991), according to whom transport costs often represent a greater barrier to trade than tariffs. The implications of domestic tariff on our results follow easily, and we will discuss it briefly later on.

We derive the following results in this section. If there is no integer constraint, domestic welfare does not depend on the transportation cost if the products are perfect substitutes. It follows from our analysis that if the products are imperfect substitutes, transportation cost reduction may reduce domestic welfare by reducing the number of domestic firms significantly. If the trade cost represents domestic tariff, domestic welfare is higher under a positive non-prohibitive tariff compared to free trade and no trade. If there is an integer constraint, transportation cost reduction

[6] Extending Ghosh and Morita (2007a), which mainly consider bilateral bargaining between the upstream and downstream agents, Mukherjee (2009) shows that entry is more likely to be excessive if there is a centralized upstream agent.

can reduce consumer surplus and increase the profits of the active domestic firms and domestic welfare, even if the products are homogeneous.

While examining the issue of excessive entry, our results are as follows. If the transportation cost is low and the marginal costs of production of the domestic firms are sufficiently high compared to the marginal cost of production of the foreign firm, entry in the domestic country is socially insufficient instead of excessive.[7] In this situation, the anti-competitive entry-regulation in the domestic country may not be justified.

If the domestic labour market is perfectly competitive, trade cost reduction does not affect the marginal costs of production of the domestic firms. However, in the presence of a domestic labour union, trade cost reduction can affect the marginal costs of production of the domestic firms by affecting the domestic wage, which may have important welfare implications. Further, the domestic wage effect may also have important implications for the social efficiency of domestic entry. Section 3 focuses on this issue by considering a domestic labour union that sets the domestic wage strategically. We show in this section that a transportation cost reduction reduces domestic welfare in the free entry equilibrium with no integer constraint and homogeneous products. If the transportation cost reduction does not affect the number of domestic firms significantly, which may be due to the integer constraint, a lower transportation cost may increase domestic welfare. We also show that entry is always socially insufficient for the domestic country. Section 4 concludes.

2. The case of perfectly competitive labour markets

Assume that there is a foreign firm, firm 1, which has invented a technology and wants to sell the product in another country, called domestic country. There is large number of firms in the domestic country. The domestic firms get the technical know-how of the foreign technology through knowledge spillover, and decide whether to enter the industry. We consider free entry in the

domestic country, where entry requires a fixed entry cost K^2. The entry cost can be viewed as a fixed investment or the opportunity cost of entering the industry. The number of domestic firms entering the industry is determined endogenously by the zero profit condition. Entry in the domestic country occurs until the net positive profit of a domestic entrant is positive. For analytical simplicity, we will mainly ignore integer constraint and will consider the number of domestic firms as a continuous variable. However, we will also discuss the implications of integer constraint.

The firms produce a homogeneous product and compete like Cournot oligopolists in the domestic country. We assume that firm 1's marginal cost of production is constant, and it is normalized to *0* for simplicity. However, exporting by firm 1 requires a per-unit trade cost, *t*, as the transportation cost. Hence, the total marginal cost of firm 1 is *t*, which includes its marginal cost of production and the transportation cost. The constant marginal cost of production of each domestic firm is *c*. The constant marginal costs of production of the foreign and the domestic firms imply that the foreign and the domestic labour markets are perfectly competitive and the transportation cost does not affect the marginal costs of production of the firms. Assuming that production requires only labour, we can normalize the labour coefficient of the foreign firm to zero to normalize its marginal cost of production equal to zero. However, assuming the labour coefficient of each domestic firm as one, we can then view *c* as the competitive wage in the domestic country. The higher labour coefficients of the domestic firms compared to the foreign firm may represent imperfect knowledge spillover.

Assume that the inverse market demand function is

$$P = a - q\,, \tag{1}$$

where P is price and q is the total output sold.

We consider the following game. At stage 1, conditional on the transportation cost, the domestic firms decide whether to enter the industry. At stage 2, the firms compete like Cournot

[7] In order to compare our results with the previous works on "excessive entry", we ignore the integer constraint while looking at the social efficiency of domestic entry. It follows from Mankiw and Whinston (1986) that entry can be

duopolists in the domestic country. If no domestic firm enters the industry, the foreign firm sells to the domestic country as a monopolist. We solve the game through backward induction.

If *n* domestic firms enter the industry, the equilibrium output and profit of firm 1 can be found respectively as

$$q_1 = \frac{a-(n+1)t+nc}{n+2} \qquad \text{and} \qquad \pi_1 = \frac{(a-(n+1)t+nc)^2}{(n+2)^2}. \tag{2a}$$

The equilibrium output and profit of the *i*th domestic firm are respectively

$$q_i = \frac{a-2c+t}{n+2} \qquad \text{and} \qquad \pi_i = \frac{(a-2c+t)^2}{(n+2)^2} - K^2, \qquad i=2,\ldots,n+1. \tag{2b}$$

The equilibrium output of firm 1 is positive if $t < \frac{a+nc}{n+1} \equiv \bar{t}$, where *n* is determined endogenously. The equilibrium outputs of all active domestic firms are positive for any transportation cost if $c < \frac{a}{2}$, which we assume to hold.

The equilibrium number of domestic firm is given by the zero profit condition $\pi_i = \frac{(a-2c+t)^2}{(n+2)^2} - K^2 = 0$, which gives the equilibrium number of domestic firms as

$$n^*(t) = \frac{a-2c+t}{K} - 2. \tag{3}$$

2.1. The welfare effects of a lower transportation cost

It is immediate from (3) that as *t* falls, it reduces the equilibrium number of domestic firms. This is intuitive. A lower transportation cost makes the foreign firm more competitive, thus reducing entry in the domestic country.

The total output in the free entry equilibrium (i.e., the sum of all domestic firms' outputs and the foreign firm's output) is $q = q_1 + \sum_{i=2}^{n+1} q_i = \frac{a(n+1)-t-nc}{n+2}$ or

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socially insufficient even in a closed economy in the presence of integer constraint.

$$q = a - c - K\,, \tag{4}$$

which is independent of *t*.

At the free entry equilibrium, the gross profit of each domestic entrant is K^2, which is independent of *t*. However, it does not imply immediately that the output of a domestic entrant will be the same irrespective of the transportation cost. The reason for this result can be found from McGuire and Ohta (2005), and it will be clear from the intuition that this result would hold even for some more general demand functions than the one considered here. At the free entry equilibrium, the tangency between the marginal domestic entrant's residual demand curve and its average cost determines the price of the product and the equilibrium output of each symmetric domestic entrant. If the market demand curve is such that a change in competitors' outputs leave the slopes of the domestic entrants' residual demand curves unaffected (as happens under linear demand), a change in the transportation cost neither affects the average cost of the domestic entrants nor affects the slopes of the domestic entrants' residual demands. Hence, a change in the transportation cost does not affect the tangency point between the marginal domestic entrant's residual demand and its average cost curve, thus creating no effect on the equilibrium price and outputs of the symmetric domestic entrants.

An interesting implication of the above discussion is that, under free entry in the domestic country where the equilibrium number of domestic firms is determined by the zero profit condition, the transportation cost does not affect the consumers. Since the total net profits of the domestic firms, which are zero, and the total outputs (and therefore, consumer surplus) do not depend on the transportation cost, the following result is immediate.

Proposition 1: *If the firms produce homogeneous products, there is no integer constraint and domestic free entry determines the equilibrium number of domestic firms through the zero profit condition, domestic welfare does not depend on the transportation cost.*

Proposition 1 is in contrast to the previous works considering given market structures, thus focusing on the short-run effects of a transportation cost reduction. Our result suggests that, in the long-run, where the transportation cost affects domestic entry, a unilateral transportation cost reduction does not affect domestic welfare in a Cournot oligopoly. Proposition 1, which considers a unilateral transportation cost reduction, is also in contrast to the result of Brander and Krugman (1983) under free entry, which shows that a bilateral transportation cost reduction increases welfare.

2.2. Discussions

Some comments are in order following the above analysis.

2.2.1. The importance of integer constraint

We have seen in (3) that as *t* reduces, it reduces entry in the domestic country. Now we want to see the difference in the number of active domestic firms under prohibitive transportation cost and free trade. This will give us the maximum difference in the equilibrium number of domestic firms, since, as *t* falls $n^*(t)$ reduces continuously. The equilibrium number of domestic firms under prohibitive transportation cost is $n^*(t = \bar{t}^* = c + K) = \frac{a-c}{K} - 1$, which is equal to the total number of active firms in this situation. On the other hand, if there is free trade, i.e., *t = 0*, the equilibrium number of domestic firms is $n^*(t = 0) = \frac{a-c}{K} - 2 - \frac{c}{K}$. Therefore, the maximum possible difference in the equilibrium number of domestic firms is $n^*(t = \bar{t} = c + K) - n^*(t = 0) = 1 + \frac{c}{K}$, and this is higher (lower) than *2* if $c > (<) K$. It is then immediate that if $c = 0$, the maximum possible difference in the equilibrium number of domestic firms is *1*.

While it may be easy to visualize $c < K$, i.e., the marginal costs of production of the domestic firms are lower than the entry costs, it may not be difficult also to think of $c > K$, if we consider that K represents alternative investment opportunities of the domestic firms or the disutility of entering to this industry. For example, if the profits of the domestic firms from alternative businesses are negligible, which they need to sacrifice in order to enter this industry, we get that K is close to zero, thus satisfying $c > K$. Alternatively, if the domestic firms want to enter this industry, they may not need to switch from their other business, but may need to incur additional costs for monitoring and coordinating different businesses, which implies $K > 0$. However, if this adjustment cost is small, we can have the situation of $c > K$.

The above discussion makes the consideration of the integer constraint important, and the following argument will show that, with integer constraint, transportation cost reduction may hurt the consumers, benefit the active domestic firms and increase domestic welfare.[8] To show it in the simplest way, consider the case of $c < K$. If we have considered the firms as integers, it follows from the above discussion that the maximum difference in the equilibrium number of domestic firms is *1* if $c < K$. Since there are only domestic firms under prohibitive transportation cost, it then implies that the total number of active firms (i.e., the foreign firm plus all the active domestic firms) can be the same under different transportation costs.

Assume that, under a prohibitive transportation cost, the equilibrium number of domestic firms is an integer n^*. If the transportation cost falls, the foreign firm starts exporting to the domestic country, which reduces the profits of the n^* domestic firms. Hence, if the transportation cost is lower than the prohibitive transportation cost, the equilibrium number of domestic firms is $(n^* - 1)$, since the net profits of n^* domestic firms are zero under prohibitive transportation cost. That is, if the transportation cost is slightly lower than the prohibitive transportation cost, one domestic firm with the marginal cost c will leave the market and the foreign firm with the marginal

cost t will replace this domestic firm. Since the prohibitive transportation cost implies that $t = c + K$, a slight reduction of the transportation cost from the prohibitive level implies that $t > c$. This implies that a transportation cost reduction replaces a domestic firm with a lower marginal cost by the foreign firm with a higher marginal cost. Hence, the total outputs and the consumer surplus reduce following a slight transportation cost reduction from the prohibitive level. However, due to the integer constraint, each of the $(n^* - 1)$ domestic entrants can now enjoy a net positive profit. These net profit gains of the domestic firms may outweigh the consumer surplus loss, which is more likely to happen if $K \to 0$, and may increase domestic welfare.

The above discussion is summarized in the following result.

Proposition 2: *If we consider the firms as integers, transportation cost reduction may reduce consumer surplus and increase the net profit of the active domestic firms and domestic welfare by replacing a domestic firm with the foreign firm.*

2.2.2. Trade cost as domestic tariff

Now ignore the integer constraint but consider the trade cost as domestic tariff. Note that, whether the trade cost represents transportation cost or domestic tariff does not make any difference to the equilibrium number of domestic firms, the foreign firm's output, the total output, net domestic profits and consumer surplus. However, if the trade cost is domestic tariff, the tariff revenue at the free entry equilibrium, which is $T = t(c + K - t)$ adds a new term to the domestic welfare. Since the tariff revenue is positive between $t = 0$ and $t = c + K$, domestic welfare is higher for any tariff between free trade and prohibitive tariff compared to both free trade and no trade. Since the tariff revenue is concave with respect to t over $t = 0$ and $t = c + K$, domestic welfare is also concave over this range of tariff.

[8] Considering a closed economy, Kabiraj and Marjit (1992) show in a different context that a marginal cost reduction

2.2.3. The implications of imperfect substitutes and Bertrand competition

We have considered homogeneous products and have shown that if the transportation cost represents trade cost, a lower transportation cost does not affect domestic welfare if we ignore the integer constraint. It follows easily from our intuition that if the firms produce imperfect substitutes and the slopes of the firms' residual demand curves do not depend on the competitors' outputs and the number of varieties, a lower transportation cost may reduce domestic welfare. If the slopes of the firms' residual demand curves do not depend on the competitors' outputs and the number of varieties, the equilibrium price and the total outputs do not depend on the transportation cost. However, a lower transportation cost reduces the number of domestic firms. If the loss of domestic firms is more than *1*, a lower transportation cost reduces the total number of active firms and the number of varieties, thus reducing domestic welfare.

It also follows from the above argument that a unilateral transportation cost reduction may also reduce domestic welfare if the firms compete like Bertrand oligopolists with imperfect substitutes. For example, ignore the integer constraint. As in the case of Cournot competition, a lower transportation cost reduces the equilibrium number of domestic firms also under Bertrand competition by increasing the competitiveness of the foreign firm. Hence, the foreign firm replaces domestic firms. If the reduction in the domestic firms is more than *1*, the total number of active firms and therefore, the total number of varieties reduce following a reduction in the transportation cost. Since, in the absence of an integer constraint, the net profits of the domestic firms are zero, this loss of varieties can reduce consumer surplus and domestic welfare following a transportation cost reduction. This is in contrast to Clarke and Collie (2003).

2.3. Socially excessive or insufficient entry

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in a firm may increase the price of a product by inducing exit of firms in the presence of scale economies.

Even if domestic welfare is not influenced by the transportation cost as shown in Proposition 1, domestic country can influence its welfare by designing an appropriate competition policy, which affects the number of firms entering the domestic industry. Now we look at this issue and determine the welfare maximizing number of domestic firms. As usual (see, Mankiw and Whinston, 1986), we assume that the domestic government can only control the number of domestic firms entering the industry, but cannot influence the domestic firms' strategic behaviour. We will consider that the domestic firms compete like Cournot oligopolists with homogeneous products. The following analysis will show that entry can be socially insufficient or excessive for the domestic country depending on the transportation cost.

It follows from Mankiw and Whinston (1986) that entry is socially excessive in a closed economy under Cournot competition, homogeneous products and no integer constraint. We ignore integer constraint in this section to show that, in the presence of foreign competition, insufficient entry may occur under Cournot competition with homogeneous products.

For a given *t*, domestic welfare maximizing number of domestic firms, *n*, is found by maximizing the following expression:

$$\underset{n}{Max} W^d = \underset{n}{Max} \frac{2n(a-2c+t)^2 + (a(n+1)-t-nc)^2}{2(n+2)^2} - nK^2 . \tag{5}$$

Domestic welfare maximizing number of *n* is the solution of the following first order condition:

$$-(n-2)(a-2c+t)^2 + (a(n+1)-t-nc)(a-2c+t) - (n+2)^3 K^2 = 0 . \tag{6}$$

Entry in the domestic country is excessive (insufficient) if left hand side (LHS) of (6) is negative (positive) at the free entry equilibrium number of firms shown in (3). Using (3) in the LHS of (6), we get that LHS of (6) is negative (positive) if

$$t > (<) \frac{3n^* c - a(n^* + 1)}{2n^* + 1} \equiv t^* . \tag{7}$$

At the free entry equilibrium, firm 1 produces positive output if $t < \frac{a + n^* c}{n^* + 1} \equiv \bar{t}^*$. Therefore, entry in the domestic country is excessive (insufficient) if $t > (<) t^*$, where $t^* < \bar{t}^*$ but $t^* > (<) 0$ for $c > (<) \frac{a(n^* + 1)}{3n^*} \equiv \hat{c}$. Further, note that the requirement for positive outputs of all active domestic firms implies $c < \frac{a}{2}$. We find that $\hat{c} < \frac{a}{2}$ for $n^* > 2$, which occurs if the cost of entry is not very high (see (3)).

The above discussion is summarized in the following proposition.

Proposition 3: *Consider* $t < \bar{t}^*$, $c < \frac{a}{2}$ *and no integer constraint. Entry in the domestic country is excessive (insufficient) for* $t \in (t^*, \bar{t}^*)$ $(t < [0, t^*))$. *However, the condition for insufficient entry can be satisfied provided* $n^* > 2$ *and* $c \in (\hat{c}, \frac{a}{2})$.

Proposition 3 shows that entry in the domestic country can be socially insufficient in the presence of foreign competition. Hence, the anti-competitive entry regulation policies suggested by the "excess-entry" theorem focusing on closed economies may not be justifiable in open economies.

The intuition for insufficient entry is as follows. It is clear from the closed economy analysis of Mankiw and Whinston (1986) that, on the one hand, free entry tends to increase social welfare through its gross profit, but, on the other hand, entry tends to reduce social welfare by contracting outputs of all the existing firms due to the business stealing effect. At the free entry equilibrium, the gross profits of all firms are equal to the entry costs. Hence, at the free entry equilibrium, the first effect does not play any role, and the second effect creates socially excessive entry.

However, if all the firms are not from the same country, as we consider here, entry also creates a rent extraction effect. As the number of domestic firms increases, it extracts more rents from the foreign firm, which creates a positive effect on the domestic welfare. This rent extraction effect under an open economy may create insufficient entry for the domestic country.

Rent extraction by the domestic firms from the foreign firm depends on the marginal cost difference between the firms and on the transportation cost. If either the marginal cost difference between the foreign and the domestic firms is large and the transportation cost is very small, rent extraction from the foreign firm is small, which creates the domestic country's incentive for having a large number of domestic firms, while lower competitiveness of the domestic firms reduces their incentives for entry. Hence, entry can be insufficient for the domestic country if the transportation cost is small and the foreign firm's marginal cost is sufficiently low compared to the marginal costs of the domestic firms. Otherwise, the business stealing effect dominates the rent extraction effect, and makes domestic entry socially excessive.[9]

It must be clear that if the trade cost means domestic tariff, insufficient entry in the domestic country can hold, since Proposition 3 holds under free trade. Since the tariff revenue and the total cost due to transportation are zero under free trade, Proposition 3 will be the same under free trade, irrespective of the way we measure the trade cost.

3. The case of an imperfectly competitive domestic labour market

So far we have considered perfectly competitive labour markets and therefore, trade cost reduction does not affect the marginal costs of production of the firms. The constant marginal cost of production of the domestic firms means that trade cost reduction does not affect the average costs of the domestic firms, which play an important role for Proposition 1. However, if the domestic labour

[9] In an independent work, Lim (2010) examines the excess-entry theorem in the presence of foreign competition and domestic tariff and VER. In contrast, we focus on the transportation cost, and ignore the effect of the tariff revenue. Further, unlike Lim (2010), we consider in the following section the effects of labour market distortion. Lim (2010) also does not consider the welfare effects of trade cost reduction, which is another focus of our paper.

market is imperfectly competitive, may be due to the existence of a labour union, trade cost reduction not only reduces the total marginal cost of the foreign firm (which include its marginal cost of production and the trade cost), it can also affect the marginal costs of production of the domestic firms by affecting the wage charged by the union. Hence, trade cost reduction affects the average costs of the domestic firms. We address this issue here. In contrast to Section 2, we will show that even if there is no integer constraint and the products are perfect substitutes, a transportation cost reduction reduces domestic welfare, thus showing the importance of the domestic labour market structure. We will also argue that a lower transportation cost may increase domestic welfare in the presence of integer constraint.

We assume that there is a labour union in the domestic country, which charges a uniform wage to all domestic firms. We consider the right-to-manage model of labour union,[10] and to show the effects of labour union in the simplest way, we assume that the union has full bargaining power. We consider that production requires only workers and every domestic firm requires one labour to produce one unit of output. Further, we normalize the reservation wage of the domestic workers to zero. Like Section 2, we assume that the foreign labour market is perfectly competitive.

We consider the following game in this section. At stage 1, the domestic firms decide whether to enter the industry. Conditional on the number of domestic firms entering the industry, at stage 2, the union charges the wage. At stage 3, all firms choose their outputs simultaneously and the profits are realized. We solve the game through backward induction.

We consider that the trade cost represents transportation cost. If n domestic firms have entered the industry and the domestic wage is w, the equilibrium output of firm 1 and the ith domestic firm, $i = 2,3,...,n+1$ can be calculated respectively as

$$q_1 = \frac{a-(n+1)t+nw}{n+2} \quad \text{and} \quad q_i = \frac{a-2w+t}{n+2}. \tag{9}$$

[10] We refer to Lommerud et al. (2003), López and Naylor (2004) and Mukherjee (2008), to name a few, for works on the right-to-manage model of labour unions.

Total demand for labour in the domestic country is $q_I = \frac{n(a-2w+t)}{n+2}$. The domestic union determines the wage by maximizing the following expression:

$$\underset{w}{Max} \frac{wn(a-2w+t)}{n+2}. \tag{10}$$

The equilibrium wage can be found as $w = \frac{a+t}{4}$, which shows that domestic wage and the transportation cost are positively related.

The equilibrium net profit of the *i*th domestic entrant is $\pi_i = \frac{(a+t)^2}{4(n+2)^2} - K^2$. The free entry equilibrium number of domestic entrant is then

$$n^{**} = \frac{a+t}{2K} - 2. \tag{11}$$

Since the net profits of all the domestic firms are zero and the trade cost represents transportation cost, social welfare is given by the sum of union utility and consumer surplus. The total equilibrium output at the free entry equilibrium is $q^{**} = q_1^{**} + \sum_{i=2}^{n^{c*}+1} q_i^{**} = \frac{a(3n^{**}+4) - t(n^{**}+4)}{4(n^{**}+2)}$.

Hence, consumer surplus is $CS^{**} = \frac{[a(3n^{**}+4) - t(n^{**}+4)]^2}{32(n^{**}+2)^2}$. We get that the union utility is $U^{**} = \frac{n^{**}(a+t)^2}{8(n^{**}+2)}$.

Welfare at the free entry equilibrium is

$$W^{**} = \frac{[a(3n^{**}+4) - t(n^{**}+4)]^2 + 4n^{**}(n^{**}+2)(a+t)^2}{32(n^{**}+2)^2}. \tag{12}$$

We get that $\frac{\partial W^{**}}{\partial t} = \frac{a+5t-4K}{16}$. Assuming that at least one domestic firm always enters the industry for any transportation cost, which implies that $a > 6K$, we get that $\frac{\partial W^{**}}{\partial t} > 0$, i.e., a

transportation cost reduction reduces domestic welfare in the free entry equilibrium. The reason for this result will be clear once we look at the effects of *t* on wage, domestic employment and output.

We have seen that the equilibrium wage is $w = \frac{a+t}{4}$ and it does not depend on the number of final goods producers, which is in line with Greenhut and Ohta (1976) and Dhillon and Petrakis (2002), but holds even under foreign competition. However, a lower transportation cost reduces the equilibrium domestic wage by creating higher competition for the domestic firms.

The total domestic labour demand at the free entry equilibrium, which is $q_I^{**} = \frac{a+t-4K}{2}$, also reduces with a lower transportation cost. Hence, a lower transportation cost reduces domestic employment and the union utility at the free entry equilibrium.

Now look at the effect of a transportation cost reduction on the total output at the free entry equilibrium, which has a positive relationship with consumer surplus. The total output at the free entry equilibrium is $q^{**} = \frac{3a-4K-t}{4}$, which increases with a lower transportation cost. Hence, transportation cost reduction increases consumer surplus at the free entry equilibrium.

Our result shows that, if there is at least one domestic firm entering the industry, the effect of transportation cost reduction on union utility dominates the effect of the consumer surplus, and a lower transportation cost reduces domestic welfare at the free entry equilibrium.

We summarize the above discussion in the following proposition.

Proposition 4: *If there is a domestic labour union and at least one domestic firm always enters the industry, a lower transportation cost reduces union utility and domestic welfare but benefits the consumer at the free entry equilibrium with homogeneous products and no integer constraint.*

Proposition 3 is in contrast to Proposition 1, and shows that even if we ignore the integer constraints, transportation cost reduction can affect the consumers and domestic welfare in the presence of input market distortion.

It must be noted that, due to the zero profit condition, lower domestic wage following transportation cost reduction does not affect the net profits of the domestic firms. However, if there is an integer constraint, and free entry in the domestic country does not reduce the net profits of the domestic firms to zero, transportation cost reduction, even if reduces the number of firms (which follows from (11)), helps the domestic active firms by reducing their wage, thus increasing their net profits. This positive effect of transportation cost reduction on the domestic net profits may help to eliminate (or at least reduce) the negative effects of transportation cost reduction on domestic welfare. In fact, if the integer constraint is significant and the transportation cost reduction does not affect the number of domestic firms, it can be shown easily that transportation cost reduction may increase domestic welfare.[11]

Finally, we want to see whether entry in the domestic country is socially excessive or insufficient in the presence of domestic labour union and foreign competition. Again, we ignore the integer constraint. Domestic welfare maximizing number of domestic firms is determined by maximizing the following expression:

$$\underset{n}{Max}\frac{8n(a+t)^2+[a(3n+4)-t(n+4)]^2+4n(n+2)(a+t)^2}{32(n+2)^2}-nK^2. \tag{13}$$

Domestic welfare maximizing number of domestic firms is determined from the following expression:

$$\frac{(a+t)(3a(n+4)-t(n-4))}{8(n+2)^3}-K^2=0. \tag{14}$$

[11] For a given number of domestic firms, domestic welfare is $W=\frac{8n(a+t)^2+[a(3n+4)-t(n+4)]^2+4n(n+2)(a+t)^2}{32(n+2)^2}-nK^2$, and $\frac{\partial W}{\partial t}=\frac{(n+4)[a(n-4)+t(5n+4)]}{16(n+2)^2}$ can be negative for lower *t* and lower *n*, which occurs for a sufficiently large cost of entry (see (11)).

Evaluating (14) at the free entry equilibrium number of firms, thus considering $n = n^{**}$, we get that LHS of (14) is $\frac{K^2(a+12K-3t)}{2(a+t)}$, which is positive, since the requirement for positive output of firm 1 at the free entry equilibrium implies $a+4K-3t>0$. Hence, it implies that domestic welfare at the free entry equilibrium is increasing with respect to the number of domestic firms, which gives the following proposition immediately.

Proposition 5: *Consider no integer constraint. Entry in the domestic country is always insufficient for the domestic country in the presence of a domestic labour union.*

We have assumed in this section that the labour union has full bargaining power. This is opposite to Section 2 where the labour market is perfectly competitive, which is equivalent to the case where the labour union has no bargaining power. Hence, the comparison of Proposition 5 with Proposition 3 shows that the possibility of insufficient entry increases with input market distortion. This result confirms Ghosh and Morita (2007b) in open economies.

If there is a domestic labour union, its strategic wage determination creates a wage effect that affects domestic welfare along with the effects mentioned for Proposition 3. The market power of the labour union creates the market wage higher than the reservation wage of the workers, thus creating the "double marginalization" problem. The distortion created by the union power increases the domestic government's incentive for attracting more domestic firms, and makes insufficient entry more prominent compared to the situation with a perfectly competitive domestic labour market.

4. Conclusion

This paper focuses on two aspects. First, it shows the welfare effects of trade cost reduction in the presence of free domestic entry. Second, it shows the social efficiency of domestic entry in the presence of foreign competition. We examine these issues under perfectly competitive and imperfectly competitive domestic labour markets.

If the labour market is perfectly competitive, we show that if we ignore the integer constraint and the trade cost represents transportation cost, trade cost does not affect the domestic welfare if the products are homogeneous. However, if the products are imperfect substitutes, transportation cost reduction may reduce welfare by reducing the number of domestic firms. If the trade cost represents domestic tariff, domestic welfare is higher under a positive non-prohibitive tariff compared to both free trade and no trade. With integer constraint, transportation cost reduction may reduce consumer surplus and increase the profits of the active domestic firms and domestic welfare with homogeneous products.

If the domestic labour market is distorted due to the presence of a labour union, we show that a lower transportation cost reduces domestic welfare with homogeneous products and no integer constraint. However, a lower transportation cost may increase domestic welfare in the presence of an integer constraint.

While examining the issue of excessive entry, we show that if the labour market is perfectly competitive, the transportation cost is not very high and the marginal cost of the domestic firm is sufficiently higher than the marginal cost of the foreign firm, entry in the domestic country is insufficient for the domestic country. In the presence of a domestic labour union, entry in the domestic country is always socially insufficient. Domestic input market distortion increases the possibility of insufficient entry in the domestic country. Hence, the anti-competitive entry-regulation may not be justified for the domestic country under foreign competition and, it may depend on the trade cost, the marginal cost difference between the firms and the domestic input market structure.

Endogenous domestic market structure in our analysis provides some interesting new insights to the two strands of the literature – on the welfare effects of trade cost reduction and on the excessive-entry theorem. Although we have considered free entry in the domestic market, we have considered the foreign firm as a technology leader. Hence, the number of foreign firm is exogenous in our analysis. It is implicit in our analysis that patent protection in the foreign country creates significant entry barrier in the foreign country, while weak patent protection in the domestic country allows domestic entry. This assumption helps us to show the implications of endogenous domestic market structure in the simplest way. However, a natural extension of this analysis is to consider free entry also in the foreign country, either due to a weak patent protection or due to innovation by other foreign firms. This is in our future research agenda.

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