Firm heterogeneity, exports and strategic FDI

Andrzej Cieślik*

Abstract
In this paper we develop a theoretical model to study how productivity differences between domestic and foreign firms affect the choice between exporting and FDI. We use an imperfectly competitive framework of the leader-follower model in which the foreign firm from a technologically advanced country decides whether to enter the market in a developing country or not while the domestic firm in that country decides whether to imitate the product developed by the technological leader and enter the market or not. In addition, the foreign firm faces the choice of entering the market in a developing country by exporting to it or investing in it. We identify the conditions necessary for exporting and FDI to occur, depending on the competing firms’ marginal cost differences as well as the trade cost, the cost of FDI and the cost of imitation. We demonstrate that several possible equilibriums may emerge depending on various combinations of the key parameters of the model: an exporting monopoly equilibrium, an exporting duopoly equilibrium, a FDI monopoly equilibrium, and a FDI duopoly equilibrium. In addition, we show that FDI can play a strategic role. In particular, if the foreign firm decides to export then the local firm decides to enter the market and the foreign firm has to share the market with the local firm. Therefore, even if exporting is a preferred strategy to FDI the foreign firm decides to do FDI to prevent the local firm from entering the market.

JEL Classification Codes: F12, F23
Keywords: entry deterrence, exporting, firm heterogeneity, strategic FDI

*: Department of Macroeconomics and International Trade Theory, Faculty of Economic Sciences, University of Warsaw, ul. Długa 44/50, Warszawa, PL-00241, Poland, phone: (4822) 8314725, fax: (48 22) 8312846, e-mail: cieslik@wne.uw.edu.pl
1. Introduction
Multinational enterprises (MNEs) which are responsible for the world foreign direct investment (FDI) flows have become an important feature of the globalized world economy. From the early 1990s onwards FDI made by MNEs grew far more rapidly than both world GDP and world trade. Global FDI flows have increased radically during the last two decades reaching $1.4 trillion by 2010 from $54 billion in 1980 (UNCTAD, 2013). According to the recent World Investment Report (2013) more than half of world FDI inflows goes currently to developing countries. “In 2012 – for the first time ever – developing economies absorbed more FDI than developed countries, accounting for 52 per cent of global FDI flows” (UNCTAD, 2013, p. ix).

While many models in the literature were proposed to study internationalization of production two main reasons why a firm should go multinational were identified: efficiency seeking and market seeking. According to the first one firms internationalize production and become multinationals in order to get access to inputs at lower costs. Foreign direct investment undertaken with the aim of reducing production costs is often called vertical FDI as it involves fragmenting production processes and locating each stage in the country where the factors used intensively in that particular stage are relatively cheap. According to the second one multinational firms are vehicles to overcome distance and lower costs of foreign markets access. Foreign direct investment undertaken to serve local markets is often called horizontal FDI and refers to producing abroad roughly the same goods and services as in the parent country.

Horizontal FDI constitutes so far the largest fraction of multinational activity in the contemporary world economy. Although horizontal FDI occurs mostly between developed countries its share is the developing countries has been rapidly increasing. To explain this phenomenon several models of horizontally integrated MNE have been developed. Typically, these models employed the tools used previously in the NTT literature that allowed addressing explicitly the issues of increasing returns and market structure. Initially, these models were extremely simple assuming identical factor endowments across countries and were based on partial equilibrium frameworks.

Probably, the most frequently cited early example of this approach is the partial equilibrium model of oligopolistic competition developed by Markusen (1984) that assumes the existence of firm-level scale economies as the driving force for FDI. The multinational firm’s headquarter produces a service of a firm-specific asset that can be simultaneously used in
multiple plants in a non-rival manner. Therefore, two-plant firms have lower fixed costs than those of two single plants and this motivates multinational production. The original Markusen (1984) model was later extended by Horstmann and Markusen (1987, 1992), Markusen and Venables (1998, 2000) and Markusen (2002) and allowed for endogenous market structure and different forms of competition between firms within the partial as well as general equilibrium frameworks. In these frameworks firms have different potential channels of entering a foreign market and each of these channels incurs different costs, however they all assumed that entry decisions were made simultaneously in the first stage of the game. A firm faces a choice between concentrating production in the home country and serving foreign markets exporting to achieve scale economies and producing abroad to benefit from proximity to consumers.

Another early attempt to integrate MNEs into the NTT was made by Smith (1987) and Motta (1992) who provided an alternative framework to study the choice between exporting and FDI in which entry decisions were made sequentially. In the Smith-Motta framework the game unfolded as follows. In the first stage the home firm decided whether or not to establish a subsidiary in the foreign country. If it did, it incurred a fixed cost of building the production capacity; if it did not, it served the foreign market via exporting. By choosing to export the firm incurred a constant per unit trade cost but saved the fixed cost of building the plant. The model assumed that the home firm’s sales to the foreign market were profitable regardless of the method of supply chosen by the home firm. In the second stage the indigenous firm from the foreign country decided whether to enter the market or not. The local firm must have incurred the higher fixed cost to enter the market consisting of two separate components: the cost of finding out about the industry (i.e. developing a product, R&D), which the multinational firm has already covered in its home country, and the fixed cost of building the plant which was the same as the cost of the multinational firm. Once both entry decisions were made the two firms engaged in Cournot competition to determine output quantities. The model assumed that the entry decisions were made taking into account their effects on the subsequent quantity equilibrium. Finally, it was assumed that marginal costs were constant and the same for all firms and that markets were segmented.

The most interesting case considered in the Smith-Motta framework was the case when entry by the local firm from the foreign country could be profitable but only if the home firm chose to export. At the same time, exporting was more profitable to the home firm if the foreign
firm chose not to enter. When these conditions held, the optimal decision for the home firm was to make an irrevocable commitment to produce in a foreign subsidiary. In this case FDI could play a strategic role, i.e. deter the entry of the local firm from entering the market. Thus, modeling multinational firm behavior in an oligopolistic environment introduced new considerations in the choice between exporting and FDI. In particular, it was possible to demonstrate that foreign production becomes a preferred entry option even when cost and trade policy variables might otherwise dictate exporting.

Despite the fact that the entry decisions in the theoretical studies by Smith (1987) and Motta (1992) were made sequentially they used a simple Cournot duopoly framework and did not consider the role of the first mover advantage. Moreover, the assumed the same marginal costs of production for all firms. Therefore, the main goal of this paper is to study the role of the first mover advantage and firm heterogeneity between firms. We use the leader-follower framework proposed by Stackelberg (1934) in which the multinational firm from the home country moves first instead of using the standard Cournot framework to derive a broader set of conclusions. Therefore, this paper can be seen as an extension of the aforementioned studies.

The organization of this paper is as follows. Section 2 discusses the key assumptions of the theoretical model, describes various market entry strategies, payoffs and participation constraints. Section 3 presents various proximity-concentration tradeoffs facing the foreign firm. Section 4 discusses the necessary conditions for particular equilibriums. Section 5 summarizes and concludes.

2. Main Assumptions, Entry Strategies, Participation Constraints and Payoffs

In this section we discuss the main assumptions of the leader-follower model, the entry strategies, the payoffs and participation constraints that imply non-negative levels of profits for foreign and domestic firms. We focus on the market in the developing country only. We assume that there are only two firms in a single industry: the foreign leader firm and the domestic follower firm. For simplicity, it is assumed that the product that can be produced by both firms is homogenous and produced under increasing returns to scale.

Increasing returns to scale for the domestic firm are modeled by assuming that the total cost function is:

\[ TC_D(x_D) = F + G + c x_D \tag{1} \]
where: F is the fixed cost of imitating the foreign product by the domestic firm, G is the fixed investment cost of entering the market (i.e. building a production capacity there), c is the constant marginal cost of production and \(x_D\) is output. It can be easily noted that the average cost of production declines with output as the total fixed cost is spread over a larger number of units:

\[
AC(x_D) = (F+G)/x_D + c.
\]

Increasing returns to scale for the foreign firm are modeled in a simple way by assuming that the total cost function is:

\[
TC_F(x_F) = G + \theta c x_F
\]

where: G is the fixed investment cost of entering the market (i.e. building a production capacity there), \(\theta\) is the measure of the productivity advantage over the domestic firm with \(\theta < 1\), c is the constant marginal cost of production and \(x_F\) is output. It can be easily noticed that the average cost of production declines with output as the fixed cost is spread over a larger number of units:

\[
AC(x_F) = G/x_F + \theta c.
\]

For simplicity, it is assumed that fixed cost \(G\) applies only to the foreign firm when it enters the domestic country market via FDI and does not apply when it exports from the home plant located in the foreign country. Exporting is for the foreign firm the alternative to the high-fixed cost option of entering via FDI. However, exporting, is a high marginal cost option, as we assume that trade cost \(t\) increases the marginal cost. The trade cost is assumed to be exogenous representing the standard exogenous trade costs such as transport costs, tariffs, insurance, etc.

For simplicity, we use an explicit simple linear inverse demand function that relates price P to total output X supplied by both firms to the market:

\[
P(X) = a - X,
\]

where \(a > c\) is the measure of the market size in the domestic country, and X is the sum of output supplied to the market by both firms: \(X = x_D + x_F\).

The foreign firm has the first mover advantage and is the industry leader which discovered the product. Once the foreign firm decides to enter the domestic market it picks its output level and then the domestic follower firm chooses its optimal quantity given the knowledge of the leader’s output, i.e. the firms play the standard Stackelberg (1934) oligopoly game. We start with the benchmark case when the foreign firm is a monopolist and discuss two standard host market entry strategies: FDI and exporting of the foreign firm. Then, we discuss a more complex case when then foreign firm has to compete with the domestic firm in the Stackelberg manner.
**Benchmark: Foreign monopoly**

First, we consider the case when the market entry costs for the domestic firm (F + G) are so high that the domestic firm decides not to enter the market in the domestic country and the foreign firm becomes a monopolist in the domestic market. This benchmark case corresponds to the historically first strand in the literature on the choice between exporting and FDI discussed in the previous section.

**FDI monopoly**

If the foreign firm decides to serve the domestic country market via FDI it must incur the cost of building the plant G in the domestic country and its profit made in that country can be written as:

$$\Pi_{F}^{M-FDI} = [a - X_{F}^{M-FDI}]X_{F}^{M-FDI} - \theta X_{F}^{M-FDI} - G$$  \hspace{1cm} (4)

Using the first order condition we can obtain the FDI monopoly equilibrium output:

$$X_{F}^{M-FDI} = \frac{a - \theta \epsilon}{2}$$  \hspace{1cm} (5)

It can be noted that the bigger productivity advantage (i.e. smaller $\theta$) implies bigger sales in the domestic market. The equilibrium monopoly price in the domestic market can be determined by substituting the FDI monopoly equilibrium output of the foreign firm (5) into the inverse demand function (3) which yields:

$$P_{F}^{M-FDI} = \frac{a + \theta \epsilon}{2}$$  \hspace{1cm} (6)

Consequently, it can be noted that the bigger productivity advantage (i.e. smaller $\theta$) implies a lower price charged in the domestic country market. Substituting equilibrium solutions for output (5) and price (6) into the profit function (4) yields the equilibrium monopoly profit from FDI for the foreign firm:

$$\Pi_{F}^{M-FDI} = \left(\frac{a - \theta \epsilon}{2}\right)^2 - G = \left[X_{F}^{M-FDI}\right]^2 - G$$  \hspace{1cm} (7)

The foreign firm enters the domestic country market via FDI only if its operating profit is bigger than the fixed cost of entry:

$$G < \left(\frac{a - \theta \epsilon}{2}\right)^2$$  \hspace{1cm} (8)
It can be noted that the smaller is the fixed investment cost of entering the domestic country market $G$ and the bigger is the productivity advantage (i.e. smaller $\theta$) of the foreign firm the more likely is that condition (8) will be satisfied.

**Exporting monopoly**

If the foreign firm decides to serve the domestic country market by exporting from its home plant located in the foreign country its profit made on the domestic country can be written as:

$$\Pi^M_{EX} = [a - X^M_{EX}]X^M_{EX} - (\theta c + t)X^M_{EX}$$

(9)

Using the first order condition, we can obtain the exporting monopoly equilibrium output:

$$X^M_{EX} = \frac{a - \theta c - t}{2}$$

(10)

The equilibrium monopoly price in the domestic market can be determined by substituting the exporting monopoly equilibrium output of the foreign firm (10) into the inverse demand function (3) which yields:

$$p^M_{EX} = \frac{a + \theta c + t}{2}$$

(11)

Substituting equilibrium solutions for output (9) and price (10) into the profit function (8) yields the equilibrium monopoly profit from exporting:

$$\Pi^M_{EX} = \left[\frac{a - \theta c - t}{2}\right]^2 = \left[X^M_{EX}\right]^2$$

(12)

The foreign firm enters the market in the domestic country via exporting only if its profit in that market is positive which implies that the following participation constraint must be satisfied:

$$t < a - \theta c$$

(13)

It can be noted that the smaller is the trade cost $t$ and the bigger is the productivity advantage (i.e. smaller $\theta$) of the foreign firm the more likely is that condition (13) will be satisfied.

**Leader-follower FDI duopoly**
If foreign firm decides to enter the domestic country market via FDI and the domestic firm decides to compete we have the standard Stackelberg leader-follower duopoly problem. In this case if the foreign firm enters the domestic country market and competes with the domestic firm its profit function can be written as:

\[ \Pi_F^{FDI} = [a - (x_F^{FDI} + x_D^{FDI})]x_F^{FDI} - \theta x_F^{FDI} - G \]  

(14)

In a similar way we can write down the profit function of the domestic firm:

\[ \Pi_D^{FDI} = [a - (x_F^{FDI} + x_D^{FDI})]x_D^{FDI} - c x_D^{FDI} - F - G \]  

(15)

Using the first order condition for the domestic firm we can first calculate its reaction function given the output of the foreign firm:

\[ x_D^{FDI} = \frac{a - c - x_F^{FDI}}{2} \]  

(16)

Subsequently, we substitute this reaction function into the profit function of the foreign firm (14) and calculate its equilibrium level of output supplied to the host country market:

\[ x_F^{FDI} = \frac{a + (1 - 2\theta)c}{2} \]  

(17)

It can be noted that the volume of output supplied by the foreign leader firm to the host country market when it enters via FDI and faces competition from the domestic firm is now larger compared to the case when the foreign firm was the monopolist.\(^1\)

Substituting the equilibrium level of output for the foreign firm into the reaction function of the domestic firm (16) yields its equilibrium level of output:

\[ x_D^{FDI} = \frac{a - (3 - 2\theta)c}{4} \]  

(18)

It can be noted that the equilibrium level of output supplied to the market by the domestic follower firm is smaller than the half of the output supplied by the foreign firm.\(^2\)

---

\(^1\)This result is different from the standard case when the foreign firm has no productivity advantage, i.e. \(\theta = 1\). In this case the volume of output of the foreign firm is exactly the same as in the case when the foreign firm is a monopolist.

\(^2\)In the standard case when the foreign firm has no productivity advantage, i.e. \(\theta = 1\), the volume of output of the domestic firm is equal to exactly the half of the output of the foreign firm.
The total equilibrium level of output supplied to the host-country market is the sum of outputs (17)-(18) supplied jointly by the foreign and domestic firms which can be written as:

\[ X^{FDI} = x^{FDI}_D + x^{FDI}_F = \frac{3a - (1 + 2\theta)c}{4} > X^M_F \]  

(19)

It can be noted that the total level of output supplied to the market is now bigger compared to the case of foreign monopoly due to the positive output response of the domestic follower firm and the higher amount of output supplied by the foreign firm.

The equilibrium price in the domestic market can be determined by substituting the sum of output (19) into the inverse demand function (3) which yields:

\[ p^{FDI} = \frac{a + (1 + 2\theta)c}{4} < p^M_F = \frac{a + \theta c}{2} \]  

(20)

Moreover, it can be noted that the equilibrium price is lower compared to the case of foreign monopoly as the equilibrium level of output is now bigger.

Using our solutions for the equilibrium quantities (17)-(18) and price (20) the total profits for the foreign and domestic firms can be written as, respectively:

\[ \Pi^{FDI}_F = 2\left(\frac{a + (1 - 2\theta)c}{4}\right)^2 - G \]  

(21)

\[ \Pi^{FDI}_D = \left(\frac{a - (3 - 2\theta)c}{4}\right)^2 - F - G \]  

(22)

It can be noted that the operating profit of the foreign firm is now lower compared to the case of foreign monopoly as now the foreign firm has to compete with the domestic firm. In the leader-follower FDI equilibrium the profit of the foreign is more than twice as big as the operating profit of the domestic firm as the market share of the foreign firm is more than twice as high as the market share of the domestic firm. Hence, the leader-follower FDI equilibrium allows the foreign firm to benefit from the first-mover advantage. Moreover, the overall profit of the foreign firm is even bigger compared to the profit of the domestic firm which has to pay a fixed market entry cost F in addition to the fixed cost of building the plant G.

To ensure that both firms are active in the domestic country market we need to impose the market participation constraints stating that both firms have non-negative levels of equilibrium profits. These conditions require that operating profits in the domestic market must be bigger than the fixed costs. The participation constraint for the foreign firm requires that
\[
G < 2 \left( \frac{a + (1 - 2\theta)c}{4} \right)^2
\]

(23)

The participation constraint for the domestic firm requires that

\[
F + G < \left( \frac{a - (3 - 2\theta)c}{4} \right)^2
\]

(24)

It can be noted that it is easier to satisfy the participation constraint for the foreign firm than for the domestic firm, hence if (24) is satisfied then also (23) is satisfied. The foreign firm earns a higher operation profit and has to pay the lower fixed cost while domestic firm earns a lower operating profit and has to pay the higher fixed cost. If both (23) and (24) are met, then both firms have non-negative profits and supply positive amounts of output to the domestic country market.

**Leader-follower exporting duopoly**

If the foreign firm decides to enter the domestic market via exporting and the domestic firm decides to compete we also have a leader-follower duopoly problem. In this case the profit function of the foreign firm can be written as:

\[
\Pi_F^{EX} = [a - (x_F^{EX} + x_D^{EX})]x_F^{EX} - (\theta c + t)x_F^{EX}
\]

(25)

For the foreign firm exporting to the domestic market from the production facility located abroad implies a high marginal cost option due to the existence of trade cost \( t \). However, this strategy allows the foreign firm to save on the fixed cost of investment \( G \).

The profit function for the domestic firm can be written as:

\[
\Pi_D^{EX} = [a - (x_F^{EX} + x_D^{EX})]x_D^{EX} - cx_D^{EX} - F - G
\]

(26)

Using the first order conditions, we can determine the equilibrium levels of output supplied by the foreign and domestic firms to the domestic market, respectively:

\[
x_F^{EX} = \frac{a + (1 - 2\theta)c - 2t}{2}
\]

(27)

\[
x_D^{EX} = \frac{a - (3 - 2\theta)c + 2t}{4}
\]

(28)

We can note that compared to FDI solutions now the equilibrium levels of output contain the trade cost. As a result the domestic firm’s output is now higher and the foreign firm’s output is lower compared to the earlier case when the foreign firm served the domestic country market.
via FDI. In the special case when trade is completely free, i.e. \( t = 0 \) the output levels of both firms are the same as in the previous case.

The total equilibrium level of output supplied to the domestic market is the sum of outputs (27) and (28) supplied jointly by the foreign and domestic firms that equals:

\[
X^{EX} = x^{EX}_D + x^{EX}_F = \frac{3a - (1 + 2\theta)c - 2t}{4} < X^{FDI}
\] (29)

It can be noted that the equilibrium level of total output supplied to the domestic market when the foreign firm enters this market via exporting is smaller compared to the equilibrium level of output in the case when it enters via FDI (19) due to the inefficiencies associated with the existence of the trade cost.

The equilibrium price in the domestic market can be determined by substituting the sum of output (29) into the inverse demand function (3) which yields:

\[
p^{EX} = \frac{a + 3c + 2(s + t)}{4} > p^{FDI}
\] (30)

It can be noted that the price in the leader-follower exporting equilibrium will always be higher compared to the leader-follower FDI equilibrium due to the technical inefficiency associated with the existence of the trade cost:

Using our solutions for the equilibrium quantities (27)- (28) and the equilibrium price (30) we can determine the equilibrium profits for the domestic and foreign firms, respectively:

\[
\Pi^{EX}_D = \frac{2}{4} \left( \frac{a + (1 - 2\theta)c - 2t}{4}\right)^2
\] (31)

\[
\Pi^{EX}_F = \left( \frac{a - (3 - 2\theta)c + 2t}{4} \right)^2 - F - G > \Pi^{FDI}
\] (32)

It can be noted that for the domestic firm it is always better off if the foreign firm enters the domestic market via exporting rather than via FDI. The domestic firm’s profit is higher when the foreign firm exports than when it enters via FDI for two reasons: i) the domestic firm’s larger sales, ii) a higher equilibrium price. Hence, for the domestic firm \( \Pi^{EX}_D > \Pi^{FDI}_D \) is always satisfied.

However, for the foreign firm such a simple generalization cannot be made. Although the operating profit associated with FDI is higher than the exporting profit, the fixed cost of investment \( G \) can make the foreign firm’s overall profit of FDI lower than the profit from exporting. Hence, whether the profit from exporting is bigger or smaller compared to the profit
from FDI for the foreign firm depends on the interplay between the trade and investment costs (t and G). This ‘proximity-concentration’ tradeoff for the foreign firm will be studied in detail in the next section.

To ensure both firms are active in the domestic market we must impose market participation constraints on the domestic and foreign firms stating that they must have non-negative levels of profits. The participation constraint for the foreign firm requires that:

$$2t < a + (1 - 2\theta)c$$  \hfill (33)

Similarly, the participation constraint for the domestic firm requires that:

$$F + G < \left( \frac{a - (3 - 2\theta)c + 2t}{4} \right)^2$$  \hfill (34)

It can be noted that now it is easier for the domestic firm to satisfy participation constraint (34) than (24) as now it has a higher operating profit compared to the previous case when the foreign firm entered the domestic market via FDI. If both (33) and (34) are satisfied, then both firms have non-negative profits and supply positive amounts of output to the domestic market.

### 3. Proximity-Concentration Tradeoffs

In this section we discuss various proximity-concentration tradeoffs facing the foreign firm. First, we discuss the tradeoff between FDI monopoly and exporting monopoly for the foreign firm, then the tradeoff between FDI and exporting under duopoly, and finally we discuss the tradeoff between FDI monopoly and exporting duopoly.

#### Tradeoff between FDI monopoly and exporting monopoly

To study the tradeoff between FDI monopoly and exporting monopoly we compare profits of the foreign firm for FDI monopoly (7) and exporting monopoly (12). The profits of the foreign firm from FDI monopoly and exporting monopoly are equal when:

$$G = \frac{2(a - \theta c)t - t^2}{4}$$  \hfill (35)

If the fixed cost of investment G is bigger (smaller) than the threshold value (35) the foreign firm prefers exporting (FDI) monopoly to FDI (exporting) monopoly. It can be noted that higher productivity (i.e. lower \(\theta\)) lowers the threshold value of the fixed cost of investment.
Tradeoff between FDI duopoly and exporting duopoly

To analyze the tradeoff between FDI duopoly and exporting duopoly we compare profits of the foreign firm from FDI duopoly (21) and exporting duopoly (31). The profits of the foreign firm from exporting duopoly and FDI duopoly are equal when:

\[ G = \frac{(a + (1-2\theta)c)t - t^2}{2} \]  

(36)

If \( G \) is bigger (smaller) than the threshold value (35) then exporting (FDI) is the preferred entry strategy for the foreign firm. It can be noted that threshold value of the fixed cost (36) is bigger than (35). This means that increased competition in the domestic market makes the entry of the foreign firm via FDI less likely. Moreover, FDI can always be a preferred to exporting for certain combinations of model parameters such as the high trade cost and the low cost of investment. Similarly, exporting can always be a preferred to FDI for certain combinations of model parameters such as the low trade cost and the high cost of investment.

Tradeoff between FDI monopoly and exporting duopoly

To analyze the tradeoff between FDI monopoly and exporting duopoly we compare profits of foreign firm from FDI monopoly (7) and exporting duopoly (31). The profits of the foreign firm from FDI monopoly and exporting duopoly are equal when:

\[ G = \frac{(a-c)^2}{8} + \frac{(a + (1-2\theta)c)t - t^2}{8} - \frac{c^2(1-\theta)^2}{4} \]  

(37)

If the fixed cost of investment \( G \) is bigger (smaller) than the threshold value (37) then exporting (FDI) is the preferred entry strategy for the foreign firm. In addition, FDI can always be a preferred to exporting for certain combinations of model parameters such as the high trade cost and the low fixed cost of investment. Similarly, exporting can always be a preferred to FDI for certain combinations of model parameters such as the low trade cost and the high fixed cost of investment.

4. Possible Equilibriums

In this model several possible equilibriums can be identified depending on various combinations of the model parameters: a FDI monopoly equilibrium, an exporting monopoly equilibrium, a FDI duopoly equilibrium, and an exporting duopoly equilibrium. First, we consider the
benchmark equilibriums in which the domestic firm decides not to enter the domestic country market and the foreign firm becomes a monopolist serving the domestic market either via FDI or via exporting.

**FDI monopoly equilibrium**

The FDI monopoly equilibrium occurs in the following three cases. In the first two cases the domestic firm is unable to compete with the foreign firm when it enters via FDI and the duopoly participation constraint (24) for the domestic firm is not satisfied, i.e. $F + G > \left(\frac{a - (3 - 2\theta)c}{4}\right)^2$ while the participation constraint (34) may or may not be satisfied. In the first case, the foreign firm can choose between entering the domestic market via exporting or via FDI and the participation constraints (8) and (13) are satisfied, i.e. $G < \left(\frac{a - \theta c}{2}\right)^2$ and $t < a - \theta c$. The FDI monopoly equilibrium occurs when the profit from FDI monopoly is higher than the profit from exporting monopoly for the foreign firm. This corresponds to the situation when the fixed cost of investment is lower than the threshold value (35), i.e. $G = \frac{2(a - \theta c)t - t^2}{4}$.

In the second case the foreign firm can enter the domestic market only via FDI.\(^3\) This means that the participation constraint (8) is satisfied while (13) is not satisfied, i.e. $G < \left(\frac{a - \theta c}{2}\right)^2$ and $t > a - \theta c$. In this case there is no tradeoff between exporting and FDI as FDI is always preferred to exporting.

Finally, in the third case FDI monopoly equilibrium occurs when the combined fixed cost (F+G) for the domestic firm is relatively large and the domestic firm is able to compete only when the foreign firm enters the domestic market via exporting and the trade cost is sufficiently high so that only the participation constraint (34) for the domestic firm is satisfied while the participation constraint (24) is not satisfied, i.e. $\left(\frac{a - (3 - 2\theta)c}{4}\right)^2 < F + G < \left(\frac{a - (3 - 2\theta)c + 2t}{4}\right)^2$. For the foreign firm both the participation

---

\(^3\) It can be noted that if condition (33) is satisfied (23) is satisfied as well.
constraint for FDI monopoly (8), i.e. \( G < \left( \frac{a-\theta c}{2} \right)^2 \) and the participation for the exporting duopoly (33), i.e. \( 2t < a + (1 - 2\theta)c \) must be satisfied. In addition, the profit from FDI monopoly must be higher than the profit from exporting duopoly for the foreign firm which implies that the cost of investment must be relatively low compared to the trade cost and below the threshold level (37), i.e. \( G < \frac{(a-c)^2}{8} + \frac{(a+(1-2\theta)c)t-t^2}{8} - \frac{c^2(1-\theta)^2}{4} \). This case corresponds to strategic FDI discussed in Smith (1987).

Our findings can be summarized in the following result:

RESULT 1. The FDI monopoly equilibrium occurs when: i) \( F + G > \left( \frac{a-(3-2\theta)c}{4} \right)^2 \),

\[
G < \left( \frac{a-\theta c}{2} \right)^2, \quad t < a - \theta c \quad \text{and} \quad G < \frac{2(a-\theta c)t-t^2}{4}, \quad \text{ii) } F + G > \left( \frac{a-(3-2\theta)c}{4} \right)^2,
\]

\[
G < \left( \frac{a-\theta c}{2} \right)^2 \quad \text{and} \quad t > a - \theta c, \quad \text{and} \quad \text{iii)}
\]

\[
\left( \frac{a-(3-2\theta)c}{4} \right)^2 < F + G < \left( \frac{a-(3-2\theta)c+2t}{4} \right)^2, \quad G < \left( \frac{a-\theta c}{2} \right)^2, \quad 2t < a + (1 - 2\theta)c \quad \text{and}
\]

\[
G < \frac{(a-c)^2}{8} + \frac{(a+(1-2\theta)c)t-t^2}{8} - \frac{c^2(1-\theta)^2}{4}.
\]

**Exporting monopoly equilibrium**

The exporting monopoly equilibrium occurs in two cases. In both cases the domestic firm is unable to compete with the foreign firm when it enters the domestic country market via exporting and the duopoly participation constraint (34) for the domestic firm is not satisfied, i.e. \( F + G > \left( \frac{a-(3-2\theta)c+2t}{4} \right)^2 \). In the first case, the foreign firm can choose between entering the domestic market via exporting or via FDI and the participation constraints (8) and (13) are

\[\text{If the constraint (34) is satisfied also the constraint (24) is satisfied and the domestic firm is unable to compete when the foreign firm enters the domestic country market via FDI.}\]
satisfied, i.e. $G < \left( \frac{a - \theta c}{2} \right)^2$ and $t < a - \theta c$. The exporting monopoly equilibrium occurs when the profit from FDI monopoly is lower than the profit from exporting monopoly for the foreign firm. This corresponds to the situation when the fixed cost of investment is higher than the threshold value (35), i.e. $G = \frac{2(a - \theta c) t - t^2}{4}$. In the second case the foreign firm can enter the domestic market only via exporting. This means that the participation constraint (8) is not satisfied while (13) is satisfied, i.e. $G > \left( \frac{a - \theta c}{2} \right)^2$ and $t < a - \theta c$. In this case there is no tradeoff between exporting and FDI as exporting is always preferred to FDI. Our findings can be summarized in the following result:

RESULT 2. The exporting monopoly equilibrium occurs when $F + G > \left( a - \frac{(3 - 2\theta)c + 2t}{4} \right)^2$ and:

i) $G < \left( \frac{a - \theta c}{2} \right)^2$, $t < a - \theta c$ and $G > \frac{2(a - \theta c) t - t^2}{4}$, and

ii) $G > \left( \frac{a - \theta c}{2} \right)^2$ and $t < a - \theta c$.

Leader-follower FDI duopoly equilibrium

FDI duopoly equilibrium occurs only in two cases when the duopoly participation constraint (24) for the domestic firm is satisfied and it is able to compete with the foreign firm irrespectively of its entry strategy, i.e. $F + G < \left( a - \frac{(3 - 2\theta)c}{4} \right)^2$. In the first case, the foreign firm can enter the domestic market either via FDI or via exporting. Hence, both participation constraints (23) and (33) are satisfied, i.e. $G < 2\left( \frac{a + (1 - 2\theta)c}{4} \right)^2$ and $2t < a + (1 - 2\theta)c$. Moreover, we need to ensure that the profit from duopoly FDI is higher than the profit from duopoly exporting for the foreign firm. This means that the fixed cost of investment $G$ must be low compared to the trade cost $t$, i.e. it must be below its threshold value (36): $G = \frac{(a + (1 - 2\theta)c)t - t^2}{2}$.

---

5 If participation constraint (24) is satisfied participation constraint (34) is also satisfied, i.e. $F + G < \left( a - \frac{(3 - 2\theta)c + 2t}{4} \right)^2$.  

16
In the second case, FDI duopoly equilibrium occurs when the participation constraint for FDI (23) is satisfied and the participation constraint for exporting (33) is not satisfied, i.e. $G < 2\left(\frac{a + (1 - 2\theta)c}{4}\right)^2$ and $2t > a + (1 - 2\theta)c$, respectively. Hence, in the second case there is no tradeoff between FDI and exporting, and FDI is the only possible domestic country market entry option. Our findings can be summarized in the following result:

RESULT 3. The leader-follower FDI duopoly equilibrium occurs when $F + G < \left(\frac{a - (3 - 2\theta)c}{4}\right)^2$ and:

1) $G < 2\left(\frac{a + (1 - 2\theta)c}{4}\right)^2$, $2t < a + (1 - 2\theta)c$ and $G < \frac{(a + (1 - 2\theta)c)t - t^2}{2}$, and
2) $G < 2\left(\frac{a + (1 - 2\theta)c}{4}\right)^2$ and $2t > a + (1 - 2\theta)c$.

**Leader-follower exporting duopoly equilibrium**

The leader-follower exporting duopoly equilibrium occurs in three cases. The first two cases occur when the combined fixed cost $(F+G)$ for the domestic firm is relatively small, and the duopoly participation constraints for the domestic firm (24) is satisfied so it is able to compete with the foreign firm irrespectively of its entry strategy, i.e. $F + G < \left(\frac{a - (3 - 2\theta)c}{4}\right)^2$. In the first case, the foreign firm can enter the domestic market either via FDI or via exporting. Hence, both participation constraints (23) and (33) are satisfied, i.e. $G < 2\left(\frac{a + (1 - 2\theta)c}{4}\right)^2$ and $2t < a + (1 - 2\theta)c$, respectively. Moreover, we need to ensure that the profit from exporting duopoly is higher than the profit from FDI duopoly for the foreign firm. This means that the fixed cost of investment must be low compared to the combined cost of exporting, i.e. it must be above its threshold value (36): $G = \frac{(a + (1 - 2\theta)c)t - t^2}{2}$.

In the second case, the leader-follower exporting duopoly equilibrium occurs when the participation constraint for FDI (23) is not satisfied while the participation constraint for
exporting (33) is satisfied, i.e. \( G > 2 \left( \frac{a + (1 - 2\theta)c}{4} \right)^2 \) and \( 2t < a + (1 - 2\theta)c \), respectively. Hence, in this case there is no tradeoff between FDI and exporting as exporting is the only viable domestic country market entry option for the foreign firm.

Finally, in the third case exporting duopoly equilibrium occurs when the combined fixed cost (F+G) for the domestic firm is relatively large and the domestic firm is able to compete only when the foreign firm enters the domestic market via exporting and the trade cost is sufficiently high so that only the participation constraint (34) for the domestic firm is satisfied while the participation constraint (24) is not satisfied, i.e. \( \left( \frac{a - (3 - 2\theta)c}{4} \right)^2 < F + G < \left( \frac{a - (3 - 2\theta)c + 2t}{4} \right)^2 \). For the foreign firm both the participation constraint for FDI monopoly (8), i.e. \( G < \left( \frac{a - \theta c}{2} \right)^2 \) and the participation for the exporting duopoly (33), i.e. \( 2t < a + (1 - 2\theta)c \) must be satisfied. In addition, the profit from exporting duopoly must be higher than the profit from FDI monopoly for the foreign firm which implies that the cost of investment must be relatively high compared to the trade cost and above the threshold level (37), i.e. \( G = \frac{(a - c)^2}{8} + \frac{(a + (1 - 2\theta)c)t - t^2}{8} - \frac{c^2(1 - \theta)^2}{4} \). Our findings can be summarized in the following result:

RESULT 4. The leader-follower exporting duopoly equilibrium occurs when: i) \( F + G < \left( \frac{a - (3 - 2\theta)c}{4} \right)^2 \), \( G < 2 \left( \frac{a + (1 - 2\theta)c}{4} \right)^2 \), \( 2t < a + (1 - 2\theta)c \), \( 2t < a + (1 - 2\theta)c \), and \( G > \frac{(a + (1 - 2\theta)c)t - t^2}{2} \); ii) \( F + G < \left( \frac{a - (3 - 2\theta)c}{4} \right)^2 \), \( G > 2 \left( \frac{a + (1 - 2\theta)c}{4} \right)^2 \) and \( 2t < a + (1 - 2\theta)c \); iii) \( \left( \frac{a - (3 - 2\theta)c}{4} \right)^2 < F + G < \left( \frac{a - (3 - 2\theta)c + 2t}{4} \right)^2 \), \( G < \left( \frac{a - \theta c}{2} \right)^2 \), \( 2t < a + (1 - 2\theta)c \) and \( G > \frac{(a - c)^2}{8} + \frac{(a + (1 - 2\theta)c)t - t^2}{8} - \frac{c^2(1 - \theta)^2}{4} \).
5. Conclusion
In this paper we developed a theoretical model to study how productivity differences between domestic and foreign firms affect the choice between exporting and FDI. We used an imperfectly competitive framework of the leader-follower model in which the foreign firm from a technologically advanced country decided whether to enter the market in a developing country or not while the domestic firm in that country decided whether to imitate the product developed by the technological leader and enter the market or not. In addition, the foreign firm faced the choice of entering the market in a developing country by exporting to it or investing in it. We identified the conditions necessary for exporting and FDI to occur, depending on the competing firms’ marginal cost differences as well as the trade cost, the cost of FDI and the cost of imitation. We demonstrated that several possible equilibriums may emerge depending on various combinations of the key parameters of the model: an exporting monopoly equilibrium, an exporting duopoly equilibrium, a FDI monopoly equilibrium, and a FDI duopoly equilibrium. Two non-degenerate leader-follower duopoly equilibriums when both firms are active in the market emerge when productivity differences between firms are not very large, and trade and investment costs are relatively low so that both firms can survive in the market. However, when the productivity differences between firms are large or trade and investment costs for the foreign firm are prohibitively high we obtain degenerate case of the model when the foreign firm can become a monopolist. In addition, we showed that FDI could play a strategic role. In particular, if the foreign firm decided to export then the local firm decided to enter the market and the foreign firm has to share the market with the local firm. Therefore, even if exporting was a preferred strategy to FDI the foreign firm might decide to do FDI to prevent the local firm from entering the market. In this paper we did not, however, study the antitrust policy and welfare implications of particular equilibriums that should be considered in future studies.
References
Stackelberg H., von (1934), Marktform und gleichgewicht. Vienna: Julius Springer.