

The FDI Chain: From Host to Parent

A partial equilibrium approach

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Abstract

For developed countries, it is commonly observed that the pattern of Foreign Direct Investment (FDI) varies over time. In particular, the ratio of inward to outward FDI stocks initially rises and then declines. In the long run, these stocks tend to balance. In this paper we examine the process by which developed countries experiencing significant economic growth ultimately balance their roles as both hosts for and sources of FDI. The nature of this process is demonstrated using a 3-country partial-equilibrium framework with asymmetric marginal costs, growth, and productivity spillovers to domestic firms from multinationals. FDI emerges as an alternative to exporting when trade costs become high. We demonstrate that this framework explains the various stages of the 'FDI Chain'. The existence of productivity spillovers is shown to be a necessary condition for inward and outward FDI stocks to balance. This result has important empirical implications. Among other things, it suggests that the ratio of inward to outward FDI is a suitable proxy for productivity spillovers in empirical testing.

1. Introduction

Foreign Direct Investment is one of the most dynamic phenomena in the recent wave of globalisation. Between 1980 and 2000 more than 60% of the world stock of inward FDI was held by industrialized countries (UNCTAD, 2002). During the same period the phenomenon has expanded dramatically in terms of number of transactions but also in geographical spread.

Empirical investigations explored the relationship between a host country's inward stocks of FDI and a variety of its economic and political characteristics. The results of these empirical analyses have produced a rough consensus concerning the determinants of FDI. For example, the UN Economic Commission of Europe's *Economic Survey of Europe* (2001) states there is a general agreement that the following characteristics are associated with larger flows of FDI: macroeconomic and political stability, developed infrastructure, good legal system and law enforcement, availability of skilled labor, foreign sector liberalization, location and country (market) size, and natural endowment ¹.

Recent work has considered two important extensions to the literature. First, a desire to analyse more complex integration strategies has initiated a departure from two-country models, with increased emphasis placed on the role of endowments as well as trade and investment costs in the rest of the world. Yeaple (2002), Ekholm *et al.* (2003), Grossman *et al.* (2003) and Egger *et al.* (2004) set-up three-country models of trade and ‘complex’ multinational enterprises. Third-country effects are important since the average country pair is relatively small as compared to the rest of the world². A second approach, in the same line of research, seeks to explain FDI flows with reference to both host and parent country characteristics. The evolution of hypotheses tested from a spatial point of view becomes obvious. Initially, attempts to explain FDI flows concentrated exclusively on the host country. More recently these analyses have been extended to look at parent country characteristics and third country effects as well. The modelling of ‘systems’ of countries interacting prevails in recent work.

This paper goes a step further in investigating the distribution of FDI stocks. We use the framework of recent extensions in the literature to formalise the stages that every country goes through before it becomes completely integrated in the global FDI network. In our view, every country incorporates both roles of FDI parent and host. A simple analysis of national-level FDI stocks reveals clear phases in the relative strength of these roles before a balance (or a ‘steady equilibrium’) is reached (see Appendix A). Some countries do not attract large investment flows; some do attract FDI but do not have large investment stocks abroad; some have recently increased their FDI stocks abroad; finally, some countries have a similar volume of inward and outward stocks.

The data analysed reveal four stages in a country’s metamorphosis from a net FDI ‘importer’ to FDI ‘exporter’. We term this 4-stage transformation the ‘FDI Chain’. In the first stage, a country is relatively not attractive to foreign investors; We observe low inward FDI stocks compared to GDP and very low outward relative to inward FDI stocks. As the country’s economy grows (second stage), its role as an FDI host strengthens. While it now attracts inward FDI stocks, its domestic firms are not yet to invest abroad. In the second stage, we observe increasing inward FDI stocks and an increased ratio of inward to outward FDI. In the third stage the country begins to metamorphose into an FDI Parent – i.e. a source of FDI. While it continues to attract FDI, domestic firms are now capable of investing abroad as well. Increasing outward FDI stocks and a decreasing ratio of inward to outward FDI (outward stocks increasing faster than inward stocks) characterise this stage. In the fourth and last phase, one observes the balancing of a country’s roles as FDI parent and host. The volume, as well as the speed of adjustment, of inward and outward stocks converges. The aim of this paper is to provide an explanation for this observed ‘FDI Chain’.

The apparent existence of a sequence of phases countries go through suggests a number of issues that have yet to be addressed in the literature. 'Does being a strong host prepare a country's firms for becoming parent firms?'; 'What is the role of spillovers in the integration process?'; 'Does this integration process itself indicate spillovers?'. In this paper, interpretations of the evidence focus on the transition from the second to the third stage of the process, which seems the most difficult to explain. A country's transition from the first to the second stage corresponds essentially to an increase of its attraction to foreign investors, the determinants of which have been analysed and tested extensively by the existing literature.

The general hypothesis we introduce about the process generating the 4-stages of the 'FDI Chain' is the following: Initially, a country's industry is controlled by small domestic firms, with lower productivity than abroad. They cannot afford foreign expansion, and thus only serve the domestic market. If the market experiences unusually high growth, foreign firms serving the domestic market through exports seek to produce inside the country or acquire domestic firms, in order to replace increasing total transportation costs with the fixed cost of producing domestically. With higher productivity the cost of production of foreign investors is lower, thus their profit margins are higher. More FDI is placed in the country especially if the industry is growing (Stage 2). This happens at the expense of domestic firms. Competition is enhanced; the price of final goods falls reducing the profit margins of all firms. Consequently, the speed and volume of foreign entry declines.

At the conclusion of stage 2 domestic firms are likely to have less market share than previously because of increased competition, thus less likely to engage in FDI projects abroad. Nevertheless, domestic firms can gradually benefit from knowledge-technology spillovers which result in a reduction of the productivity gap between themselves and foreign firms. The increased productivity of the domestic firms induces outward FDI activity to the rest of the world, which will be more intense to countries hosting firms with productivity disadvantages. Outward stocks are expected to increase with unusually high pace; thus the country moves to stage 3.

Lastly, since one country's outward FDI is another country's inward FDI, by symmetry it is natural to expect that the same factors leading to a steady volume and growth of inward stocks in a host country are expected to lead to steady volume and growth of its outward stocks, after it strengthens its role as a parent of FDI. This leads to a balancing of stage 4 of the Chain.

In the rest of the paper we develop a simple partial-equilibrium model where FDI emerges as an alternative to exporting when trade costs become high. Distinguishable features of the model are the introduction of a third country, asymmetric marginal costs, growth, and productivity spillovers to domestic firms from multinationals. We show that growth by itself is not

sufficient in explaining the different stages of the FDI Chain. The existence of productivity spillovers is shown to be a necessary condition for inward and outward FDI stocks to balance. The implications of this result and conclusions are left for the last section.

2. A static model of FDI

2.1. General Framework

In order to explain the main driving forces of the 'FDI Chain' we use a simple partial equilibrium framework to model trade and investment. Three countries trade one homogeneous good. Each country is home to one firm. This firm's production plants may be located locally or abroad. 'Home country' is the location of its headquarters.

Each market is served by both domestic and foreign firms. Firms can serve foreign markets by exporting to, or setting up production facilities in the host country, that is undertaking FDI. A profit maximising firm will not simultaneously produce in and export to the same market; if one of the options is more profitable then the total output sold in the foreign market will be exported or produced within the foreign country.

Each firm sinks cost F to establish its headquarters and a production plant at home. A fixed cost $G < F$ is incurred for each production plant established abroad. Both F and G are invariant to the location of the firm's headquarters. Furthermore, each firm faces a constant marginal cost of production c_i , and a transportation cost τ per unit exported. While marginal cost varies with firms' nationality, transportation costs do not. Hence, firms headquartered in countries with relatively low marginal cost will *ceteris paribus* be able to sell their output more cheaply worldwide. Note also that marginal cost depends only on nationality, not on the location of production. Firms thus carry their technology with them to those countries where they establish production plants. Consequently, it is not profitable for firms to ship back their foreign-produced output to home - vertical FDI is not considered in this paper.

This framework allows potentially for four types of firms: those which export to both foreign markets, those which produce in both foreign markets, and those which export to one foreign market and produce in the other.

We consider a perfect information 2-stage game. In the first stage, each firm decides on the location of its production, i.e chooses among the 4 types of production mentioned above. Considering that only 3 firms exist in the world (one in each country), this first stage can yield 12 possible combinations of production structures for the world. In the second stage firms are assumed to compete in Cournot terms in all three countries. Taking as given the output

choices of its foreign competitors, each firm chooses how much to produce in the domestic and foreign markets in order to maximize profits. The game is solved backwards for a subgame perfect Nash equilibrium.

2.2. Stage 2: Cournot Equilibrium

Inverse demand for the homogeneous good in country i is given by the linear function

$$p_i = \alpha_i - Y_i \quad i = 1, 2, 3 \quad (1)$$

where p_i represents the price of the good in i , when Y_i units are sold in i . Parameter α_i will be interpreted as a measure of the size of the market in i . In equilibrium total demand equals total supply in each country. Total supply in market j , equals the sum of individual firm outputs, y_{ij} , produced by firms headquartered in each of the three countries i , and sold in j

$$Y_j = \sum_{i=1}^3 y_{ij} \quad (2)$$

Marginal cost of production of each firm is assumed to be constant and independent of its total output; consequently, markets are assumed to be segmented and can be considered separately in solving the profit-maximisation problem of the firm. Total profits π_i for a firm headquartered in country i can be written as the sum of profits the firm earns from sales in each market j , π_{ij}

$$\pi_{ij} = (p_j - c_i - I_{ij}(E) \cdot \tau) y_{ij} - I_{ij}(M) \cdot G - F \quad (3)$$

$$\pi_i = \sum_{j=1}^3 \pi_{ij} = \sum_{j=1}^3 (p_j - c_i - I_{ij}(E) \cdot \tau) y_{ij} - \sum_{\substack{j=1 \\ j \neq i}}^3 I_{ij}(M) \cdot G - F \quad (4)$$

where c_j denotes the constant marginal cost of production for a firm headquartered in j ; τ denotes the per unit transportation cost the firm faces when exporting; $I_{ij}(E)$ is an indicator function which takes the value of 1 if the firm headquartered in i exports to country j and 0 otherwise; $I_{ij}(M)$ is an indicator function which takes the value of 1 if the firm from i manufactures in country j (i.e. undertakes FDI in j) and 0 otherwise. For example, a firm headquartered in country 1, undertaking FDI in 2, and exporting in 3 will face the following profit function

$$\pi_1 = (p_1 - c_1)y_{11} + (p_2 - c_1)y_{12} + (p_3 - c_1 - \tau)y_{13} - F - G \quad (5)$$

Note the subscripts of the indicator functions in (4): actions taken in j by one of the three firms, headquartered in the country i alter equilibrium outputs and profits of *all* firms in country j .

From (3), we derive the first order conditions for profit-maximisation³ for a firm headquartered in i and selling in j

$$\frac{\partial \pi_{ij}}{\partial y_{ij}} = p_j - (c_i + I_{ij}(E) \cdot \tau) + \frac{\partial p_j}{\partial Y_j} y_{ij} = (\alpha_j - Y_j) - (c_i + I_{ij}(E) \cdot \tau) - y_{ij} = 0 \quad (6)$$

$i, j = 1, 2, 3$

Solving simultaneously the nine-equation system (6) yields equilibrium outputs, market prices, and profits of each firm in terms of exogenous parameters (sizes of markets, marginal, fixed, and transportation costs).

Equilibrium output from a firm headquartered in i , sold in market j is given by the following general formula

$$y_{ij} = \frac{1}{4} \left(\alpha_j - 3c_i + \sum_{\substack{k=1 \\ k \neq i}}^3 c_k + 2\tau - I_{ij}(E) \cdot 4\tau - \sum_{\substack{k=1 \\ k \neq i}}^3 I_{kj}(M) \cdot \tau \right) \quad (7)$$

Given the outputs of all firms in j , the inverse demand function (1) yields the equilibrium price in the market

$$p_j = \frac{1}{4} \left(\alpha_j + \sum_{k=1}^3 c_k + 2\tau - \sum_{\substack{k=1 \\ k \neq j}}^3 I_{kj}(M) \cdot \tau \right) \quad (8)$$

For example, if there is no FDI between the three countries, equilibrium outputs and price in country 2 are given by

$$y_{12} = \frac{1}{4} (\alpha_2 - 3c_1 + (c_2 + c_3) - 2\tau) \quad (9)$$

$$y_{22} = \frac{1}{4} (\alpha_2 - 3c_2 + (c_1 + c_3) + 2\tau) \quad (10)$$

$$y_{32} = \frac{1}{4} (\alpha_2 - 3c_3 + (c_1 + c_2) - 2\tau) \quad (11)$$

$$p_2 = \frac{1}{4} (\alpha_2 + c_1 + c_2 + c_3 + 2\tau) \quad (12)$$

If there is FDI from country 1 to 2, and exports in all other directions, equilibrium outputs and price in country 2 will change to

$$y_{12} = \frac{1}{4}(\alpha_2 - 3c_1 + (c_2 + c_3) + \tau) \quad (13)$$

$$y_{22} = \frac{1}{4}(\alpha_2 - 3c_2 + (c_1 + c_3) + \tau) \quad (14)$$

$$y_{32} = \frac{1}{4}(\alpha_2 - 3c_3 + (c_1 + c_2) - 3\tau) \quad (15)$$

$$p_2 = \frac{1}{4}(\alpha_2 + c_1 + c_2 + c_3 + \tau) \quad (16)$$

Equilibrium output decreases with respect to the marginal cost of the firm producing it and increases with respect to the marginal cost of its competitors. Domestic output (i.e output produced by the firm headquartered inside the country where it is sold) increases with respect to transportation costs whereas equilibrium foreign outputs decrease. However, if a foreign firm decides to replace exports by setting up production in the country, then its equilibrium output will increase with respect to transportation costs.

Actions taken in the domestic country by one of the three firms alter equilibrium outputs and profits of all firms in the market. If a foreign firm decides to replace exports by FDI in the country then its own output increases by $3\tau/4$, and its two competitors' outputs decrease by $\tau/4$. Consequently, total output in the market increases by $\tau/4$, the price of the good falls and consumer surplus increases. This reflects the fact that one of the market's distortions, transportation costs, has been removed.

2.3. Stage 1: Choosing the mode of foreign entry

In the first stage of the game firms choose where to produce their foreign-destined output. To do so, firms rank profits under the four available options on the location of production, namely profits if they (i) export to both foreign markets (ii) produce in both foreign markets, (iii-iv) export to one foreign market and produce in the other. Due to markets being segmented, the choice of whether or not to invest in one foreign country is independent to the mode of entry the same firm chooses for the other foreign country (see Appendix B). However, profits from output sold in a foreign market are not independent to the mode of entry the rest of the world chooses for the same foreign market (see equation 4). For example, profits of a firm from Country 1 from output sold in Country 2 are not independent to the mode of entry the firm from Country 3 chooses for the same market (Country 2). Therefore, in order to solve the first stage of the game for Nash Equilibrium we consider one payoff matrix for each market where payoffs of the two foreign firms

		Firm from k	
		Export in j	FDI in j
Firm from i	Export in j	$\pi_{ij}^{EE}, \pi_{kj}^{EE}$	$\pi_{ij}^{EM}, \pi_{kj}^{EM}$
	FDI in j	$\pi_{ij}^{ME}, \pi_{kj}^{ME}$	$\pi_{ij}^{MM}, \pi_{kj}^{MM}$

Figure 1

vary according to the mode of entry both choose for the same market.

In order to form the payoff matrix (see Figure 1), we introduce superscripts in profits π_{ij} given by equation (3) to distinguish the four versions the equation takes as the mode of entry of firms from i and k changes. The first letter of the superscript designates the mode of entry of the firm from i , and the second one from k . E denotes exports and M denotes FDI (see Figure 2). We form three such matrices and solve for three Nash Equilibria, one for each country in the world.

In order to solve for equilibrium we need to compare profits firms make under the two different choices for the location of production, taking as given the mode of entry the rest of the world chooses for the same market. The payoffs to each firm from selling in country j are largely symmetric ⁴; thus we focus on their differences which simplify the problem. We introduce two differences in profits from replacing exports with FDI in j (for a firm from country i) where the superscript denotes the mode of entry of the third

Profits of the firm headquartered in i from output sold in j

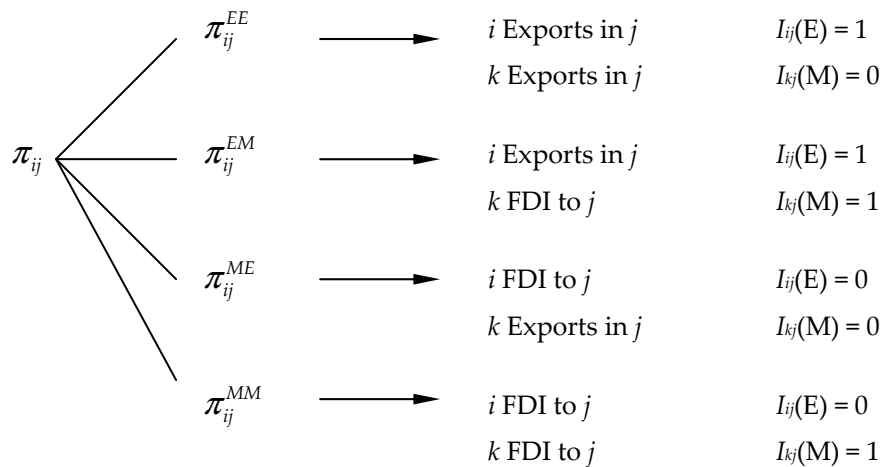


Figure 2

country firm

$$\Delta\pi_{ij}^E = \pi_{ij}^{ME} - \pi_{ij}^{EE} \quad (17)$$

$$\Delta\pi_{ij}^M = \pi_{ij}^{MM} - \pi_{ij}^{EM} \quad (18)$$

The interpretation of these differences is simple. If $\Delta\pi_{ij}^E$ is positive then it is more profitable for a firm from i to engage in FDI in j , given the choice of the firm from k to *export* to the same market. If $\Delta\pi_{ij}^M$ is positive then it is more profitable for a firm from i to engage in FDI in j , given the choice of the firm from k to *produce* in the same market. If both $\Delta\pi_{ij}^E$ and $\Delta\pi_{ij}^M$ are positive then engaging in FDI in country j is the dominant strategy for a firm from i .

The general formula for the difference in profits by replacing exports with FDI is given by ⁵

$$\Delta\pi_{ij} = -G + \frac{3\tau}{16} \left[2(\alpha_j - 3c_i + c_j + c_k - I_{kj}(M) \cdot \tau) - \tau \right] \quad (19)$$

The two differences given by equations (17) and (18) emerge as sub-cases of the general equation (19) for $I_{kj}(M) = 0$, and $I_{kj}(M) = 1$ respectively. Taking into account equation (7), we see that the factors affecting equilibrium outputs in the market (its size and marginal costs) have the same impact on the firm's profit difference by replacing exports with FDI ⁶.

According to the values of the exogenous parameters we solve for a Nash Equilibrium in each market using (19) for $i = 1,2,3$, $i \neq j$. For example, for the choice of both firms to export in j to be a Nash equilibrium it has to be that both $\Delta\pi_{ij}^E < 0$ and $\Delta\pi_{kj}^E < 0$ hold. We repeat the process for $j = 1,2,3$ and solve for three Nash Equilibria, one for each country in the world.

The static equilibria just described are not sufficient to provide evidence on the 'FDI Chain'. In our model we focus on one country j . The phenomenon we are trying to model implies that FDI undertaken in country j by a firm headquartered in a lower marginal cost country i , eventually leads to firms headquartered in j undertaking their own FDI. In order to find evidence on this process we need to introduce a dynamic setting which will help explore how the equilibrium choices of firms from j as well as i evolve as the exogenous parameters of the model change over time.

3. Introducing Dynamics

In this section we focus on two of the main parameters of the model; the size of each market α_i and the marginal cost c_i of firms. In a dynamic setting these two parameters do not maintain constant values. Growth causes the size of the market to increase over time and the evolution of technology causes marginal cost of firms to gradually fall.

3.1. Growth

If we assume that there is steady growth in all countries then α_i becomes an increasing function of time t .

$$\frac{d\alpha_i}{dt} > 0 \quad (20)$$

Do the equilibrium choices of firms at the first stage of the game change as the sizes of markets increase? From equation (19) it is straight-forward to prove that if we replace the size of the host country α_j by $\alpha_j(t)$ then

$$\frac{d(\Delta\pi_{ij})}{dt} = \frac{d(\Delta\pi_{ij})}{d\alpha_j} \frac{d\alpha_j}{dt} > 0 \quad (21)$$

Equation (21) demonstrates that over time, FDI becomes a more profitable option for firms serving a growing market. Furthermore, the choice of firms on where to invest depends on the evolution of the size gap between foreign markets. In the long-run this gap depends on relative growth rates of the markets. The market which grows faster will be the most profitable to invest to in the long-run, although the conclusion drawn from the static analysis still holds: if it is independently profitable to invest to both markets ($\Delta\pi_{ij} > 0$ and $\Delta\pi_{ik} > 0$ for a firm from i) then the profit maximising choice for the firm will be to invest in both.

Equation (21) demonstrates that, if at $t = 0$ trade dominates all other firms' choices in all directions, and assuming steady growth in all three countries, there will be a 'domino' process until exports are replaced by FDI in all directions. The profit differences given by (19) for any pair of countries, will be negative for $t = 0$, and will gradually all turn positive as the sizes of the host markets grow. According to (19), we conclude that, *ceteris paribus*, profit differences first turn positive for host countries (i) with a large market size (ii) where domestic firms are less productive (iii) where no other foreign firm has already invested in. These three criteria determine the sequential timing of investments, as well as the trade-offs in determining the location of potential

investments. For example, a firm from country i has the option of investing in country j or k . Country j can be very large in size and hosting firms with a small productivity disadvantage with respect to i ; on the other hand, country k 's domestic firms could be very inefficient in producing the traded good, but the size of the market could be not as large as j . Both these factors (i.e market size and productivity disadvantage of domestic firms) increase potential profits for i from investing in the country. The relative balance between the two will determine which one will be the first to receive FDI from i .

What are the implications of this analysis for the 'FDI Chain' proposition? The pattern of inward to outward investment observed could be partially justified by the sequential timing of investments when there are productivity differences, and growth in all three countries. Assume that Country 1 has a productivity advantage over the rest of the world, and that Country 2 has a productivity advantage over Country 3 ($c_1 < c_2 < c_3$). For simplicity, also assume that markets are identical in size ($\alpha_1 = \alpha_2 = \alpha_3$). We will focus on the evolution of the ratio of inward to outward FDI for Country 2 over time. Starting from a situation where there is trade in all directions and constant growth in all three countries, the firm headquartered in Country 1 will be the first one to engage in FDI. It will first start producing within Country 3 and then in Country 2, where it faces stiffer competition. The firm headquartered in Country 2 (which is less efficient) will engage in FDI after Country 1. The sequence of the location of its investments will depend on the balance between the lower productivity of firms in Country 3 and the fact that Country 1 has already invested in 3 (which reduces potential profits in that location). Country 3 will be the last one to engage in FDI, and it will simultaneously invest in Countries 1 and 2. According to this scenario, the ratio of inward to outward FDI for Country 2 will first increase due to inward FDI from 1; then decrease due to outward FDI in 1 and 3; lastly it will increase due to inward FDI from Country 3 and the reduction of outward FDI to 1 due to investment from 3 to 1.

The key assumption to obtain this result is the *identical* exogenous increase in market sizes of *all* three countries. Firms respond to growth in foreign markets by replacing exports with FDI. Productivity differences between firms create an asymmetry in the timing of investments across locations which lead to a pattern of inward to outward FDI similar to that observed in the 'FDI Chain'. However, this result does not provide concrete evidence on the phenomenon.

The pattern of inward to outward stocks of the 'FDI Chain' is observed in countries experiencing unusually high growth with respect to the rest of the world. In the previous scenario, if country 2 experiences much higher growth than countries 1 and 3, then it would attract a large amount of inward FDI but at the same time outward stocks would not increase. As a result, the ratio of inward to outward FDI for that country would be increasing with an

increasing rate over time. The controversy is justified by the fact that the increase of outward FDI in the previous scenario is *not* and endogenous process. Because of markets being segmented, the increase in outward stocks depends entirely on growth in foreign countries relative to the domestic market.

On the other hand, an improvement in the productivity of domestic firms does explain the increase in outward FDI stocks as an endogenous process when there is growth and increasing inward stocks in a country.

3.2. Spillovers

If a foreign firm has a productivity advantage over domestic manufacturers then it is able to compete effectively in the domestic market, even though it faces increased fixed costs associated with decentralised production facilities. However, the presence of foreign production activity inside a host country potentially allows domestic firms to learn from their foreign competitors. This effect of FDI (also called *Veblen-Gerschenkron effect* in acknowledgement of the early intuition of the two authors (Veblen, 1915; Gerschenkron, 1952)) represents a positive externality of foreign presence in the industry. Domestic producers can reduce their marginal cost of production gradually by imitating production techniques of the foreign firms, or possibly by acquisition of human capital.

The net effects of FDI have to be evaluated empirically, but recent empirical studies have found both positive and negative effects, depending on the focus, the data and the method used ⁷.

In order to model the adjustment of domestic marginal cost over time we follow Findlay's (1978) principle ⁸, and assume that

$$\frac{dc_j}{dt} = \lambda [c_i - c_j(t)] \cdot I_{ij}(M) \quad (22)$$

where $c_j(t)$ is the domestic marginal cost at time t , c_i is the marginal cost of the foreign firm (constant over time), λ is a positive constant, and $I_{ij}(M)$ ensures that the mode of entry of the foreign firm is FDI. Note that for spillovers to take effect it must be the case that the foreign firm has the productivity advantage over its domestic competitor, $c_i < c_j(t)$, which gives the derivative a negative sign.

Equation (22) is the differential equation to integrate in order to solve for the domestic marginal cost as a function of exogenous parameters and time. The integration yields

$$c_j(t) = c_i + (c_j^0 - c_i) e^{-\lambda t} \quad (23)$$

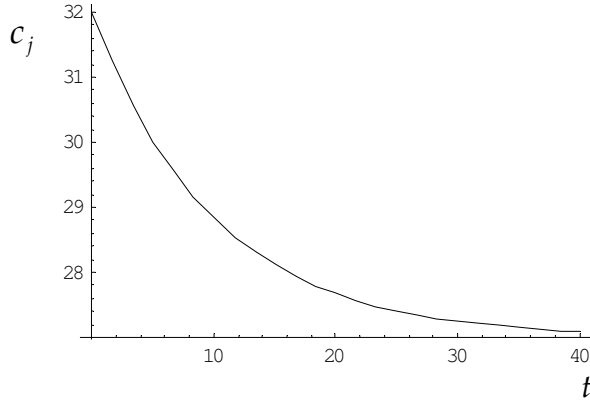


Figure 3 Parameter values, $c_j^0 = 32$, $c_i = 27$, $\lambda = 0.1$

where c_j^0 is the domestic marginal cost of country j for $t = 0$. It is trivial to prove that the domestic marginal cost starting to adjust downwards from some exogenous value c_j^0 will converge to the marginal cost of the foreign firms in the long run (for $t \rightarrow +\infty$)

$$\lim_{t \rightarrow 0} c_j(t) = c_j^0 \quad (24)$$

$$\lim_{t \rightarrow +\infty} c_j(t) = c_i \quad (25)$$

The pace of adjustment of marginal cost depends on the gap between c_i and c_j^0 as well as parameter λ . A numerical example is given in Figure 3.

Solving the same system of equations given by (6) and assuming productivity spillovers from FDI, yields the same solutions for outputs (7) (and consequently for prices and profits) in all three countries, except that now c_j is replaced by the $c_j(t)$ formulation given by equation (23). Once productivity spillovers take effect, domestic firms become more efficient and competition is enhanced both domestically and abroad. In this setting it becomes trivial to prove that output of domestic firms increases and output of foreign firms decreases over time in all three countries. From the chain rule we have

$$\frac{dy_{ij}}{dt} = \frac{dy_{ij}}{dc_j} \frac{dc_j}{dt} \quad (26)$$

On the RHS, the second term is always negative because of productivity spillovers. Taking into account equation (7), the first term is negative for $i = j$, and positive for $i \neq j$; hence, once spillovers take effect output of domestic

firms and foreign firms (y_{ij}) will increase and decrease respectively in all three countries.

An important point in our analysis is that once spillovers take effect, market segmentation is no longer present. In this new setting, growth in one of the three countries attracts FDI, strengthening the productivity of domestic firms through spillovers and therefore enhancing competition in all three countries. The output of firms in all three countries will be affected; markets are no longer segmented.

In this new setting, the implication of spillovers is that the 'FDI Chain' can be justified as an endogenous process. Reconsider the case where Country 1 has a productivity advantage over the rest of the world, and Country 2 has a productivity advantage over Country 3 ($c_1 < c_2 < c_3$). Also assume that country 2 experiences growth while the rest of the world does not. What will be the evolution of inward to outward FDI in Country 2? Growth will attract FDI from countries 1 and 3. Exports will be replaced by foreign production inside the country, and foreign-controlled output will increase. Over time, foreign presence in the country will provoke spillovers improving the productivity of domestic firms. Domestic firms will start producing more both domestically and abroad; therefore the potential difference in their profits from replacing exports to foreign markets with FDI will increase as well. In order to demonstrate this result we solve for that profit difference for domestic firms when there are spillovers from multinationals, and differentiate it with respect to time. Equation (19) for the case of spillovers will be transformed to

$$\Delta\pi_{jk} = -G + \frac{3\tau}{16} \left[2(\alpha_k + c_k - 2c_i + 3(c_i - c_j^0)e^{-\lambda t} - I_{ik}(M) \cdot \tau) - \tau \right] \quad (27)$$

where $\Delta\pi_{jk}$ represents potential profits of firms headquartered in j from replacing exports with production in k . The interdependence emerging from the breaking of market segmentation is obvious in equation (27). Growth in country j , modelled by an increase in α_j , will turn the binary indicator function $I_{ij}(M)$ positive in equation (22); the marginal cost of the domestic firm will start falling. This will have an effect over time on the profitability of investments from j to k , through spillovers. Differentiating (27) with respect to time t , yields

$$\frac{d(\Delta\pi_{jk})}{dt} = \frac{9}{8} \lambda \tau (c_j^0 - c_i) e^{-\lambda t} > 0 \quad (28)$$

Equation (28) shows that potential profits of firms headquartered in j from replacing exports with production in k will increase with a decreasing pace

over time, which follows the result that marginal cost of domestic firms will also fall with a decreasing pace

$$\lim_{t \rightarrow 0} \frac{d(\Delta\pi_{jk})}{dt} = \frac{9}{8} \lambda \tau (c_j^0 - c_i) \quad (29)$$

$$\lim_{t \rightarrow +\infty} \frac{d(\Delta\pi_{jk})}{dt} = 0 \quad (30)$$

In conclusion, the Chain hypothesis suggests that FDI undertaken in a country by foreign firms headquartered in a lower marginal cost country, eventually leads to domestic firms undertaking their own FDI in the rest of the world, till a ‘steady equilibrium’ is reached. The pattern of inward to outward stocks of the Chain is observed in countries close to the western world in terms of development, and during periods when they are experiencing unusually high growth. The results of our model are in accordance with the evidence.

In our model, spillovers create interdependence between inward and outward FDI, which is the crucial condition for the transition to take place as the country grows. Unusually high growth in a country attracts inward FDI, which in turn through spillovers creates over time the conditions for outward investment to become more profitable and expand.

4. Discussion

The results we obtain in this paper have important implications. Productivity spillovers to domestic firms from increased foreign presence are an issue that has been widely studied and tested in the last decade, yet with contradictory results. There are studies showing evidence of positive spillovers of FDI, no effect of foreign presence on domestic firms, or negative spillovers. In these studies researchers try to correlate the intensity of foreign presence in an industry and the productivity of domestic firms⁹.

In this paper there are two important points we want to draw attention to. First, the connection between the ‘FDI Chain’ and spillovers is inevitable. Spillovers are essentially a process of imitation of multinational firms by domestic firms. If the domestic firm eventually becomes a multinational then imitation is successful and complete. Increasing outward FDI from a country is an indication that domestic firms have started operating exactly the way foreign multinationals are; it is clear evidence on spillovers.

The second point we want to draw attention to is that, taking into account the FDI Chain hypothesis and evidence, the contradictory empirical

results on the presence of spillovers seem to be all possible if linked to different stages of the Chain. The FDI Chain suggests that initially, when inward FDI starts increasing with unusually high pace, we expect domestic firms to be weakened by increased competition. Negative spillovers are possible for the first stages of the Chain. Positive spillovers according to our hypothesis take effect for countries with specific characteristics (i.e closer to the western world in terms of development; experiencing unusually high growth) and become apparent with a time lag. The time lag according to the indications from the data could be up to 10 years.

In most empirical studies the productivity of domestic firms is linked *simultaneously* to foreign presence in an industry which can give mixed, positive or negative results according to the case and the time period examined. Many studies have used cross-sectional data; many have used data from countries where the FDI Chain is still observed to be in its initial stages. There are very few studies remaining that can be referenced for our hypothesis. However, most of these studies find mixed results on the presence of spillovers possibly because of the simultaneous link of productivity and foreign presence.

It is obvious that more work needs to be done in this topic in order to reach a consensus on the determinants and the extend of spillovers from multinationals. The Chain hypothesis offers a new framework to use in order to formalise the testing for spillovers empirically.

Alternative scenarios for the reduction in the productivity gap between domestic and foreign firms could be developed so as to justify the pattern of FDI we observe, although with weaker explanatory power. For example, the reduction in the gap could also be explained by economies of scale. Ignoring the effect of foreign firms, growth in the home country combined with increasing returns could lead to larger and more productive domestic firms, which become, at a certain point in time, able to bear the cost and the risk of investing abroad. The key to this scenario is the assumption that the ability of a firm to conduct FDI depends on its size. Large firm size incorporates the firm's ownership-specific advantages which produce a cumulative and dynamic effect on the expansion of multinational companies. This result had been established empirically in the seventies and eighties (Caves, 1974; Blomström and Lipsey, 1986), but the methods used in these papers do not allow us to use their conclusions with much confidence now. Furthermore, this scenario does not provide an explanation for the time lag between the strengthening of the two roles of parent and host in each country. If growth increases both inward and outward FDI stocks there is no reason why it cannot have these effects simultaneously, in which case the country should not be expected to go through the stages revealed in the data.

The reduction in the productivity gap between domestic and foreign firms could be also explained by spillovers of different type; for example, as

the result of increased competition by foreign firms. Many models have emphasised the role of competition in the increase of domestic firms' productivity (see Wang and Blomström, 1992; Glass and Stagi, 2002). In this last scenario even if domestic firms are unable to imitate the technology of multinationals operating in the country, because of increased competition they are under pressure to use the existing technology more efficiently, yielding productivity gains. However, the model we develop in the previous sections does not change significantly if instead of technology spillovers we adopt competition spillovers. In both cases increased foreign presence in a market will result in a fall of domestic firms' marginal cost with similar consequences.

In this paper we used a simple partial-equilibrium theoretic setting to explain the main driving forces of the Chain. It will be interesting to extend this setting and test the compatibility of the Chain with more complex general equilibrium models of FDI. Lastly, the FDI Chain essentially formalises the expansion through spillovers of the system of countries interacting with FDI. Revealing the spatial stages of this expansion observed in pure geographic terms will be an interesting extension of both the theory and empirical evidence on the Chain.

Notes

- [1] For latest contributions to this literature see, for example, Carr *et al.* (2004), Garibaldi *et al.* (2002), Borensztein *et al.* (1998), Lipsey (2004), and Saggi (2002).
- [2] Recent studies exploring the explanatory power of such aspects for FDI flows are Crozet *et al.* (2004), Blonigen *et al.* (2005).
- [3] First order condition for firm i in a Cournot oligopolistic market with n firms ($n > 2$) is given by

$$\frac{\partial \pi_i}{\partial y_i} = p - c_i + \frac{\partial p}{\partial Y} y_i$$

(Varian, 1992) which transforms into equation (6) when we take into account transportation costs τ , and the inverse demand function given by (1).

- [4] Profits for country i under the four cases of the matrix in are given by

$$\pi_{ij}^{EE} = \frac{1}{16} (\alpha_j + c_j + c_k + \tau) (\alpha_j - 3c_i + c_j + c_k - 2\tau) - F$$

$$\pi_{ij}^{EM} = \frac{1}{16} (\alpha_j + c_j + c_k) (\alpha_j - 3c_i + c_j + c_k - 3\tau) - F$$

$$\pi_{ij}^{ME} = \frac{1}{16} (\alpha_j + c_j + c_k + 2\tau) (\alpha_j - 3c_i + c_j + c_k + 2\tau) - G - F$$

$$\pi_{ij}^{MM} = \frac{1}{16}(\alpha_j + c_j + c_k + \tau)(\alpha_j - 3c_i + c_j + c_k + \tau) - G - F$$

By symmetry, profits for country k under the four cases of the matrix in are given by

$$\pi_{kj}^{EE} = \frac{1}{16}(\alpha_j + c_j + c_i + \tau)(\alpha_j - 3c_k + c_j + c_i - 2\tau) - F$$

$$\pi_{kj}^{EM} = \frac{1}{16}(\alpha_j + c_j + c_i)(\alpha_j - 3c_k + c_j + c_i - 3\tau) - F$$

$$\pi_{kj}^{ME} = \frac{1}{16}(\alpha_j + c_j + c_i + 2\tau)(\alpha_j - 3c_k + c_j + c_i + 2\tau) - G - F$$

$$\pi_{kj}^{MM} = \frac{1}{16}(\alpha_j + c_j + c_i + \tau)(\alpha_j - 3c_k + c_j + c_i + \tau) - G - F$$

- [5] By symmetry, the difference in profits by replacing exports with FDI for the firm from k is given by

$$\Delta\pi_{kj} = -G + \frac{3\tau}{16} \left[2(\alpha_j - 3c_k + c_j + c_i - I_{ij}(M) \cdot \tau) - \tau \right]$$

- [6] When a firm's exports increase then the incentive to replace increasing total transportation costs by the fixed cost of FDI is higher ($\Delta\pi_{ij}$ increases). The effect of per-unit transportation cost which seems ambiguous in equation (19), is clarified by the derivative of the profit difference with respect to τ

$$\frac{d(\Delta\pi_{ij})}{d\tau} = \frac{3}{8}(\alpha_j - 3c_i + c_j + c_k - \tau - I_{ij}(M) \cdot \tau) > 0$$

We derive the last result by taking into account that all outputs to all directions in equation (7) cannot be negative. Overall, $\Delta\pi_{ij}$ increases with respect to total output in a market and transportation costs when the firm is exporting to the market in consideration.

- [7] Advocates of a positive role of FDI through technological transfer are Findlay (1978), Das (1987), and Wang and Blomström (1992). Recent empirical studies confirming the link between the intensity of foreign presence and the fall in the productivity of domestic firms for developed countries using panel data are Keller and Yeaple (2003), Ruane and Ugur (2003), Görg and Strobl (2003), Castellani and Zanfei (2002), Haskel *et al.* (2002). Rodriguez-Clare (1993) and Markusen and Venables (1999) argue that FDI benefits local suppliers and local consumers. Fosfuri *et al.* (2001) and Glass and Saggi, 1998 and Glass and Saggi, 2002 document that they could increase the human capital of the local labor force. On the other hand, FDI could out-compete local firms forcing them out of production without employing local labor because of skill mismatch. This is argued in Aitken and Harrison (1999). A combination is Barrios *et al.* (2005).
- [8] For a discussion of this assumption see Appendix C
- [9] For an extensive review of the literature on spillovers see Görg and Greenway (2003)

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Appendix A

Figures 5-11 show four stages in a country's metamorphosis from a net FDI 'importer' to FDI 'exporter'. According to the transformation of the 'FDI Chain' the ratio of inward to outward FDI stocks for most countries is expected to form the inverse U-shaped curve over time as in Figure 4.

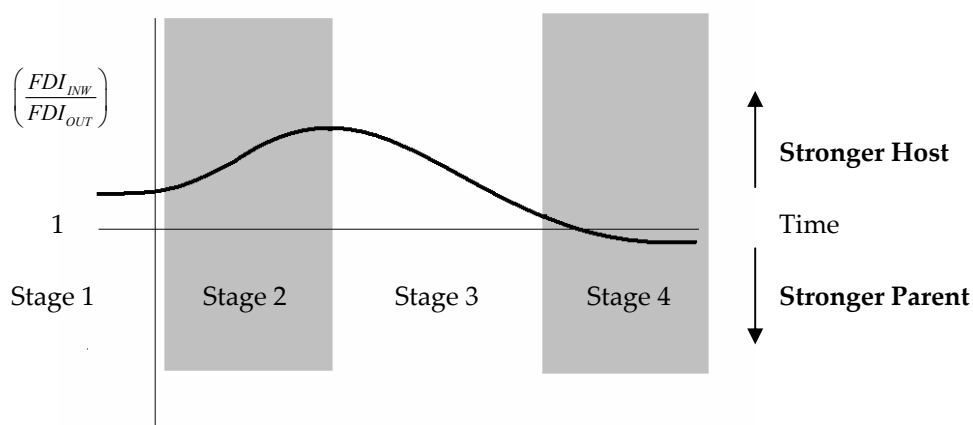


Figure 4

The data analysed cover the period from 1980-2004 and include FDI inward and outward stocks for every country (Source UNCTAD). The logarithmic ratio of inward to outward FDI stocks for each country over this period, takes positive values if the country foreign stocks exceed stocks of its own interest abroad (stronger host), and negative values if outward FDI exceeds inward (stronger parent). The data show clear patterns for some group of countries (Figures 5-11).

It is straight-forward to observe that the world's most industrialised countries of Europe and North America had already reached the steady state described as stage 4. Northern Europe and Austria passed from stage 3 to stage 4 during the 90s. For the countries of Southern Europe, which experienced unusually high growth during the 80s and the 90s, we can clearly see evidence of the first three stages. Spain has already reached the balance of the stage 4. Eastern European countries have moved from stage 1 to 2 and the most developed ones seem to pass now to stage 3. Lastly, outside Europe, for Australia and the industrialised countries of Asia we have evidence of stages 3 and 4. For the case of Singapore all stages are clear in its curve, like for Spain. Overall, following the evidence, the patterns we predicted and observed can be considered as stylised facts.

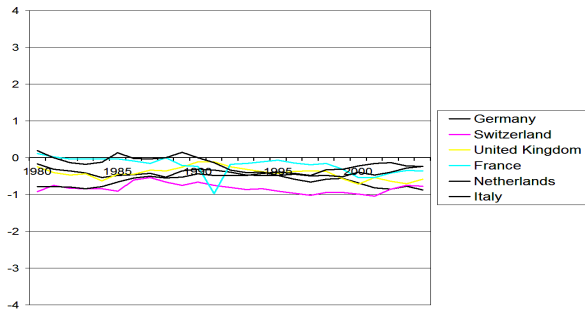


Figure 5
Industrialized countries of Western Europe

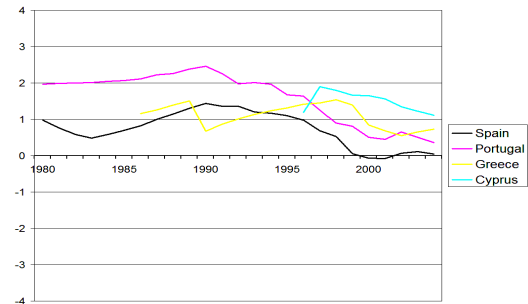


Figure 6
Southern Europe (EU)

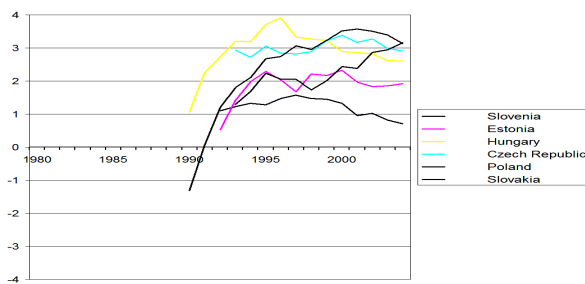


Figure 7
Eastern Europe (more developed countries, EU)

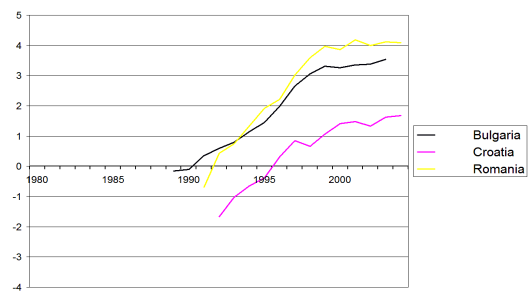


Figure 8
Eastern Europe (less developed, non- EU)

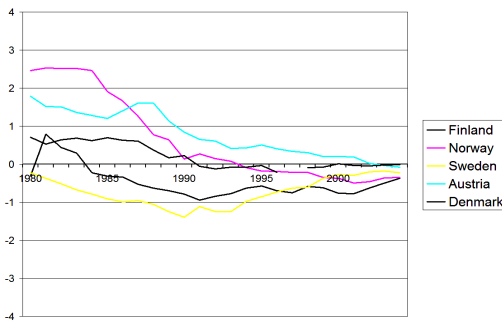


Figure 9
Northern Europe and Austria

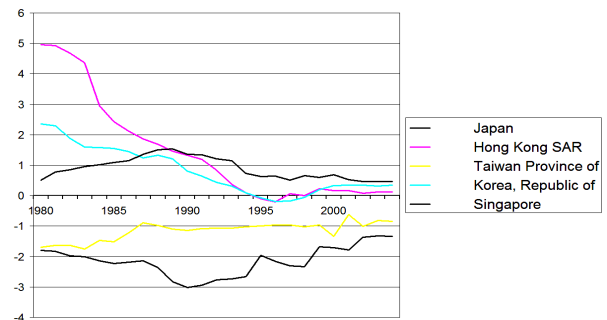


Figure 10
Asia

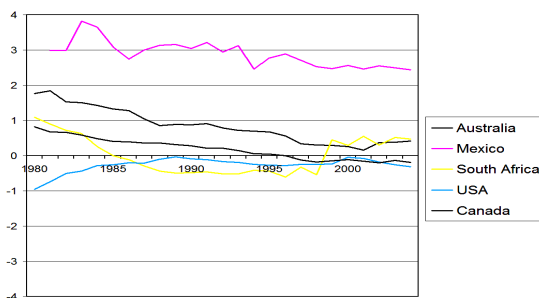


Figure 11
OECD non-European and South Africa

Appendix B

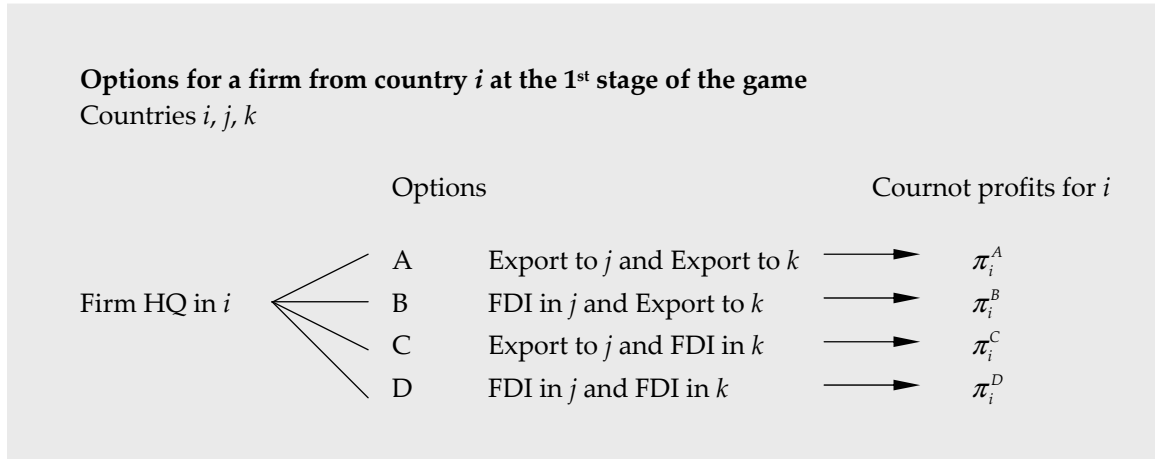


Figure 12

In order to rank profits under the four available choices of firms we need to make six comparisons between $\pi_i^A, \pi_i^B, \pi_i^C, \pi_i^D$. However, the assumption that markets are segmented creates symmetries between profits which facilitate the ranking process.

The differences in profits between choices A, B and B, D are identical. The reasons leading a firm headquartered in country i to invest in j do not affect its decision to invest in country k ; hence, the difference in firm i 's profits when they replace exports with FDI in j , will be the same whether or not i is at the same time producing within country k . Equivalently, the difference in profits between choices A, C and C, D is identical as well. The only difference between choices A, B and A, C is in the size of the foreign market the firm is contemplating to produce in. Lastly, the ranking of option D (investing in both foreign countries) is not independent of the profitability of the rest of the options. When comparing choices A, D we see that the difference in firm i 's profits by replacing exports with FDI simultaneously in both j and k , will be the sum of the differences in firm's profits if it conducted FDI separately in j and in k . The justification of this equality follows the same market segmentation argument. A firm headquartered in country i invests in j for reasons that do not have an impact on its decision to invest in country k .

Overall, in equilibrium, because of markets being segmented we need to focus on the profitability of investing in each foreign country separately.

Appendix C

Findlay (1978) is a pioneering theoretic contribution suggesting that the higher the productivity gap between multinationals and domestic firms in a less advanced economy, the greater the backlog of available opportunities to exploit in the market, therefore the greater the pressure and effort of the lagging firm to improve its effectiveness. Empirical results did not entirely confirm his hypothesis. Kokko (1994), Kokko *et al.* (1996) Girma *et al.* (2001) as well as other studies show evidence that domestic firms using very backward production technology and low-skilled workers are unable to learn from multinationals. This evidence reflects the effect of foreign presence in a country where domestic firms have *large* productivity disadvantages with respect to multinationals.

Findlay's approach to spillovers has the advantage of giving asymptotic results over time when the marginal cost of domestic firms approaches the one of foreign firms; hence taking indirectly into account that a productivity advantage of foreign firms is essentially supported by firms-specific assets that cannot be totally imitated. The domestic firm will be able over time to improve its productivity through a learning process that will become more and more difficult as the firm's marginal cost approaches the one of its foreign competitors. In contrast to the discussion of the empirical evidence, this hypothesis reflects the effect of foreign presence in a country where domestic firms have *small* productivity disadvantages with respect to multinationals.

According to the above, it is reasonable to assume that when spillovers take effect the curve of marginal cost of domestic firms for a given intensity of foreign presence in a country must look like in Figure 13; concave for large, and convex for small productivity differences between multinationals and domestic firms.

The empirical evidence on Findlay's assumption does not add to our model. In our model there is only one homogeneous good traded in the world. For trade and FDI to always remain positive between all countries, it has to be that productivity

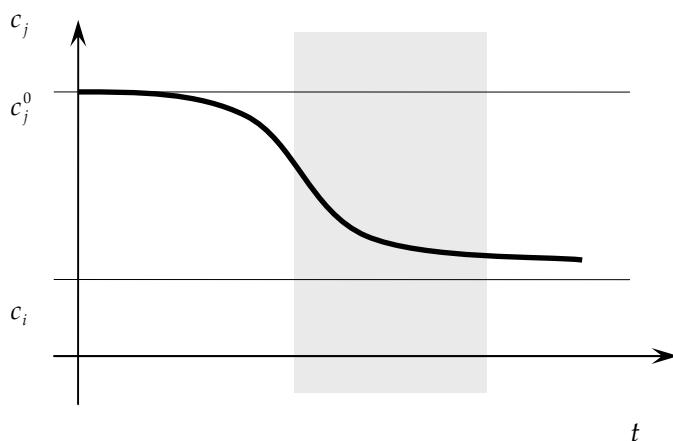


Figure 13 Parameters t , time; c_j , marginal cost of domestic firms; c_j^0 , marginal cost of domestic firms for $t = 0$; c_i , marginal cost of multinationals;

differences are not strong enough so as to influence negatively the learning process of domestic firms once foreign firms set production in the country. If the productivity advantage of multinationals was very strong then foreign presence in a country would eliminate all domestic output through competition, which is by assumption not the case in our model. Therefore the convex part of the spillover curve (shaded part area of Fig.13) is a more appropriate representation of the process we describe here.

For this reason we keep following Findlay's theoretic approach in modelling the adjustment process of domestic marginal cost.