

Foreign direct investment, tariff jumping argument and the market conduct in the North –South trade^o

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Abstract

We reconsider the tariff “jumping” argument in a North-South trade in which the Southern market is domestic market, prices are perfectly flexible, and knowledge spills over from Northern to Southern firm. The novelty in this setup is the pricing mechanism through which prices are set in the market. We show that unlike in analogues setups with Bertrand or Cournot competition, in the absence of spillovers, a tariff induced FDI enhances or at least preserves the free trade social welfare. It does so by inducing an aggressive pricing strategy. When the R&D spillovers are positive, the role of tariff protection is to induce, whenever possible, the most competitive conduct. More precisely, when domestic firms are inefficient, and spillovers are small, the socially enhancing policy is to encourage foreign investors to establish subsidiaries in the domestic market that price aggressively and drive the inefficient (local) firms out of the market. When domestic firms are inefficient but spillovers are high, foreign subsidiaries would find fighting entry to be too costly, so they would behave “nice” towards their rivals and charge monopoly prices. Therefore, it becomes socially optimal to set small tariff that still bring some tariff rents but preserve to some extent foreign firms’ cost advantage and thus, their incentive to fight the entry of the domestic firms. However, when domestic firms are efficient, exports and FDI are equivalent in all respects: domestic and foreign profits, prices, and supplied quantities.

Keywords: market conduct, FDI, tariff jumping argument, R&D spillovers

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INTRODUCTION

There are several channels through which inward foreign direct investment (FDI) can contribute to the increase in wealth in developing and transition countries (from now on referred as developing countries). First, as developing countries often lack the necessary resources for capital and technological investment and such assets can be provided through FDI. Second, developing countries in general experience unemployment levels that are well above those of northern countries. FDI can contribute to job creation and thus can ease the unemployment problems in these countries. Third, the presence of FDI investment may increase the competition, at least in the highly concentrated sectors, resulting in benefits like enhanced productivity and enhanced consumers' welfare. Fourth, through FDI the domestic output, product variety and/or product quality might increase to the benefit of domestic consumers. And last but not least, the presence of foreign technology and know-how can have positive R&D spillovers effects on the local firms. Given these potential benefits resulting from FDI inflows, many developing countries have set policies aiming to attract foreign investments. One such policy can be tariff protection. Indeed, tariff protection, among other things, has been perceived as a policy that may enhance the incentive for the inward FDI. When trade barriers are high multinational enterprises (MNEs), faced with a choice between exporting to the local market and local production may opt for the latter in order to "jump" over the domestic tariffs. Many empirical studies support this insight as they have found a positive correlation between the level of tariff and non-tariff protection and the levels of inward FDI (see for example Brainard, 1997).¹

Besides the tariff protection level there are other country characteristics that are likely to influence foreign investors' choice between serving foreign markets through exports or by means of FDI. One such factor is the level of IPR protection in the foreign country. In developing countries IPRs are often infringed, foreign investors' technological advantage being repeatedly eroded by leakages of information (Ferrantino, 1993). In addition, the entry of foreign firms with better organizational and management techniques into a local market enables domestic firms to watch and imitate the way foreigners operate (Kokko, 1990). Moreover, organizational and management knowledge can spread within an industry and across sectors as a result of the mobility of experts and labour. Therefore, even in environments in which IPR are strongly enforced, organizational, cost saving and management methods spill over to local firms. Unlike tariffs, R&D spillovers discourage FDI investments.

¹ Note that the tariff jumping argument differs substantially from the infant industry protection line of reasoning. If in the latter case, governments set tariffs in order to diminish or even to deter the participation of foreign firms into the local market, in the first case tariffs induce a high level of involvement of foreign investors.

Markets in which technology and know-how are crucial assets for firm performance have in general an oligopolistic structure. Most studies that assess the impact of government policies on inward FDI and welfare in imperfectly competitive markets assume that firms interact either in Bertrand or Cournot manner. We know very little about the linkage of tariff protection and FDI under different market structures. However, in some markets, the pricing or the production strategies might be different than those arising from Cournot or Bertrand interaction. For example, unlike for Cournot and Bertrand market conducts, in some markets sellers can change a quoted price directly after a price cut by some competitor (Farm and Weibull, 1987). Such situations were present in the corn market and nowadays, to some extent, occur in retail and internet firms.

Unlike Cournot or Bertrand type of conduct, when there is price flexibility, the similarity or dissimilarity of firms' costs might be a decisive factor that determines how competitive is the market conduct in an industry. More precisely, when the distribution of cost efficiency is rather uneven, most efficient firms might have an incentive to behave aggressively and under-price some of the less efficient competitors in the industry. However, when firms are similar in terms of cost efficiency, there is balance of power and hence firms might tend to be "nice" to each other and charge high prices. Therefore, foreign subsidiaries that are highly efficient might always have a strong pro-competitive effect on domestic market. The resulting increase in consumer surplus might be high enough so to offset losses in tariff revenues and domestic producer surplus. Consequently, unlike in Bertrand or Cournot frameworks where the impact of FDI inducing tariffs could easily have adverse welfare effects (see Levy and Nolan, 1992, for example), in the case of price flexibility this impact might always be positive.

This paper attempts to fill this gap in the literature by studying a North-South trade situation in which prices in the target market are flexible and, when foreign investors establish subsidiaries in the South, knowledge spill over from North to South firms. In this context, we analyse the role of tariff in inducing inward FDI and its impact on domestic welfare. In addition, we study how these relations change when FDI is accompanied with positive, intra-industry R&D spillovers.

Even though sellers react only with some delay to certain prices and have to incur some adjustment costs, we study a perfect price flexibility situation in which price changes are costless and instantaneous. We model perfect price flexibility by relying on the new extensive form pricing game recently developed by Boone (2002). Since the tariff "jumping" argument appears usually in situations in which the MNEs decide to produce only for the local markets we consider a setup in which domestic (South) and foreign (North) firms produce only for the domestic market. Before production stage, domestic government first chooses the level of tariff protection and then foreign firms decide whether to serve the market through exports or through FDI. If they export, they have

to pay tariff duties. On the other hand, when they enter via FDI, technology and know-how spills over from foreign subsidiaries to local firms. In this context, we analyse the optimal tariff policy. As it is already clear, while tariffs are endogenously determined, we treat the level of IPR protection in the domestic country as given. IPR protection level is likely to influence all the markets that form the economy of one country and therefore it should be studied in general equilibrium model. However, in this paper we concentrate our attention on only one specific industry in a partial equilibrium framework.²

The paper is organized in the following way. First we introduce the core model and discuss the role of government intervention. Next, we describe the pricing game and its equilibrium. In Section 4 we discuss foreign investors' decision on the mode of entry (export or FDI) in the domestic, developing country market. The optimal tariff policy is analysed in Section 5. Section 6 concludes.

1. THE SET-UP

1.1. Supply, demand and the pricing game

Consider an industry in which N “domestic” and n “foreign” firms produce a homogenous good. Initially, all domestic firms hold the same technology and can produce one unit of good at the same constant cost, $\alpha \geq 0$. Foreign firms have a better technology than domestic firms. To simplify, we assume that they produce one unit of good at 0 cost. If foreign firms produce their goods in the domestic country, local firms can imperfectly imitate the foreign technology and adapt it to their production process. The extent to which this imitation can occur is captured by the spillover parameter, $\beta \in [0,1]$. At a β level of spillovers, domestic firms produce at a $\alpha(1-\beta)$ unit cost.

We focus on the interaction between the domestic and foreign firms that take place in the domestic market.³ As already mentioned in introduction, we follow Boone's (2002) approach in modelling this interaction.

Domestic demand in this industry is $D(p)$, where $D()$ is a continuous and decreasing function of the market price, p . $P(q)$ is the inverse demand. We assume that $D(p)(p - \alpha)$ is concave in $p \in \mathbb{R}^+$, and that $\alpha \leq \operatorname{argmax}_p \{D(p)(p - \alpha)\}$. Consequently, in this market, a monopolist that has a unit (marginal) cost of production α gets positive profits and has a concave profit function.

² For an approach where IPR is treated endogenously as a policy instrument of the developing country's government, see, for instance, Žigić (1998) and Žigić (2000).

³ We have in mind the case when the foreign economy is a developed, Northern economy, while the domestic country is a developing, or the most, a transition economy. We further consider that for the foreign firms, their local market and developing market are segmented.

Further, we assume that prices, p , the unit cost, α , and the spillover parameter, β , belong to the denumerable set of rational numbers, Q . This assumption ensures that the pricing game considered below is finite.

The heuristic mechanism by which Boone models the price formation resembles an auction. The underlying idea is that the firms react to each other prices before the sales takes place. More specifically, the domestic market price is established after repeating rounds of bidding. The bidding process starts at $p^0 = P(0)$ with all N domestic firms and all n foreign firms participating in the first bid. Each round s is defined by the numbers of players still in the game, N^s and n^s respectively, and the current price, p^s . A round has two stages. First, the firms still in the game bid new prices that either undercut or preserve the current price. The resulting new price, p^{s+1} , equals the lowest bid. Second, the firms that do not want to follow the price p^{s+1} can leave the game. The bidding rounds continue until a round s^* in which there is no more undercutting. Then, the market price equals $p^* = p^{s^*}$ and the number of firms is $N^* = N^{s^*}$ in the domestic country and $n^* = n^{s^*}$ in the foreign country. Once the market price is set, each firm that remained in the market has to produce $\frac{D(p^*)}{N^* + n^*}$ units of homogenous good.⁴ Firms that have already left the market do not produce and get zero profits. These rules regarding the distribution of production and profits ensure that the bidding process does not become a “cheap talk”.

1.2. The first stage of the game and the role of the domestic government

The above described pricing procedure can be viewed as the last stage in the three-stage game. The first stage of the game involves another important player- the domestic government -that commits to tariff prior to the pricing game. The level of tariff protection changes the cost distribution in the domestic market and this is the key variable that determines the last stage outcome. Namely, it may affect market conduct to such an extent that the domestic firms, even though with less efficient technology, can become the price leaders (the notion of price leadership is defined in the next section). However, the foreign firms may avoid paying tariff duties by establishing a plant in the domestic country (Motta, 1992). By doing so they are subject to the (imperfect) imitation of their technology. In other words, there are spillovers from developed to developing country firm that, for instance, occurs due to the lax of IPR protection in the domestic country.

We assume that the domestic government is a benevolent one and therefore chooses a tariff protection level that maximizes a social welfare that assigns the same weights to consumer surplus,

⁴ One could imagine that, since all firms deliver the same product at the same price, consumers pick randomly their

domestic profits, and to the tariff revenue:

$$W(t) = CS(t) + N \pi^d(t) + R(t) \quad (1)$$

where $CS(t)$ is the consumer surplus, $\pi^d(t)$ is the profit of one domestic firm, and $R(t)$ is the tariff revenue. Given our specifications, $CS(t) = \frac{1}{2}(A - p)^2$. In case foreign firms export their goods and $t > 0$, $R(t) = tQ^f$, where Q^f is the total quantity produced by foreign firms; otherwise $R(t) = 0$.

The timing of the game is the following: first the government sets the tariff protection level ($t = 0$ if there is no government intervention). Second, foreign firms decide if to export or to set up a subsidiary in the domestic country. At the end, the market price is established through the pricing game. We assume that all domestic and foreign firms participate in the bidding process. Consequently, if the entry of some firms is deterred or not, is ultimately decided at this stage.

In order to simplify the analysis of the game, we consider that the market demand is linear, namely $D(p) = A - p$. Accordingly, in order for a domestic monopolist to make positive profits in this market, α should be smaller than the market size A . We rule out cases in which domestic firms are so inefficient that in the absence of spillover, without tariff protection, its foreign rivals drive them out of the market by charging their monopoly price. Therefore, we assume that

$$A > 2\alpha \quad (a)$$

We look for subgame perfect equilibrium (SPE). Consequently, we solve these games backwards, starting with the last stage.

2. PRICING GAME – ITS EQUILIBRIUM

When the pricing game is reached, domestic government has already announced the tariff protection level t (0 for free trade) and foreign firms have already chosen between exporting and producing in the domestic country. We denote by C and c the marginal costs that domestic and foreign firms, respectively, have at this stage. In the case foreign firms export their goods into the domestic market, we assume that the local firms cannot copy the technology and therefore $C = \alpha$ and $c = t$. If the tariff t is high enough ($t > \alpha$), domestic firms have the lowest unit cost. Otherwise, the opposite is true. In the case foreign firms have established a subsidiary in the domestic country, $C = \alpha(1 - \beta)$ and $c = 0$. Given that the spillover parameter, β , is never higher than 1, at this stage the foreign producers always deliver the homogenous good at a lower, or at the most, equal cost as domestic firms. Firms that produce at the lowest unit cost hold the price leadership position in the pricing game (all proofs are consigned to the Appendix):

Lemma 1. Let $P^* \equiv \arg \max_p \frac{D(p)}{N(p) + n(p)} (p - C)$ and $p^* \equiv \arg \max_p \frac{D(p)}{N(p) + n(p)} (p - c)$ where $N(p) = \begin{cases} N, & C \leq p \\ 0, & C > p \end{cases}$ and $n(p) = \begin{cases} n, & c \leq p \\ 0, & c > p \end{cases}$. When $c < C$ ($C < c$), foreign (domestic) firms are the price leaders in the market, namely $p^* \leq P^*$ ($P^* \leq p^*$).

The notion of price leadership that we use in this pricing game is different than that used in Stakelberg games, where the price leader is the first to commit to a price. On the contrary, here, the possible reaction of the price leader to undercutting from the equilibrium ensures its position.

We can now characterize the SPE for this pricing game:

Theorem 1. Assume that firms do not play weakly dominated strategies. When $C < c$, domestic firms are price leaders and the pricing game has a unique SPE in pure strategies

$$(P^*, N(P^*), n(P^*)).$$

If $c < C$, foreign firms are price leaders and the pricing game has a unique SPE in pure strategies

$$(p^*, N(p^*), n(p^*)).$$

Regardless which are the price leaders, in any round s of the pricing game, domestic and foreign firms choose their prices according to the following rules:

Domestic firms	Foreign firms
if $p^s > P^* \Rightarrow$ bid P^*	if $p^s > p^* \Rightarrow$ bid p^*
if $p^s \leq P^* \Rightarrow$ do not undercut p^s	if $p^s \leq p^* \Rightarrow$ do not undercut p^s
if $p^s > C \Rightarrow$ stay in the game	if $p^s > c \Rightarrow$ stay in the game
if $p^s \leq C \Rightarrow$ leave the game	if $p^s \leq c \Rightarrow$ leave the game

We denote by $P^m = \operatorname{argmax}_p \{D(p) (p - C)\} = \frac{A+C}{2}$ and $p^m = \operatorname{argmax}_p \{D(p) (p - c)\} = \frac{A+c}{2}$ domestic and foreign monopoly prices, respectively. By replacing in Theorem 1 the actual demand function, we can further describe the SPE.

2.1. Exports

We start by analysing the case in which foreign firms export their goods into the domestic countries and therefore pay a tariff t for each unit of good. In this case $C = \alpha$ and $c = t$. Depending on the level of tariff protection we have two possibilities: if the tariff is low ($t < \alpha$) foreign firms are price leaders, otherwise ($t > \alpha$), domestic firms become price leaders.

3.1.2. Low tariff protection ($t < \alpha$)

Depending on the relationship between parameters (A , α , β , N , and n) and the level of tariff protection t , three different situations might arise: foreign firms are unconstrained or constrained “monopolists” in the market, thus preventing the participation of local firms into the domestic market, or they accommodate the entry of the domestic firms.

First, if

$$C > p^m \quad \Leftrightarrow \quad t < 2\alpha - A,$$

domestic firms are unconstrained “monopolists”. However, the assumption (a) rules out this possibility and therefore foreign firms, as price leaders, have two alternatives. The first one is to price at C to drive domestic firms out of the market. In this case foreign firms are constrained “monopolists”, the SPE is $(\alpha, 0, n)$, and each foreign firm gets a profit of

$$\pi^{cm,f} = \frac{(A - \alpha)(\alpha - t)}{n}. \quad (2)$$

The second one implies foreign firms pricing at p^m , and thus allow for domestic competition. Then the SPE is $(\frac{A+t}{2}, N, n)$ and each domestic and foreign firm gets a

$$\pi^{e,d} = \frac{(A - t)(A - 2\alpha + t)}{4(N + n)} \quad (3)$$

$$\pi^{e,f} = \frac{(A - t)^2}{4(N + n)}, \quad (4)$$

profit, respectively. When

$$4(N + n)(A - \alpha)(\alpha - t) \geq n(A - t)^2 \quad (5)$$

the first outcome is the SPE while if condition (5) does not hold, the second case gives the SPE for the pricing game.

3.1.2. High tariff protection ($t > \alpha$)

Depending on the level of tariff protection t , and given that $t > \alpha$, three different situations may arise: domestic firms might be unconstrained or constrained “monopolists” in the market, or they might accommodate the entry of the foreign firms.

First, if

$$c > P^m \Leftrightarrow t > \frac{A + \alpha}{2} \quad (6)$$

domestic firms are unconstrained “monopolists”, the SPE is $(\frac{A+\alpha}{2}, N, 0)$, and each domestic firm earns a profit of

$$\pi^{m,d} = \frac{(A-\alpha)^2}{4N} \quad (7)$$

However, when the inequality (6) does not hold, domestic firms as price leaders, have two alternatives. The first one is to price at c to drive foreign firms out of the market. In this case domestic firms are constrained “monopolists”, the SPE is $(t, N, 0)$, and each domestic firm gets a profit of

$$\pi^{cm,d} = \frac{(A-t)(t-\alpha)}{N}. \quad (8)$$

The second alternative is that domestic firms set price at P^m , and allow for foreign competition. Then the SPE is $(\frac{A+\alpha}{2}, N, n)$ and each domestic and foreign firm gets a

$$\pi^{e,d} = \frac{(A-\alpha)^2}{4(N+n)} \quad (9)$$

$$\pi^{e,f} = \frac{(A-\alpha)(A+\alpha-2t)}{4(N+n)} \quad (10)$$

profit, respectively. When

$$4(N+n)(A-t)(t-\alpha) \geq N(A-\alpha)^2 \quad (11)$$

domestic firms choose to price as “constrained” monopolists; otherwise they charge the monopoly price and accommodate the foreign entry.

2.2. FDI

In the case domestic tariff is too high, the foreign firm might “jump” over it by setting up a subsidiary in the domestic country. However, in this case its advanced technology might be copied by domestic firms, and therefore $C = \alpha(1-\beta)$ and $c = 0$.

Since foreign firms have the lowest costs, they are the price leaders in the market. Due to condition (a), regardless of the level of parameters, they cannot act as unconstrained monopolists (at a price $p^m = A/2$ domestic firms earn positive profits). Therefore the only possibilities that foreign firms have is either to deter the entry of the domestic firms by pricing at their marginal cost, C , or to accommodate entry by charging their monopoly price p^m . In the first situation, domestic firms get zero profits while each foreign firm earns

$$\pi^{cm,f} = \frac{\alpha(1-\beta)[A-\alpha(1-\beta)]}{n}. \quad (12)$$

In the latter case, each domestic firm has a positive profit of

$$\pi^{e,d} = \frac{A[A-2\alpha(1-\beta)]}{4(N+n)} \quad (13)$$

and each foreign firm earns

$$\pi^{e,f} = \frac{A^2}{4(N+n)}. \quad (14)$$

The SPEs are given by $(\alpha(1-\beta), 0, n)$ and $(\frac{A}{2}, N, n)$, respectively. When

$$4(N+n)\alpha(1-\beta)[A-\alpha(1-\beta)] \geq nA^2, \quad (15)$$

foreign firms prefer to deter the participation of domestic firms into the market. Otherwise, they accommodate domestic rivals' entry.

3. EXPORTS VERSUS FDI

In this section, for any value of tariff protection we assess the strategies followed by the domestic and foreign firms. What is immediate to notice is that a level of tariff protection higher than α induces FDI. Under FDI, each foreign firm gets at least a profit given by formula (14). This profit is higher than zero – the profit that foreign firms get under constrained or unconstrained domestic monopoly – or than the profit given in formula (10) – the profit that they would get if domestic firms accommodate their entry. Therefore, for $t > \alpha$ foreign firms always set up subsidiaries in the domestic country and insure a price leadership position in the market. What remains to be analysed is the foreign firms' strategies for low levels of tariff protection ($t < \alpha$). We already know that when $t < \alpha$, foreign firms are always the price leaders. However, depending on the levels of parameters (A , α , β , N , and n) and on the level of tariff, they might decide to serve domestic market either through exports or by means of FDI.

4.1 $t < \alpha$

When the tariff is small, $t < \alpha$, and foreign firms choose to accommodate the entry of domestic firms, they prefer to do it through a subsidiary rather than through exports (the profit given by formula (14) is higher than the one given by (4)). Consequently, foreign firms deter the entry of their domestic rivals only if either condition (15) or a modified version of condition (5):

$$4(N+n)(A-\alpha)(\alpha-t) \geq nA^2 \quad (5')$$

hold. The likeliness that these conditions hold decreases with an increase in t and β or a decrease in α . Therefore, in order for conditions (5') and (15) to be verified it is necessary that α is at least as high so that conditions (5') and (15) hold with equality for $t = \beta = 0$. Therefore, the initial level of domestic unit cost should be at least as high as

$$\alpha > \frac{A}{2} \left(1 - \sqrt{\frac{N}{N+n}} \right) = \underline{\alpha}. \quad (16)$$

When (16) holds, condition (5') is verified by levels of tariff

$$t \leq \alpha - \frac{nA^2}{4(N+n)(A-\alpha)} = \tilde{t} \quad (17)$$

and condition (15) holds for level of spillover that are not higher than

$$\beta < 1 - \frac{A}{2\alpha} \left(1 - \sqrt{\frac{N}{N+n}} \right) = \tilde{\beta}. \quad (18)$$

If $\alpha < \underline{\alpha}$, regardless of the level of tariff protection and the level of β , foreign firms establish subsidiaries in the domestic country and accommodate the participation of their local rivals to the market. This is also the case when $\alpha > \underline{\alpha}$ but the level of tariff protection is higher than \tilde{t} and the level of spillover is higher than $\tilde{\beta}$ (thus neither condition (17) nor (18) hold). Thus, when domestic firms are efficient ($\alpha < \underline{\alpha}$), it is costly for foreign firms to deter their entry into the domestic market, and therefore they prefer to charge the monopoly price and split the monopoly profits with the local firms. Since in the case of FDI the costs are smaller and therefore the monopoly profits are higher, foreign firms set up subsidiaries in the domestic country. A similar situation might arise when domestic firms are inefficient ($\alpha > \underline{\alpha}$) but, due to high levels of tariff and spillover foreign firms cannot exploit their technological advantage neither by exporting nor by FDI: a high t diminishes significantly their cost advantage when they serve domestic markets through exports while in case of FDI a high β results in a drastic increase in domestic firms' efficiency.

If $\alpha > \underline{\alpha}$ and the other parameters and tariff protection are such that at least one of conditions (17), and (18) is fulfilled, foreign firms choose to deter the entry of their domestic rivals. If condition (17) holds but (18) not, they do it through exports. If the reverse is true, they do it through FDI. When both conditions (17) and (18) hold, foreign firms deter the entry of domestic firms through exports if the level of tariff protection is smaller than

$$t \leq \alpha - \frac{\alpha(1-\beta)[A-\alpha(1-\beta)]}{A-\alpha} = t_{FDI}, \quad (19)$$

otherwise, they do it through FDI. It is easy to verify that this level of tariff protection is above zero but below α , and more importantly, below \tilde{t} .⁵

4. THE OPTIMAL TARIFF

From the previous section we know that for a given level of tariff t there are at most three different situations that can arise in the market: foreign firms deter domestic entry through exports, foreign firms deter domestic entry through FDI, and foreign firms set up subsidiaries in the domestic market and accommodate the entry of the local firms.

4.1. Entry deterrence by means of exports

Domestic profits are zero. Foreign firm charge a price equal with α and produce a total quantity $Q^f = A - \alpha$. The consumer surplus is $CS = \frac{1}{2}(A - \alpha)^2$. Therefore the domestic welfare given in formula (1) equals:

$$W_{exp} = (A - \alpha) \left[\frac{A - \alpha}{2} + t \right] \quad (20)$$

4.2. Entry deterrence by means of FDI

In this case domestic profits are also zero. There are no tariff revenues as foreign firms set up their own subsidiaries in the domestic country. Since they price at $\alpha(1 - \beta)$, the consumer surplus is $CS = \frac{1}{2}[A - \alpha(1 - \beta)]^2$. Therefore domestic welfare equals the consumer surplus:

$$W_{FDI, cm} = CS = \frac{1}{2}[A - \alpha(1 - \beta)]^2 \quad (21)$$

4.3. Entry accommodation (FDI)

Domestic profits are given in formula (13). There are no tariff revenues. Since firms charge a price of $A/2$, the consumer surplus equals $CS = A^2/8$. Therefore, domestic welfare is given by:

$$W_{FDI, e} = \frac{AN}{4(N + n)} [A - 2\alpha(1 - \beta)] + \frac{A^2}{8} \quad (22)$$

Table 1. Domestic welfare for $\alpha > \underline{\alpha}$, different levels of β and different tariff levels

⁵ In case $t = 0$ and $\alpha < \underline{\alpha}$ foreign firms always accommodate the participation of the local firms into the market. Yet, they are indifferent between setting up their own subsidiaries and exporting. Since regardless of their choice domestic welfare does not change, we assume that in this case foreign firms serve the local market through local subsidiaries, and

	$t < t_{FDI}$	$t_{FDI} < t < \tilde{t}$	$\tilde{t} > t$
$\beta < \tilde{\beta}$	W_{exp}	$W_{FDI,cm}$	$W_{FDI,cm}$
$\beta > \tilde{\beta}$	W_{exp}	W_{exp}	$W_{FDI,e}$

4.4. The optimal tariff

In the case domestic firms are efficient ($\alpha < \underline{\alpha}$), any level of tariff above zero induces a “tariff” jumping behaviour to the foreign firms. In this case domestic and foreign firms share the market and charge a price of $A/2$. Each domestic firm earns a profit given by formula (13) and domestic welfare, $W_{FDI,e}$, is given by formula (22). The same situation applies for inefficient domestic firms ($\alpha > \underline{\alpha}$) that benefit from a high tariff protection ($t > \tilde{t}$) and a lax level of IPR protection in their home country ($\beta > \tilde{\beta}$) (see Table 1).

In the case domestic firms are inefficient ($\alpha > \underline{\alpha}$) and the level of spillovers is high ($\beta > \tilde{\beta}$), by choosing a low ($t < \tilde{t}$) tariff protection level, domestic government induces the welfare W_{exp} given in formula (20) (see Table 1). Meanwhile, foreign firms deter the entry of domestic firms. The welfare W_{exp} increases and t and therefore reaches its maximum at \tilde{t}

$$W_{exp}|_{t=\tilde{t}} = \frac{A^2 - \alpha^2}{2} - \frac{A^2 n}{4(N+n)}. \quad (23)$$

Thus, when domestic firms are inefficient ($\alpha > \underline{\alpha}$) but the level of spillovers is high ($\beta > \tilde{\beta}$), by choosing an appropriate level of tariff protection, the government either can induce the welfare $W_{exp}|_{t=\tilde{t}}$ given above, or the welfare $W_{FDI,e}$ given in formula (22). However, the welfare $W_{exp}|_{t=\tilde{t}}$ is higher than the one associated with FDI (see Appendix 2 for the proof). In case of FDI, due to the high level of spillover, foreign firms prefer to charge their monopoly price and share the market with local firms. However, as a result there are no tariff revenues and consumer surplus decreases. From the social point of view, the fact that domestic firms earn positive profits cannot offset these losses and therefore domestic government prefers to induce lower prices through foreign exports by setting a level of tariff protection right below \tilde{t} . Consequently, the participation of domestic firms to the market is deterred.

In the case the domestic firms are inefficient ($\alpha > \underline{\alpha}$), but the level of spillovers is small ($\beta <$

therefore we concentrate our attention to the three different situations described above.

$\tilde{\beta}$), by choosing a low ($t < t_{FDI}$) or a high ($t > t_{FDI}$) tariff protection level, domestic government induces either the welfare W_{exp} given in formula (20) or $W_{FDI,cm}$ given in (21), respectively (see Table 1). Regardless the level of tariff protection, foreign firms act as constrained monopolists. As the welfare W_{exp} increases in t , when the government would like to induce foreign exports, it sets a tariff of $t = t_{FDI}$:

$$W_{exp}|_{t=t_{FDI}} = \frac{1}{2}[A - \alpha(1 - \beta)]^2 - \frac{1}{2}\alpha^2\beta(2 - \beta). \quad (24)$$

This welfare is smaller than $W_{FDI,cm}$. Therefore, domestic government raises the tariff above t_{FDI} in order to induce foreign investment and through it, higher social welfare. Even though in this case the government has to forgo its tariff revenue, it prefers to encourage foreign entry in order to induce a lower price.

The above results are summarized in the next theorem:

Theorem 2

1. *If domestic firms are efficient ($\alpha < \underline{\alpha}$), regardless the level of tariff protection, foreign firms set up subsidiaries in the domestic country and share the market with their domestic competitors.*
2. *If domestic firms are inefficient ($\alpha > \underline{\alpha}$),*
 - a. *For low level of spillover ($\beta < \tilde{\beta}$), any tariff above t_{FDI} is optimal. Foreign firms establish subsidiaries into the local market and deter the entry of their domestic rivals.*
 - b. *For high level of spillover and ($\beta > \tilde{\beta}$), the optimal level of tariff protection is $\tilde{t} - \varepsilon$. Foreign firms export their goods into domestic market and the entry of local firms is deterred.*

As a straightforward corollary of the above theorem, it follows that in the absence of R&D spillovers ($\beta = 0$), a tariff induced FDI either preserves ($\alpha < \underline{\alpha}$) or enhances ($\alpha > \underline{\alpha}$) the domestic welfare as compared with the social welfare in a free trade situation. When domestic firms are efficient, exports and FDI are equivalent in all respects: domestic and foreign profits, prices, and supplied quantities.⁶ However, when domestic firms are inefficient, the domestic government finds optimal to induce an aggressive pricing strategy by encouraging FDI. This result is different than previous results obtained under Cournot competition where the gains in consumer surplus due to FDI cannot often offset the losses in tariff revenues and domestic profits (Levy and Nolan, 1992).

⁶ When there are positive transportations costs associated with exports and when $\alpha < \underline{\alpha}$, then even under free trade foreign investors choose to serve the domestic market through FDI.

5. CONCLUSIONS

In this paper we reconsider the tariff “jumping” argument in a North-South trade situation in which the market of interest is the one in the South, prices are perfectly flexible, and knowledge spills over from North to South. The novelty in this setup is the pricing mechanism through which prices and then quantities are set in the market.

We show that unlike in analogues setups with Bertrand or Cournot competition, in the absence of spillovers, a tariff induced FDI enhances or at least preserves the free trade welfare. It does so by inducing an aggressive pricing strategy. When the R&D spillovers are positive, the main role of tariff protection is to induce, whenever possible, the most competitive conduct. More precisely, when domestic firms are inefficient, and spillovers are small, the socially enhancing policy is to encourage foreign investors to establish subsidiaries in the domestic market that price aggressively and drive the inefficient (local) firms out of the market. When domestic firms are inefficient but spillovers are high, foreign subsidiaries would find fighting entry to be too costly, so they would behave “nice” towards their rivals and charge monopoly prices. Therefore, it becomes socially optimal to set small tariff that still bring some tariff rents but meanwhile, preserve to some extent foreign firms’ cost advantage and thus, their incentive to fight the entry of the domestic firms. However, when domestic firms are efficient, exports and FDI are equivalent in all respects: domestic and foreign profits, prices, and supplied quantities.

In our analysis we constrained the foreign investors to either exporting their goods in developing countries or establishing their own subsidiaries (FDI) in the domestic market. However, another possibility that foreign investors might consider is to acquire already existing firms. Since in this case the resulting cost distribution in the local market will be different than the ones already discussed, in the future research we would like to go further in analysing the impact of FDI on domestic welfare by allowing for different types of FDI.

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APPENDIX 1

PROOF OF LEMMA 1

We consider the case that $C \leq c$ and show that domestic firms are price leaders and $P^* \leq p^*$. The proof for the other case ($c \leq C$) follows exactly the same logic.

We prove it by contradiction. Assume that $p^* < P^*$. Then $D(p^*) > D(P^*)$. Also, given the definitions of $N(p)$ and $n(p)$ this relation between prices implies that $n(p^*) + N(p^*) \leq n(P^*) + N(P^*)$. By using the definition of P^* and the fact that $C \leq c$ we get:

$$\begin{aligned}
 0 &\leq \frac{D(P^*)}{N(P^*) + n(P^*)}(P^* - C) - \frac{D(p^*)}{N(p^*) + n(p^*)}(p^* - C) = \\
 &= \frac{D(P^*)}{N(P^*) + n(P^*)}P^* - \frac{D(p^*)}{N(p^*) + n(p^*)}p^* + C \left(\frac{D(p^*)}{N(p^*) + n(p^*)} - \frac{D(P^*)}{N(P^*) + n(P^*)} \right) \leq \\
 &\leq \frac{D(P^*)}{N(P^*) + n(P^*)}P^* - \frac{D(p^*)}{N(p^*) + n(p^*)}p^* + c \left(\frac{D(p^*)}{N(p^*) + n(p^*)} - \frac{D(P^*)}{N(P^*) + n(P^*)} \right) = \\
 &= \frac{D(P^*)}{N(P^*) + n(P^*)}(P^* - c) - \frac{D(p^*)}{N(p^*) + n(p^*)}(p^* - c).
 \end{aligned}$$

This implies that the foreign firms can get higher profits from choosing P^* rather than p^* . Therefore p^* cannot be the $\arg \max_p \frac{D(p)}{N(p) + n(p)}(p - c)$.

PROOF OF THEOREM 1

Again we consider only the case $C \leq c$. The proof for the other case ($c \leq C$) follows exactly the same logic.

1. First we will prove that $(P^*, N(P^*), n(P^*))$ together with the strategies described in Theorem 1 for each round s for the domestic and foreign firms form is a subgame perfect equilibrium (SPE) of the pricing game.

By definition of P^* (p^*), a domestic (foreign) firm cannot do better by quoting another price. Therefore, if the price at stage s is higher than P^* (p^*), a domestic (foreign) firm will undercut it to P^* (p^*). Moreover, since $D(\cdot)$ ($\cdot - \alpha$) is a concave function on \mathbb{R}^+ for any $x \in [0, \alpha]$ ($D(\cdot)$ is in fact a linear function), given that the other firms will keep the strategies specified in the theorem, a domestic (foreign) firm's profit is increasing in p as long as $p < P^*$ ($p < p^*$). Therefore, a domestic (foreign) firm will not undercut a price $p \leq P^*$ ($p \leq p^*$). Also, a firm cannot gain by changing unilaterally its exit strategy.

Given the equilibrium strategies and the result from Lemma 1, the SPE of the pricing game will be $(P^*, N(P^*), n(P^*))$.

2. We will show that the above SPE is unique.

Since $D(\cdot)$ is a linear function, $D(\cdot) (\cdot - \alpha)$ is a concave function on \mathbb{R}^+ for any $x \in [0, \alpha]$. This implies that P^* is a singleton and the profit function $\frac{D(p)}{N(p) + n(p)}(p - C)$ is single peaked on $[C, P^*]$. We will again prove by contradiction that $(P^*, N(P^*), n(P^*))$.

Suppose that there is a price $p' \neq P^*$ which is also a SPE price. Since firms do not play weakly dominated strategies, this implies that firms with cost below this price are active in the market while firms with cost higher than this price, have left the market. Therefore at this price, there will be $n(p') + N(p')$ firms in the market, where $N(p') = \begin{cases} N, & C \leq p' \\ 0, & C > p' \end{cases}$ and $n(p) = \begin{cases} n, & c \leq p' \\ 0, & c > p' \end{cases}$.

First, let's assume that $p' < P^*$. If only one firm has reduced its price to p' , since the profit function is concave and $p' < P^* \leq p^*$, that firm could have been better off by bidding P^* . If at least 2 firms have quoted the price p' , each of these firm can never lose by bidding P^* (on the contrary, they might even gain from quoting this higher price). Thus p' can form a SPE only if firms choose weakly dominated strategies, case which is rule out by our assumptions.

Now, let's suppose that $p' > P^*$. Unless there is a credible threat that a price reduction to P^* will trigger a further reduction in the price, the domestic firm can do strictly better by lowering the price to P^* . However, in our game, such a credible threat can exist only if firms are allowed to play weakly dominated strategies (see the argument above).

APPENDIX 2

PROOF OF THEOREM 2

1. We show that when $\alpha > \underline{\alpha}$ and $\beta > \tilde{\beta}$, $W_{exp}|_{t=\tilde{t}} > W_{FDI,e}$:

$$W_{exp}|_{t=\tilde{t}} - W_{FDI,e} = \frac{A^2 + 4\alpha A(1-\beta) - 4\alpha^2}{2} - \frac{\alpha A(1-\beta)n}{2(N+n)}.$$

This difference is decreasing in β : $\frac{\partial(W_{exp}|_{t=\tilde{t}} - W_{FDI,e})}{\partial\beta} = -\frac{\alpha An}{2(N+n)}$. As $W_{exp}|_{t=\tilde{t}} - W_{FDI,e}$ in $\beta = 1$

equals $\frac{1}{8}(A^2 - 4\alpha^2)$, which due to the assumption (a) is positive, for any value of β between 0

and 1 $W_{exp}|_{t=\tilde{t}} - W_{FDI,e}$ is positive. Therefore, $W_{exp}|_{t=\tilde{t}} > W_{FDI,e}$.