Imperfect competition, productivity differences and proximity-concentration trade-offs

Andrzej Cieślik*

Abstract

In this paper we study how productivity differences between foreign and home country firms affect the proximity-concentration trade-off in two imperfectly competitive frameworks: the Cournot duopoly and the monopoly that occurs when one of the competing firms is driven out of the market. We identify the conditions necessary for exporting and foreign direct investment (FDI), depending on the competing firms' marginal cost differences as well as the trade cost and the fixed sunk cost of FDI. We demonstrate that five possible equilibria: an incumbent monopoly equilibrium, a FDI duopoly equilibrium, a FDI monopoly equilibrium, an exporting duopoly equilibrium and an exporting monopoly equilibrium, may emerge depending on various combinations of the key parameters of the model.

Keywords: imperfect competition, productivity differences, proximity-concentration trade-offs
JEL Codes: F23
DOI: http://dx.doi.org/10.17451/eko/40/2015/106

* 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

One of the frequently mentioned stylized facts about the contemporary world economy is the importance of multinational enterprises (MNEs) that shape world trade and investment patterns. In the last decades foreign direct investment (FDI) made by these firms grew far more rapidly than both world trade and GDP. These real-world developments led to the emergence of the new theory of multinational enterprise (NTME) that has been an extension of the new trade theory (NTT) literature. The NTME replaced the previous neoclassical literature based on the number of unrealistic assumptions such as perfect competition, product homogeneity and constant returns to scale. The central plank of this alternative theoretical framework is known as the proximity-concentration trade-off. According to this new framework "FDI occurs when the benefits of producing in the foreign market outweigh the loss of economies of scale from producing exclusively in the firm's home plant" (Neary 2008, p.13).

Although this new theoretical framework introduced some within-industry heterogeneity resulting from product differentiation and imperfect competition at the same time it completely neglected the role of individual firm's characteristics. In particular, it has been assumed that firms were symmetric in terms of costs and technology which implied similar productivity levels and similar participation in international trade and FDI for all firms within the industry. This unrealistic prediction has been recently questioned by numerous empirical studies based on firm-level data. These empirical studies found significant within-industry heterogeneity with respect to an individual firm's productivity levels and their participation in international trade and foreign direct investment.

Therefore, there is an obvious need to investigate the role of firm heterogeneity in the proximity-concentration trade-off. The most recent strand in the NTT literature has partly addressed this issue by studying the relationship between intra-industry heterogeneity and the choice of foreign market entry modes. This strand predicts that firms follow different internationalization strategies according to their productivity levels, with more efficient firms being more capable of competing in foreign markets (Helpman 2006; Bernard *et al.* 2007). However, the majority of existing theoretical studies continue to employ the monopolistic competition framework based on the Melitz (2003) model that imposes limits on the number of possible equilibria.

In this paper we study the role of productivity differences in the choice between exporting and FDI in the two other imperfectly competitive frameworks: the Cournot duopoly and its special case – the monopoly which occurs when one of the competing firms is driven out of the market. First, we identify the conditions necessary for exporting and FDI, depending on the competing firms' marginal cost differences as well as the trade cost and the cost of foreign direct investment. Then,

we show that five possible equilibria: the incumbent monopoly equilibrium, the FDI duopoly equilibrium, the FDI monopoly equilibrium, the exporting duopoly equilibrium and the exporting monopoly equilibrium, may emerge depending on various combinations of the key parameters of the model. The contribution of this paper to the existing literature is thus purely theoretical.

The organization of this paper is as follows. Section 2 summarizes the relevant literature. Section 3 discusses key assumptions, describes various market entry strategies, payoffs and participation constraints. Section 4 presents various proximity-concentration trade-offs facing the foreign firm. Section 5 discusses the necessary conditions for particular equilibria. Section 6 summarizes and concludes.

2. Literature Review

There has been an extensive theoretical literature on the choice between exporting and FDI. However, until very recently this literature focused on how the choice of foreign market entry mode was affected by the industry- and national-level characteristics of the home and the host countries and neglected completely the role of firm-level characteristics. In this literature three main strands can be distinguished.

The earliest strand in the proximity-concentration literature was initiated in the early 1970s by the studies of Copithorne (1971), Horst (1971), and Hirsch (1976) which attempted to model an exporting versus FDI decision of a monopolist using a partial equilibrium framework. [1] In this framework a firm faced a trade-off between proximity to foreign markets obtained by setting up production plants abroad, which allowed it to economize on transportation and tariff costs, and concentration of production in the home country and serving foreign markets by exporting, which allowed it to save on fixed costs of duplicating production capacity abroad. According to this framework firms invested abroad in those industries in which the gains from avoiding trade costs outweigh the costs of setting up production plants abroad.

The second strand in this literature was the consequence of the development of the NTT literature in the late 1970s and early 1980s. This literature was based on the tools borrowed from the industrial organization literature which allowed the researchers to extend the neoclassical trade theory models based on not very realistic assumptions of perfect competition and constant returns to scale. The new trade theory models included more realistic market structures and embedded increasing returns to scale and imperfect competition into the general equilibrium

[1] See chapter 2 in Caves (2007) for a survey of the early literature on the choice between exporting and FDI.

framework.[2] Although particular models within this strand differed with respect to assumptions concerning the market structure, the main prediction from this framework was as follows: firms are more likely to enter the foreign market via FDI rather than via exporting the higher trade costs and the lower fixed costs of entry and the lower size of economies of scale at the plant level compared to the firm level. Although each model proposed a different version of the proximity-concentration trade-off, they all neglected firm-level heterogeneity within industries with respect to the level of productivity and their shares in foreign markets.[3]

The third strand in the literature is related to the recent microeconomic empirical research based on firm-level data that found significant within-industry heterogeneity with respect to an individual firms' productivity levels and their participation in international trade and FDI.[4] This extensive empirical evidence resulted in increasing dissatisfaction with "the representative firm" assumption employed in the previous theoretical approaches. Under the growing pressure of the microeconometric firm-level studies, the theoretical literature turned its attention toward the issue of intra-industry heterogeneity. This resulted in two main approaches toward modeling firm heterogeneity. The first approach proposed by Bernard *et al.* (2003), introduced stochastic productivity differences between firms into the multi-country Ricardian framework of Eaton and Kortum (2002), while the second approach initiated by Melitz (2003) introduced firm heterogeneity into Krugman's (1980) monopolistic model of intra-industry trade.[5]

Although initially Melitz's (2003) approach was designed to study the intra-industry effects of international trade, his model is nowadays treated as the "workhorse" of the modern international trade theory that has many possible applications. In particular, Helpman *et al.* (2004) generalized Melitz's (2003) model to study the role of firm characteristics in the choice between exporting and FDI.

---

[2] See Markusen (2002) and Barba Navaretti and Venables (2004) for the review of this literature.

[3] In contrast to the neoclassical trade theory literature, the new trade theory literature introduced within-industry heterogeneity resulting from product differentiation and imperfect competition assuming at the same time that firms are symmetric in terms of costs and technology. This assumption implied similar productivity levels and similar participation in international trade and FDI for all firms within the industry.

[4] There is an extensive empirical literature that relates exporting to firm productivity. For example, Clerides *et al.* (1998) provide evidence for Columbia, Mexico and Morocco, Aw *et al.* (1998) for Taiwan and Bernard and Jensen (1999) for the U.S. There are also studies that find that multinational firms outperform firms with no foreign direct investment. For example, Cieślik and Ryan (2009) provide evidence for Japan, Doms and Jensen (1998) for the U.S., Pffaffermayer and Bellak (2002) for Austria and De Backer and Sleuwagen (2003) for Belgium.

[5] See Helpman (2006) and Bernard *et al.* (2007) for the surveys of the literature on exporting, FDI, and the organization of firms.

They showed that only high-productivity firms can enter foreign markets, with the most productive of these firms entering via FDI, while lesser productive firms entering via exports.

In this paper we study the role of productivity differences in the choice between exporting and FDI using the following imperfectly competitive theoretical frameworks: the Cournot duopoly with heterogeneous firms and its extreme case when one of the competing firms becomes a monopolist. On the one hand this paper can be regarded as an extension of seminal papers by Brander (1981) and Brander and Krugman (1983) that focused on intra-industry trade building on the simple Cournot duopoly framework with homogenous firms.

On the other hand, it is closely related to the recent study of Cieślik and Ryan (2012) who extended the previous literature on foreign market entry strategies to account for various types of joint-ventures and demonstrated how the ownership choice in the joint-venture was affected by the productivity differences, the trade cost and the cost of FDI. However, in their framework it was not possible to study the standard choice between exporting and FDI due to the fact that the cooperative joint-venture equilibria were always preferred to non-cooperative exporting and FDI equilibria.

Therefore, to study the choice between exporting and FDI we use a simplified version of the model with heterogeneous firms in which we assume that the formation of joint ventures is not possible for some reasons. Hence, this study complements the previous work by Cieślik and Ryan (2012) by offering some additional results. This study can also be viewed as the extension of the recent paper by Cieślik (2015) which summarizes the main findings concerning the proximity concentration trade-offs in the simple Cournot duopoly framework with homogenous firms.

3. Key Assumptions, Internationalization Strategies, Participation Constraints and Payoffs

In this section we discuss the key assumptions of the theoretical model, internationalization strategies, payoffs and participation constraints that imply non-negative levels of outputs and profits for competing firms. We start with a benchmark in which the indigenous firm is a monopolist and then discuss two standard firm internationalization strategies: FDI and exporting.

In our study we focus on the market in the foreign country only. We assume that there are only two firms that can operate in this market: the indigenous incumbent firm and the firm from the home country that decides which internationalization strategy to follow. Once the home country firm decides how to enter the foreign country market firms compete in quantities, i.e. they employ a standard Cournot strategy. Each firm maximizes its profit assuming the output of other firm remains

the same. For simplicity, it is assumed that the good produced by both firms is homogenous and manufactured under increasing returns to scale. Following Brander (1981), increasing returns to scale at the firm level are modeled assuming that the total cost function is:

$$TC(x) = F + cx \tag{1}$$

where: F is the fixed sunk investment cost of entering the market (i.e. building a production capacity there), c is the constant marginal cost of production and x is output.

It can be easily noted that the average cost of production declines with output as the fixed cost is spread over a larger number of units: $AC(x) = F/x + c$. Moreover, firms are assumed not to be capacity constrained. For simplicity, it is assumed that fixed sunk investment cost F applies only to the home country firm and only if it enters the foreign country market via FDI. For the indigenous incumbent firm which is already operating in the foreign country market the fixed sunk cost of investment was incurred in the past and can be neglected.

For the firm from the home country exporting is an alternative to the high-fixed cost option of entering via FDI. Exporting, however, is a high marginal cost option, as we assume existence of per unit trade cost t that increases the marginal cost of the home country firm. The trade cost is assumed to be completely exogenous representing the standard exogenous trade costs such as transport costs, tariffs, insurance, etc.

Moreover, we assume that the foreign country incumbent firm is less efficient than the firm from the home country. We model this assuming a higher marginal cost of production of the indigenous firm, $(1+\alpha)c$, where the parameter $\alpha \geq 0$ represents the productivity difference between the foreign and home country firms. In the limit, when both firms become equally productive this parameter converges to zero.

For simplicity, following the industrial organization literature, we use a very simple linear inverse demand function that relates price p to total output x supplied by both firms to the foreign country market:[6]

$$p(x) = a - bx, \tag{2}$$

where a and b are the parameters representing consumer preferences. In order to reduce the number of parameters in the model we simply set $b = 1$ and assume that $a > c$. The sum of output supplied to the foreign country market by both firms is defined as: $x = x_h + x_f$, where x_h (x_f) denotes output supplied by the home (foreign) country firm.

[6] It can be easily noted that the linear demand function can be derived from the following quadratic utility function: $U(x) = ax - \frac{b}{2}x^2$.

Incumbent Monopoly

First, we consider the case when the foreign country market entry costs are so high that the firm from the home country is unable to enter that market neither via FDI nor via exporting. In this case the indigenous incumbent firm enjoys a monopoly power and its profit function can be written as:

$$\pi_f^M = [a - x_f^M)]x_f^M - (1+\alpha)cx_f^M \tag{3}$$

Using the first order condition we can determine the foreign market monopoly equilibrium output supplied by the indigenous firm:

$$x_f^M = \frac{a - c - c\alpha}{2} \tag{4}$$

The indigenous monopolist is active in the foreign country market as long as the following market participation constraint for the positive output is satisfied:

$$\alpha_f^M < \frac{a-c}{c} \tag{5}$$

The equilibrium monopoly price in the foreign country market can be determined by substituting the equilibrium monopoly output (4) into the inverse demand function (2) which yields:

$$p_f^M = \frac{a + c + c\alpha}{2} \tag{6}$$

Substituting equilibrium solutions for output (4) and price (6) into the profit function (3) we obtain the equilibrium monopoly profit for the indigenous firm:

$$\pi_f^M = \left(\frac{a - c - c\alpha}{2}\right)^2 = \left[x_f^M\right]^2 \tag{7}$$

FDI duopoly

In the case of the open economy if the firm from the home country decides to enter the foreign country market via FDI we have the Cournot duopoly problem. In this case the profit function of the indigenous firm becomes:

$$\pi_f^{FDI} = [a - (x_f^{FDI} + x_h^{FDI})]x_f^{FDI} - (1+\alpha)cx_f^{FDI} \tag{8}$$

In a similar way we can write down the profit function of the firm from the home country:

$$\pi_h^{FDI} = [a - (x_f^{FDI} + x_h^{FDI})]x_h^{FDI} - cx_h^{FDI} - F \tag{9}$$

Using the first order conditions for the indigenous and home country firms the outputs supplied by both firms to the foreign country market can be written as, respectively:

$$x_f^{FDI} = \frac{a - c - 2c\alpha}{3} \tag{10}$$

$$x_h^{FDI} = \frac{a - c + c\alpha}{3} \tag{11}$$

It can be noted that the bigger the marginal cost difference between the foreign and home country firms the lower is the output, and consequently the market share, of the indigenous firm and the higher is the output and the market share of the home country firm in the foreign market.

To ensure the indigenous firm still produces a positive amount of output after the entry of the home country firm into the foreign market the following 'market participation constraint' for the foreign country firm must be satisfied:

$$\alpha_f^{FDI} < \frac{a - c}{2c} = \frac{1}{2}\alpha_f^M \tag{12}$$

This condition shows that the threshold level of α is now two times lower compared to the case when the indigenous firm was a monopolist in the foreign country market.

In addition, to ensure the participation of the home country firm in the foreign market, we should impose the market participation constraint that also assures a positive volume of output:

$$\alpha_h^{FDI} > -\frac{a - c}{c} \tag{13}$$

It can be noted that this constraint is always satisfied for $a > c$. However, the positive amount of output does not automatically guarantee that the home country firm will always enter the foreign country market. Therefore, we must impose an additional market participation constraint which requires that its operating profit in the foreign market must be bigger than the fixed sunk cost of investment associated with entering that market. Otherwise the entry cannot occur and the indigenous firm remains a monopolist. This additional constraint can be written as:

$$F < \left(\frac{a - c + c\alpha}{3}\right)^2 \tag{14}$$

It can be easily noted that if the fixed cost of investment increases then the threshold value of the marginal cost difference between the firms must also in-

crease to result in the entry via FDI. In other words, the productivity difference between the foreign and home country firms must be bigger to compensate for the higher fixed cost of FDI.

Alternatively, this constraint can be rewritten in terms of the threshold value of the productivity difference, expressed as a function of the investment cost F, at which the home country firm makes a positive profit if it enters via FDI:

$$\alpha_h^{FDI} > \frac{-(a-c)+3\sqrt{F}}{c} \tag{14'}$$

Note that equation (13) implies a positive output, while equations (14) and (14') are the positive profit constraints. As such, equations (14) and (14') encompass equation (13).

If all participation constraints are met, then both foreign and home country firms supply positive amounts of output to the foreign market. Hence, the total equilibrium level of output supplied to the foreign market is the sum of outputs supplied jointly by the foreign and home country firms that equals:

$$x^{FDI} = x_f^{FDI} + x_h^{FDI} = \frac{2(a-c)-c\alpha}{3} > x_f^M \tag{15}$$

It can be easily noted that the equilibrium total output supplied to the foreign market when the home country firm enters this market via FDI is bigger compared to compared to the monopoly equilibrium output supplied by the indigenous firm only (4).

The equilibrium price in the foreign market can be determined by substituting the sum of output (15) into the inverse demand function (2) which yields:

$$p^{FDI} = \frac{a+c(2+\alpha)}{3} < p_f^M \tag{16}$$

Using our solutions for the equilibrium quantities (10) – (11) and price (16) the profits for the foreign and home country firms are, respectively:

$$\pi_f^{FDI} = \left(\frac{a-c-2c\alpha}{3}\right)^2 = \left[x_f^{FDI}\right]^2 \tag{17}$$

$$\pi_h^{FDI} = \left(\frac{a-c+c\alpha}{3}\right)^2 - F = \left[x_h^{FDI}\right]^2 - F \tag{18}$$

FDI monopoly

If the market participation constraint for the firm from the foreign country (12) is not satisfied, i.e. $\alpha \geq \frac{a-c}{2c}$, the indigenous firm is unable to compete with the firm from the home country when it enters the foreign market via FDI. In this case the home country firm becomes a monopolist in the foreign market and its profit function can be written as:

$$\pi_h^{M-FDI} = [a - x_h^{M-FDI}]x_h^{M-FDI} - cx_h^{M-FDI} - F \tag{19}$$

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

$$x_h^{M-FDI} = \frac{a-c}{2} \tag{20}$$

The equilibrium FDI monopoly price in the foreign country market can be determined by substituting the monopoly equilibrium output of the home country firm (20) supplied to that market into the inverse demand function (2) which yields:

$$p_h^{M-FDI} = \frac{a+c}{2} \tag{21}$$

Substituting equilibrium solutions for output (20) and price (21) into the profit function (19) yields the equilibrium monopoly profit from FDI for the home country firm:

$$\pi_h^{M-FDI} = \left(\frac{a-c}{2}\right)^2 - F = \left[x_h^{M-FDI}\right]^2 - F \tag{22}$$

The firm from the home country enters the foreign country market via FDI if its operating profit is bigger than the fixed sunk investment cost of entry:

$$F < \left(\frac{a-c}{2}\right)^2 \tag{23}$$

Exporting duopoly

If the home country firm decides to enter the foreign market via exporting we have again a Cournot duopoly problem. In this case the profit function of the indigenous firm can be written as:

$$\pi_f^{EX} = [a - (x_f^{EX} + x_h^{EX})]x_f^{EX} - (1+\alpha)cx_f^{EX} \tag{24}$$

For the home country firm exporting to the foreign market from the production facility located in the home country implies a high marginal cost option due to the

existence of trade costs t. However, this strategy allows the home country firm to save on the fixed sunk cost of investment. In this case the profit function from exporting for the home country firm can be written as:

$$\pi_h^{EX} = [a - (x_f^{EX} + x_h^{EX})]x_h^{EX} - (c + t)x_h^{EX} \tag{25}$$

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

$$x_f^{EX} = \frac{a - c - 2c\alpha + t}{3} \tag{26}$$

$$x_h^{EX} = \frac{a - c + c\alpha - 2t}{3} \tag{27}$$

We can note that compared to FDI equilibrium output solutions now the equilibrium levels of output supplied by foreign and home country firms contain the trade cost. As a result the indigenous firm's output and its market share are now generally higher while the home country firm's output and its market share are lower compared to the case of FDI equilibrium. In the special case when $t = c\alpha$ the trade cost can fully compensate the productivity disadvantage of the indigenous firm, and then the market shares of both firms are equal.

To ensure both firms supply positive amounts of output to the foreign market we must impose market participation constraints on the foreign and home country firms of the following form, respectively:

$$t > 2c\alpha - (a - c) \tag{28}$$

$$t < \frac{a - c + c\alpha}{2} \tag{29}$$

Alternatively, these constraints can be expressed in terms of the threshold values of the marginal cost differences between the foreign and home country firms as the functions of trade cost t, at which both firms make positive profits, respectively:

$$\alpha_f^{FDI} < \alpha_f^{EX} < \frac{(a - c) + t}{2c} \tag{28'}$$

$$\alpha_h^{EX} > \frac{2t - (a - c)}{c} \tag{29'}$$

The constraint for the indigenous firm implies that both higher trade costs and a larger market size allow for a bigger productivity difference between the foreign and home country firms, whereas a higher marginal cost of production requires a

lower productivity difference for the indigenous firm to stay in the foreign market after the entry of the home country firm to this market.

Moreover, it can also be noted that the threshold value of the productivity difference for the indigenous firm can be higher when the home country firm exports to the foreign market compared to the case when it enters this market via FDI. It is because the non-zero trade cost can at least partly compensate for the lower efficiency of the indigenous firm. From the constraint for the home country firm, we can infer that the threshold level of the marginal cost difference is positively related to trade cost as well as marginal production cost, while inversely related to the foreign market size.

If both participation constraints are met, then both firms supply positive amounts of output to the foreign market. Hence, the total equilibrium level of output supplied to the foreign market when the home country firm enters it via exporting equals:

$$x^{EX} = x_f^{EX} + x_h^{EX} = \frac{2(a-c) - c\alpha - t}{3} < x^{FDI} \tag{30}$$

It can be noted that the equilibrium total output supplied to the foreign market when the home country firm exports is smaller compared to the FDI equilibrium output (15) due to the technical inefficiency associated with the existence of the trade cost.

The equilibrium price in the foreign market can be determined by substituting the sum of output (30) into the inverse demand function (2) which yields:

$$\pi_f^{EX} = \left(\frac{a - c - 2c\alpha + t}{3} \right)^2 = \left[x_f^{EX} \right]^2 \tag{31}$$

It can be noted that the price in the non-cooperative exporting equilibrium is always higher compared to the non-cooperative FDI equilibrium due to the technical inefficiency associated with the existence of the trade cost.

Using our solutions for the equilibrium quantities (26) – (27) and the equilibrium price (31) we can determine the equilibrium profits for the foreign and home country firms, respectively:

$$\pi_f^{EX} = \left(\frac{a - c - 2c\alpha + t}{3} \right)^2 = \left[x_f^{EX} \right]^2 \tag{32}$$

$$\pi_h^{EX} = \left(\frac{a - c + c\alpha - 2t}{3} \right)^2 = \left[x_h^{EX} \right]^2 \tag{33}$$

The indigenous firm's profit is higher when the home country firm exports compared to the situation when it enters the foreign market via FDI for two reasons: i) the home country firm's larger sales, and ii) a higher equilibrium price.

Hence, for the indigenous firm $\pi_f^{EX} > \pi_f^{FDI}$ is always satisfied.

However, such a simple generalization cannot be made for the home country firm. Although for this firm the operating profit associated with FDI is higher than the exporting profit, the fixed sunk cost of investment (F) can make the home country firm's overall profit from 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 home country firm depends on the interplay between the trade and investment costs (t and F). This 'proximity-concentration' tradeoff will be studied in the next section. However, prior to this we consider also the case when the home country firm becomes an exporting monopolist in the foreign market.

Exporting monopoly

If the market participation constraint for the indigenous firm (28) is not satisfied, i.e. $t < 2c\alpha - (a - c)$, then the home country firm may become an exporting monopolist. In this case, the profit function of the home country firm can be written as:

$$\pi_h^{M-EX} = [a - x_h^{M-EX}]x_h^{M-EX} - (c + t)x_h^{M-EX} \tag{34}$$

Using the first order conditions, we can obtain the exporting monopoly equilibrium level of output supplied by the home country firm to the foreign market:

$$x_h^{M-EX} = \frac{a - c - t}{2} \tag{35}$$

The home country firm enters the foreign market via exporting only if its output sold in this market is positive which implies the following participation constraint:

$$t < a - c \tag{36}$$

If the participation constraint is met, the exporting equilibrium monopoly price in the foreign market can be determined by substituting the exporting monopoly equilibrium output of the home country firm (35) into the inverse demand function (2) which yields:

$$p_h^{M-EX} = \frac{a + c + t}{2} \tag{37}$$

Substituting equilibrium solutions for output (35) and price (37) into the profit function (34) yields the home country firm equilibrium monopoly profit from exporting:

$$\pi_h^{M-EX} = \left(\frac{a-c-t}{2}\right)^2 = \left[x_h^{M-EX}\right]^2 \tag{38}$$

4. Proximity-Concentration Tradeoffs

In this section we discuss various proximity-concentration trade-offs facing the home country firm. First, we start a discussion of the trade-off between FDI and exporting under duopoly, then we discuss the trade-off between FDI monopoly and exporting duopoly, and finally the trade-off between FDI monopoly and exporting monopoly for the home country firm.

Tradeoff between FDI duopoly and exporting duopoly

To analyze the tradeoff between FDI duopoly and exporting duopoly we compare profits of the home country firm from FDI duopoly (18) and exporting duopoly (33). The profits of the home country firm from exporting duopoly and FDI duopoly are equal when:

$$F = \frac{4t(a-c+c\alpha)-4t^2}{9} \tag{39}$$

If F is bigger (smaller) than the threshold value then exporting (FDI) is the preferred entry strategy for the home country firm.

Alternatively, a threshold value for the marginal cost difference at which the home country firm is indifferent between exporting and FDI can be calculated. This value equals:

$$\alpha_h^{EX=FDI} = \frac{t-(a-c)}{c} + \frac{9F}{4tc} \tag{39'}$$

For the marginal cost difference above (below) this threshold the home country firm prefers to enter the foreign country market via FDI (exporting). Moreover, FDI can always be preferred to exporting for certain combinations of model parameters such as the high trade cost and the low fixed cost of investment, regardless of the marginal cost differences between the foreign and home country firms. Similarly, exporting can always be preferred to FDI for certain combinations of model parameters such as the low trade cost and the high fixed cost of investment, regardless of the marginal cost differences between firms.

Tradeoff between FDI monopoly and exporting duopoly

To analyze the tradeoff between FDI monopoly and exporting duopoly we compare profits of home country firm from FDI monopoly (22) and exporting duopoly (33). The profits of the home country firm from FDI monopoly and exporting duopoly are equal when:

$$F = \frac{4t(a-c+c\alpha) - 4t^2 - 2(a-c)c\alpha - c^2\alpha^2 + 5\left(\frac{a-c}{2}\right)^2}{9} \tag{40}$$

If the fixed sunk cost of investment F is bigger (smaller) than the threshold value then exporting (FDI) is the preferred entry strategy for the home country firm.

Alternatively, a threshold value for the marginal cost differential at which the home country firm is indifferent between exporting and FDI can be calculated. This value equals:

$$\alpha_h^{EX=FDI} = \frac{-2(a-c-2t) + 3\sqrt{(a-c)^2 - 4F}}{2c} \tag{40'}$$

For the marginal cost difference above (below) this threshold the home country firm prefers to enter the foreign market via FDI (exporting). Moreover, FDI can always be preferred to exporting for certain combinations of model parameters such as the high trade cost and the low fixed cost of investment, regardless of the marginal cost differences between the firms. 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, regardless of the marginal cost differences between the firms.

Tradeoff between FDI monopoly and exporting monopoly

To study the tradeoff between FDI monopoly and exporting monopoly we compare profits of the home country firm for FDI monopoly (22) and exporting monopoly (38). The profits of the home country firm from FDI monopoly and exporting monopoly are equal when:

$$F = \frac{2(a-c)t - t^2}{4} \tag{41}$$

If the fixed sunk cost of investment *F* is bigger (smaller) than the threshold value the home country firm prefers exporting (FDI) monopoly to FDI (exporting) monopoly. It can be noted that in this case the marginal cost difference does not play any role in determination of the threshold value of the fixed cost of investment

as the indigenous firm is not present in the market and the home country firm does not have to compete with it.

5. Possible Equilibria

In this model five possible equilibria can be identified depending on various combinations of the model parameters: a closed-economy monopoly equilibrium with an indigenous firm being the monopolist, an open-economy FDI duopoly equilibrium, an open-economy FDI monopoly equilibrium with the home country firm being the monopolist, an open-economy exporting duopoly equilibrium and an open-economy exporting monopoly equilibrium with the home country firm being the monopolist. First, we consider the closed economy benchmark case where the firm from the home country does not enter the foreign country market neither via FDI nor via exporting and the indigenous firm continues to be a monopolist.

Incumbent monopoly equilibrium

The incumbent monopoly equilibrium occurs in two cases when the home country firm decides not to enter the foreign market neither via FDI nor via exporting. In the first case, when the productivity difference between the foreign and home country firms is small, i.e. $\alpha \in \left[0, \frac{a-c}{2c}\right)$, the duopoly participation constraints for the indigenous firm are satisfied and it is able to compete with the home country firm when it enters either via FDI or via exporting. Therefore, in order to prevent the entry of the home country firm both the fixed sunk cost of investment and the trade cost must be prohibitively high so that duopoly profits from both FDI and exporting are negative. In other words, participation constraints (14) and (29) for the home country firm are not satisfied, i.e. $F > \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t > \frac{a-c+c\alpha}{2}$, respectively.

In the second case, when the productivity difference between the foreign and home country firms is large, i.e. $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, the indigenous firm is able to compete with the home country firm only if it enters the foreign market via exporting. Therefore, the home country firm will not enter the foreign market if the

monopoly profit from FDI and duopoly profit from exporting are negative. This implies that participation constraints (23) and (29) for the home country firm are not satisfied, i.e. $F > \left(\frac{a-c}{2}\right)^2$ and $t > \frac{a-c+c\alpha}{2}$, respectively. Our findings can be summarized in the following result:

RESULT 1. *The incumbent monopoly equilibrium occurs when: i)* $\alpha \in \left[0, \frac{a-c}{2c}\right)$, $F > \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t > \frac{a-c+c\alpha}{2}$, and *ii)* $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, $F > \left(\frac{a-c}{2}\right)^2$ and $t > \frac{a-c+c\alpha}{2}$.

FDI duopoly equilibrium

FDI duopoly equilibrium occurs only in two cases when the productivity difference between the foreign and home country firms is small, i.e. $\alpha \in \left[0, \frac{a-c}{2c}\right)$, and the duopoly participation constraints for the indigenous firm are satisfied so it is able to compete with the home country firm irrespectively of its entry strategy. In the first case, the home country firm can enter the foreign market either via FDI or via exporting. Hence, both participation constraints (14) and (29) are satisfied, i.e. $F < \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t < \frac{a-c+c\alpha}{2}$. Moreover, we need to ensure that the profit from duopoly FDI is higher than the profit from duopoly exporting for the home country firm. This means that the fixed sunk cost of investment must be low compared to the cost of exporting, i.e. it must be below its threshold value (39): $F < \frac{4}{9}t(a-c+c\alpha-t)$.

In the second case, FDI duopoly equilibrium occurs when the participation constraint for FDI (14) is satisfied and the participation constraint for exporting (29) is not satisfied, i.e. $F < \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t > \frac{a-c+c\alpha}{2}$, respectively. Hence, in the second case there is no trade-off between FDI and exporting, and FDI is the only foreign market entry option for the home country firm. Our findings can be summarized in the following result:

RESULT 2. The FDI duopoly equilibrium occurs when: i) $\alpha \in \left[0, \frac{a-c}{2c}\right)$, $F < \left(\frac{a-c+c\alpha}{3}\right)^2$, $t < \frac{a-c+c\alpha}{2}$ and $F < \frac{4}{9}t(a-c+c\alpha-t)$, and *ii)* $\alpha \in \left[0, \frac{a-c}{2c}\right)$, $F < \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t > \frac{a-c+c\alpha}{2}$.

FDI monopoly equilibrium

The FDI monopoly equilibrium occurs in the following three cases. In the first case when the productivity difference between the foreign and home country firms is large, i.e. $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, the indigenous firm is able to compete with the home country firm only if it enters the foreign market via exporting and the trade cost is sufficiently high. The indigenous firm survives in this market if the participation constraint (28) is satisfied, i.e. $t > 2c\alpha - (a-c)$, while the home country firm can choose between entering the foreign market via exporting, if the participation constraint (29) is satisfied, and via FDI, if the participation constraint (23) is satisfied. In this case, the profit from FDI monopoly must be higher than the profit from exporting duopoly for the home country firm. This means that the fixed sunk cost of investment must be relatively low compared to the cost of exporting, i.e. it must be below its threshold value (40).

In the second case when the productivity difference between the foreign and home country firms is very large that the indigenous firm exits the foreign market, i.e. $\alpha \geq \frac{a-c}{c}$, the home country firm can choose between entering the foreign market via exporting and via FDI, if the participation constraints (36) and (23) are satisfied. In this case, the FDI monopoly equilibrium occurs when the profit from FDI monopoly is higher than the profit from exporting monopoly for the home country firm. This corresponds to the situation when the fixed sunk cost of investment is lower than the threshold value (41).

Finally, in the third case the FDI monopoly equilibrium occurs when the indigenous firm exits the foreign market, i.e. $\alpha \geq \frac{a-c}{c}$, and the home country firm can enter the foreign market only via FDI. This means that the participation constraint (36) is not satisfied while (23) is satisfied. In the last case there is no trade-off between exporting and FDI as FDI is always preferred to exporting. Our findings can be summarized in the following result:

RESULT 3. The FDI monopoly equilibrium occurs when: i) $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, $F < \left(\frac{a-c}{2}\right)^2$, $2c\alpha - (a-c) < t < \frac{a-c+c\alpha}{2}$ and $F < F = \frac{4t(a-c+c\alpha) - 4t^2 - 2(a-c)c\alpha - c^2\alpha^2 + 5\left(\frac{a-c}{2}\right)^2}{9}$, *ii)* $\alpha \geq \frac{a-c}{c}$, $F < \left(\frac{a-c}{2}\right)^2, t < a-c$ and $F < \frac{2(a-c)t - t^2}{4}$, and *iii)* $\alpha \geq \frac{a-c}{c}, F < \left(\frac{a-c}{2}\right)^2$, and $t > a-c$.

Exporting duopoly equilibrium

Exporting duopoly equilibrium occurs in three cases. The first two cases occur when the productivity difference between the foreign and home country firms is small, i.e. $\alpha \in \left[0, \frac{a-c}{2c}\right)$, and the duopoly participation constraints for the indigenous firm (12) and (28) are satisfied so it is able to compete with the home country firm irrespectively of its entry strategy.

In the first case, the home country firm can enter the foreign market either via FDI or via exporting. Hence, both participation constraints (14) and (29) are satisfied, i.e. $F < \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t < \frac{a-c+c\alpha}{2}$, respectively. Moreover, we need to ensure that the profit from exporting duopoly is higher than the profit from FDI duopoly for the home country firm. This means that the fixed sunk cost of investment must be low compared to the cost of exporting, i.e. it must be above its threshold value (39): $F > \frac{4}{9}t(a-c+c\alpha-t)$.

In the second case, FDI duopoly equilibrium occurs when the participation constraint for FDI (14) is not satisfied while the participation constraint for exporting (29) is satisfied, i.e. $F > \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t < \frac{a-c+c\alpha}{2}$, respectively. Hence, in this case there is no trade-off between FDI and exporting as exporting is the only viable foreign market entry option.

Finally, in the third case exporting duopoly equilibrium occurs when the productivity difference between the foreign and home country firms is large,

i.e. $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, and the indigenous firm is able to compete only when the home country firm enters the foreign market via exporting and the tariff is sufficiently high so that the participation constraint (28) for the indigenous firm is satisfied i.e. $t > 2c\alpha - (a-c)$. For the home country firm both the participation constraint for FDI monopoly (23), i.e. $F < \left(\frac{a-c}{2}\right)^2$ and the participation for the exporting duopoly (29), i.e. $t < \frac{a-c+c\alpha}{2}$ must be satisfied. In addition, the profit from exporting duopoly must be higher than the profit from FDI monopoly for the home country firm which implies that the cost of investment must be relatively high compared to the trade cost and above the threshold level (40), i.e. $F > F = \frac{4t(a-c+c\alpha) - 4t^2 - 2(a-c)c\alpha - c^2\alpha^2 + 5\left(\frac{a-c}{2}\right)^2}{9}$. Our findings can be summarized in the following result:

RESULT 4. The exporting duopoly equilibrium occurs when: i) $\alpha \in \left[0, \frac{a-c}{2c}\right)$, $F < \left(\frac{a-c+c\alpha}{3}\right)^2$, $t < \frac{a-c+c\alpha}{2}$ and $F > \frac{4}{9}t(a-c+c\alpha-t)$, *ii)* $\alpha \in \left[0, \frac{a-c}{2c}\right)$, $F > \left(\frac{a-c+c\alpha}{3}\right)^2$ and $t < \frac{a-c+c\alpha}{2}$, and *iii)* $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, $F < \left(\frac{a-c}{2}\right)^2$, $2c\alpha - (a-c) < t < \frac{a-c+c\alpha}{2}$, and $F > F = \frac{4t(a-c+c\alpha) - 4t^2 - 2(a-c)c\alpha - c^2\alpha^2 + 5\left(\frac{a-c}{2}\right)^2}{9}$.

Exporting monopoly equilibrium

The exporting monopoly equilibrium occurs in three cases. In the first case when the productivity difference between the foreign and home country firms is large, i.e. $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, the indigenous firm is unable to compete with the home

country firm when it enters the foreign market via exporting if the tariff is too low and the participation constraint (28) for the indigenous firm is not satisfied i.e. $t < 2c\alpha - (a - c)$. For the home country firm both the participation constraint for FDI monopoly (23), i.e. $F < \left(\frac{a-c}{2}\right)^2$ and the participation for the exporting monopoly (36), i.e. $t < a - c$ must be satisfied. However, if (28) is not satisfied (36) is satisfied as (28) encompasses (36). Moreover, the profit from exporting monopoly must be higher than the profit from FDI monopoly which implies that the fixed sunk cost of investment must be relatively high compared to the trade cost and above the threshold level (41), i.e. $F > \frac{2(a-c)t - t^2}{4}$.

In the second case, if the productivity difference between the foreign and home country firms is very large so the indigenous firm exits the foreign market, i.e. $\alpha \geq \frac{a-c}{c}$, the home country firm can choose between entering the foreign market via exporting and via FDI if the participation constraints (23) and (36) are satisfied, i.e. $F < \left(\frac{a-c}{2}\right)^2$ and $t < a - c$, respectively. The exporting monopoly equilibrium occurs when the profit from FDI monopoly is lower than the profit from exporting monopoly for the home country firm. This corresponds to the situation when the fixed sunk cost of investment is higher than the threshold value (41), i.e. $F > \frac{2(a-c)t - t^2}{4}$.

Finally, in the third case the exporting monopoly equilibrium occurs when the indigenous firm exits the foreign market, i.e. $\alpha \geq \frac{a-c}{c}$, and the home country firm can enter the foreign market only via exporting. This means that the participation constraint (36) is satisfied, i.e. $t < a - c$, while (23) is not satisfied, i.e. $F > \left(\frac{a-c}{2}\right)^2$. In this case there is no trade-off between exporting and FDI as exporting is always preferred to FDI. Our findings can be summarized in the following result:

RESULT 5. The exporting monopoly equilibrium occurs when: i) $\alpha \in \left[\frac{a-c}{2c}, \frac{a-c}{c}\right)$, $F < \left(\frac{a-c}{2}\right)^2$, $t < 2c\alpha - (a-c)$ and $F > \frac{2(a-c)t - t^2}{4}$,

ii) $\alpha \geq \frac{a-c}{c}$, $F < \left(\frac{a-c}{2}\right)^2$, $t < a-c$ and $F > \frac{2(a-c)t - t^2}{4}$, and

iii) $\alpha \geq \frac{a-c}{c}$, $F > \left(\frac{a-c}{2}\right)^2$ and $t < a-c$.

6. Conclusion

In this paper we studied how productivity differences between foreign and home country firms affected the proximity-concentration trade-off in two imperfectly competitive frameworks: the Cournot duopoly and its extreme cases – the monopoly that occurred when one of the competing firms was driven out of the market. First, we identified the conditions necessary for exporting and FDI, depending on the competing firms' marginal cost differences as well as the trade cost and the cost of foreign investment. Then, we demonstrated the existence of different equilibria under different economic regimes. In particular, it was shown that, depending on various combinations of key parameters of the model, the following five possible equilibria might emerge: an incumbent monopoly equilibrium, a FDI duopoly equilibrium, a FDI monopoly equilibrium, an exporting duopoly equilibrium and an exporting monopoly equilibrium.

Two non-degenerate duopoly equilibria when both foreign and home country firms are active in the foreign market emerge when productivity differences between the firms are small, and trade and investment costs are relatively low which allows both firms to survive in the market. However, when the productivity differences between the firms are large or trade and investment costs for the home country firm are prohibitively high we obtain a degenerate case of the model when either an indigenous or a home country firm becomes a monopolist in a foreign market.

It must be remembered, however, that the theoretical framework employed in this paper was based on very specific assumptions. In particular, following the previous industrial organization literature, it was assumed for simplicity that the demand function was linear. Therefore, in future studies it would be desirable to investigate whether and how the theoretical findings reported in this paper can be generalized to other demand functions. In particular, it would be very useful to consider also as iso-elastic demand function derived from CES utility that is frequently used in the theoretical trade literature. Finally, in this paper we did not

study the antitrust policy and welfare implications of particular equilibria that could also be considered in future theoretical studies.

References

Aw B., Chung S., Roberts M. (1998), *Productivity and the decision to export: microevidence from Taiwan and South Korea.* NBER Working Paper No. 6658. Available at: http://www.nber.org/papers/w6558.pdf.

Barba Navaretti G., Venables A. (2004), *Multinational Firms in the World Economy. Princeton*: Princeton University Press.

Bernard A., Jensen J.B. (1999), "Exceptional export performance: cause effect or both?", *Journal of International Economics* vol. 47, No. 1, pp. 1–25.

Bernard A., Eaton J., Jensen J.B., Kortum S. (2003), "Plants and productivity in international trade", *American Economic Review* vol. 93, No. 4, pp. 1268–1290.

Bernard A., Jensen J.B., Redding S.J., Schott P.K. (2007), "Firms in international trade", *Journal of Economic Perspectives* vol. 21, No. 3, pp. 105–130.

Brander J.A. (1981). "Intra-industry trade in identical commodities", *Journal of International Economics* vol.11, No. 1, pp 1–14.

Brander J.A., Krugman P. (1983), "A 'reciprocal dumping' model of international trade", *Journal of International Economics* vol.15, *pp.313–321.*

Caves R. (2007), *Multinational Enterprise and Economic Analysis,* 3rd ed., Cambridge: Cambridge University Press.

Clerides S.K., Lach S., Tybout J.R. (1998), "Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico and Morocco", *Quarterly Journal of Economics* vol. 113, No. 3, pp. 903–948.

Cieślik A. (2015), *Export versus FDI in Cournot duopoly framework,* Institute of Economic Research Working Paper 11/2015.

Cieślik A., Ryan M. (2009), "Firm heterogeneity, foreign market entry mode and ownership choice", *Japan and the World Economy* vol. 21, No. 3, pp. 213–218.

Cieślik A., Ryan M. (2012), "Productivity differences and foreign market entry in an oligopolistic Industry", *Open Economies Review* vol. 23, No. 3, pp. 531–557.

Copithorne L. (1971), "International corporate transfer prices and government policy", *Canadian Journal of Economics* vol. 4, No. 3, pp. 324–341.

De Backer K., Sleuwagen L. (2003), "Does foreign direct investment crowd out domestic entrepreneurship?", *Review of Industrial Organization* vol. 22, No. 1, pp. 67–84.

Doms M.E., Jensen J.B. (1998), *Comparing wages skills and productivity between domestically and foreign owned manufacturing establishments in the United States.* In: Baldwin R., Lipsey R., Richardson J.D. (eds.), *Geography and Ownership as Basis for Economic Accounting*, Chicago: University of Chicago Press.

Eaton J., Kortum S. (2002), "Technology, geography and trade", *Econometrica* vol. 70, No. 5, pp. 1741–1779.
Grossman G., Helpman E. (2004), "Managerial incentives and the international organization of production", *Journal of International Economics* vol. 63, No. 2, pp. 237–262.
Helpman E., Melitz M., Yeaple S. (2004), "Export versus FDI with heterogeneous firms", *American Economic Review* vol. 94, No. 1, pp. 300–316.
Helpman E. (2006), "Trade, FDI and the organization of firms", *Journal of Economic Literature* vol. 44, No. 3, pp. 589–630.
Hirsch S. (1976), "An international trade and investment theory of the firm", *Oxford Economic Papers* vol. 28, No. 2, pp. 258–269.
Horst T. (1971), "The theory of the multinational firm: optimal behavior under different tariff and tax rules", *Journal of Political Economy* vol. 79, No. 5, pp. 1059–1072.
Krugman P. (1980), "Scale Economies, product differentiation and the pattern of trade", *American Economic Review* vol. 70, No. 5, pp. 950–959.
Markusen J. (2002), *Multinational Firms and the Theory of International Trade,* Cambridge, MA: MIT Press.
Melitz M. (2003), "The impact of trade on intra-industry reallocations and aggregate industry productivity", *Econometrica* vol. 71, No. 6, pp. 1695–1725.
Neary P.J. (2008), *Trade Costs and Foreign Direct Investment.* In: Brakman S., Garretsen H. (eds.), *Foreign Direct Investment and the Multinational Enterprise,* Cambridge, MA: MIT Press.
Pffaffermayer M., Bellak C. (2002), *Why Foreign-Owned are Different: A Conceptual Framework and Empirical Evidence for Austria.* In: Jungnickel R. (ed.), *Foreign-Owned Firms: Are They Different?*, Houndsmill: Palgrave-MacMillan.