Abstract

In a two countries model, I theoretically derive a partial equilibrium relation for home and foreign investment stocks by multiproduct multinational firms, each located separately in one of the two countries. I then address the existence of a Market Share Effect, that is the more than proportional growth in the stock of investment following an initial rise in the market share of a multinational firm. The explanation is that this rise originates a reciprocal adjustment in the worldwide market shares of the two multinationals, eventually feeding back in foreign investment stocks. In the empirical sections, working on data on Japan and US, I present some stylized evidence and estimate the theoretical predictions of the model. The empirical evidence provides only partial support to the theory.

Keywords: Foreign direct investment; Gravity equation; Market power; Multinational companies.
JEL Classification: F12; F23; L13

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1 Introduction

This paper aims at achieving two objectives. The first is to present a microeconomic foundation for a gravity equation for Foreign Direct Investment (FDI) stocks. The second objective, once accomplished the first, is to highlight interdependencies among the stocks of FDI in different countries. In particular, I analytically characterize how FDI stocks in different countries are connected through market shares (either domestic or foreign) of multinational companies (MNCs). Since market shares of multinational companies depend on each other, this eventually gives rise to interesting interactions, which I am going to analyze.

The model’s outline follows Baldwin and Ottaviano (1998). In a two countries’ world, two multiproduct multinational firms engage in horizontal FDI, with iceberg transport and foreign investment costs. The two MNCs are based in different countries. I extend their paper working out an explicit relation for FDI stocks, thus providing a microeconomic foundation to a gravity equation for FDI stocks. The gravity equation has some standard features in common with the horizontal FDI literature, as the positive impact of trade costs on the stock of FDI, but I also derive some new results concerning the interaction between MNCs’ market shares and FDI stocks. In particular, previewing one result in the paper, a rise in the foreign market share by a MNC generates a more than proportional rise in the world stock of FDI. The intuition behind the result is the following. The first impact of a foreign market share’s rise is to make more profitable investment abroad, due to an increase in market power. But as a MNC’s market share rises, the market share of the opponent is necessarily reduced in that market. The opponent then finds optimal to re-balance its capital, increasing its stock of FDI, in the home country of the first MNC. Hence, an initial increase in foreign market shares, leads to an increase in FDI due to two separate effects. The first is a direct one: if the foreign market share increases it is more convenient to invest abroad. The other is an indirect one, working through the reaction of the opponent to the initial increase in market share. Overall, this gives rise to a more than proportional surge in the stock of FDI following an increase in market share.

Papers giving a microeconomic foundation to gravity equations for trade flows are well known. Among them, one can find Anderson (1979), and Anderson, and van Wincoop (2003). There also exists a literature analyzing the theoretical aspects of the flows of FDI among countries. Many models of this nature are examined in the book by Razín and Sadka (2007).

On the side of gravity equations for FDI stocks, less effort has been spent. One noticeable exception is the paper by Head and Ries (2006) who develop a control-based model for FDI stocks. They base their analysis on the fact that a good deal of FDI consists of mergers and acquisitions, rather than greenfield investment, and model FDI stocks as the outcome of a bidding process by headquarters over subsidiaries’ assets.

Differently from Head and Ries, I stick to a more traditional view of the determinants of
FDI. I view FDI stocks as originating from market seeking behaviour by multinational companies. Product differentiation and increasing returns to scale fosters contemporaneously intra-industry FDI and intra-industry trade. Different subsidiaries of MNCs supply differentiated products to world markets. Each subsidiary produces a single variety. When a MNC decides to open a subsidiary abroad, FDI displace some exports of existing home varieties but also generate re-imports of the new variety produced abroad to the home country.

2 Stylized facts

A look at raw data will show why the issue under scrutiny is an interesting one. Here, I unveil some interesting empirical links between MNCs’ total sales (both at home and abroad) and FDI stocks in the two biggest national economies worldwide, Japan and the US.

2.1 Construction of the dataset

I gather data from different data sources. Due to data constraints, I work with yearly data pertaining to all the sectors, not only manufacturing. They are collected over the period 1983-2004.

The first data source is the *World Investment Directory* by UNCTAD. From this source, both for US and Japan, I retrieved for the period 1990-2002 the following variables: total sales of home-based MNCs, the total export (to all countries) made by parent companies, the total sales of foreign affiliates of American and Japanese MNCs in Japan and US respectively, and the total export of American and Japanese foreign affiliates in Japan and US back to their country of origin (i.e., US and Japan). This source is supplemented with other databases to get the former variables for the additional years that are included in the empirical analysis (1983-1989, and 2003-2004). For Japan, I used various issues of the yearly publication *Wagakuni Kigyo no Kaigai Jigyo Katsudo* (Survey on Overseas Business Activities), by the Japanese Ministry of Economy, Trade and Industry (METI). For the US, I used data from the International Investment Division (IID) of the Bureau of Economic Analysis (BEA).

The other variables are the bilateral stocks of FDI, from the *International Direct Investment Statistics*, the bilateral flows of exports, from the *STAN Bilateral Trade Database*, and current prices GDP of US and Japan, from the *Main Economic Indicators*. All these datasets are available on the SourceOECD website.

The model I will present in detail below is based on the overall market shares enjoyed by MNCs in each national market; that is, the shares accruing to parent companies and their foreign affiliates. Four of such market shares exist: the home market share of American MNCs, the foreign

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1 These data are freely available on BEA website.
market share of American MNCs (in Japan), and the symmetric variables for Japanese MNCs (the home market share in Japan, and the foreign market share in the US). I get market shares as the corresponding values of sales normalized by GDP.

The domestic sales of MNCs are computed as the sum of domestic sales by parent companies (e.g., sales of American parents in the US) plus the exports of foreign affiliates back to the economy of origin (e.g., sales of US affiliates based in Japan back into the American market). Domestic sales by parent companies are computed as the difference between total sales and total exports by parent companies. Total domestic sales are divided by current price GDP both for US and Japan. I then obtain the domestic market shares: I call $S_h^h$ the share by country $h$’s MNCs in their own domestic market, while $S_f^f$ is country $f$ MNCs’ share in their own domestic market. In the rest of the paper I will assume that country $h$ is the US and country $f$ is Japan.

The MNCs’ total sales abroad are the sum of foreign affiliates sales abroad plus the exports of MNCs to the foreign economy that are not directed to foreign affiliates themselves. Unfortunately, it is not possible to single out the exports of parent companies to a given country out of total exports. Then, foreign market shares by MNCs are built summing foreign affiliates’ sales and total exports in a given country, and subtracting exports to foreign affiliates. The foreign sales are then divided by current prices GDP in each year. I call these variables $S_f^h$, a mnemonic for the market share of MNCs belonging to country $f$ (i.e., Japan) in country $h$ (i.e., the US), and, symmetrically, $S_h^f$ (i.e., the American market share in Japan).

### 2.2 Stylized fact 1: in a given national market, domestic MNCs’ and foreign MNCs’ market shares are inversely related

The sales of American MNCs coexist with the sales of Japanese MNCs in the American market. I then expect that the market share of Japanese MNCs, $S_f^f$, and the domestic market share of local MNCs, $S_h^h$ are inversely related; in fact, the correlation among the two times-series turns out to be -0.63. The same inverse relation holds in the Japanese market, where the correlation between Japanese MNCs domestic market share and foreign US MNCs’ share is -0.19. The explanation for this fact is that American and Japanese MNCs, when they compete for the same national markets, fight each other, so that when one increases its market share it does so at the expenses of the other.

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2 All Japanese nominal variables were first converted into US dollars through the yen-dollar nominal exchange rate.

3 I have to exclude both intra-firm trade, and arms-length trade directed to foreign affiliates.

4 This measure of MNCs’ foreign market shares includes exports by non-MNCs in the destination country. I cannot avoid this inclusion, because data on exports by parent companies disaggregated by destination country are not available neither for US nor for Japan.
2.3 Stylized fact 2: in a given national market, foreign MNCs’ market shares and FDI stocks are positively related

The other interesting piece of evidence is that FDI stocks as a share of host country GDP are positively related to the corresponding MNCs’ foreign market share. In the case of US MNCs, the correlation between the share of outward FDI stock to Japan GDP, $\text{fdi}_h^f$, and $S_h^f$ equals 0.78. In the case of Japan MNCs, the correlation between the outward FDI stock’s share to GDP, $\text{fdi}_f^h$, and $S_f^h$ equals 0.45.

As a corollary of the two stylized facts identified above, I get that, in the host economy, domestic MNCs’ shares, and FDI stocks as a share of GDP should be inversely related. For instance, in the US, domestic MNCs’ market shares and Japanese FDI stock as a share of US GDP should be inversely related. This is confirmed by the data, provided that the correlation is -0.64. In the case of the Japanese economy, the correlation among the domestic MNCs’ market shares and FDI stock from US to Japan as a share of Japanese GDP is -0.51. The full set of correlations among the relevant variables employed in the paper is provided in Table 1.

[Insert Table 1 about here]

2.4 OLS regressions

Bringing together the information coming from the correlations identified above, I consider the following linear regression. Let us consider the Japanese economy. I regress the stock of FDI from US to Japan as a share of Japanese GDP, $\text{fdi}_h^f$, on: a constant, the market share of American MNCs in Japan, $S_h^f$, the market share of domestic MNCs, $S_f^f$. A similar analysis is performed for the American economy. The results of the statistical analysis are presented in Table 2.

[Insert Table 2 about here]

Results are broadly consistent with the correlations identified before. The market share of American MNCs in Japan, $S_h^f$, is positively associated to the share of outward FDI stocks. The market share of Japanese MNCs in the home economy, $S_f^f$, is negatively related to the stock FDI from the US, but it does not survive the inclusion of a linear time trend. There are two factors influencing this result. The first is that the share of US FDI stock to Japanese GDP shows a clear upward trend (see how the R-squared of the regression increases after the inclusion of a linear time trend). The second is that the domestic market share of Japanese MNCs is also declining over time.

Turning to the US economy we get a quite similar picture: outward Japanese FDI stocks as a share of US GDP, $\text{fdi}_f^h$, are positively associated to Japanese market shares, $S_f^f$, and inversely related to domestic American market shares, $S_h^h$. The coefficient on $S_h^h$ is even statistically more significant after the inclusion of the linear time trend.
3 The model

The main objective I want to accomplish in this theoretical section is to provide a formal representation through a gravity equation for FDI stocks of the role played by MNCs’ market shares.

As in Baldwin and Ottaviano (1998), I consider a partial equilibrium framework made of two countries, with a single factor of production, labour, whose endowment is fixed across countries, and a single differentiated-goods sector, manufacturing. These countries are perfectly symmetric apart from the fact that total expenditure on the manufacturing sector is greater in one country, $E_h > E_f$, with $E_h$ being the size of the home market, and $E_f$ being the size of the foreign market. There exist two multinational companies and they can produce more than one variety. A fixed cost $F$ in terms of labour must be borne to produce each single variety. It can be thought to be the cost necessary to set up a plant. If the MNC wants to produce a variety in an additional plant, it has to bear the fixed cost $F$ again. This implies that MNC will never find profitable to replicate the production of an existing variety in another factory, and they will opt for establishing a brand new variety, which guarantees higher profits.\(^5\) By choice of measurement units, the wage rate going to labour can be normalized to one, similarly to the unit labour requirement for manufacturing the differentiated good. This amounts to saying that the total cost function for each variety is $F + x(i)$, where $x(i)$ is total production of variety $i$.

Each multinational firm faces additional general costs to co-ordinate its operations at home and abroad. These general expenses stay constant irrespectively of the number of varieties produced, and in equilibrium each multinational firm will find convenient to produce more than one variety. The strong assumption I make, for the sake of analytical tractability, is that only two multinational firms exist, one located with its headquarters at home, and the other located abroad. Each multinational may set up the production of varieties in both countries. Hence, the choices made by the MNCs concern the spatial distribution and the total number of varieties (first stage), and the quantity of each variety to be produced (second stage). The FDI decision consists in locating the production of some varieties in the foreign region. For example, the MNC headquartered in region $f$ locates some varieties in region $h$. Another key assumption is that building a plant abroad is generally more costly than building a plant at home. If the MNC makes FDI, the fixed cost to establish a plant abroad is $\Gamma F$, with $\Gamma \geq 1$. This is due to barriers to foreign investment. Finally, shipping final goods across countries is also costly. To represent this fact I introduce iceberg transport costs: in order to sell one unit abroad, $\tau \geq 1$ units must be shipped.

Turning to the preference side of the model, each consumer has a utility function equal to

$$U = \int_{i=0}^{N} c(i)^{1-1/\sigma} \, di$$

(1)

where $c(i)$ is consumption of variety $i$, $N$ is the total mass of varieties produced in both countries,

\(^5\)This is exactly the same logic that is found in the standard Dixit-Stiglitz monopolistic competition model.
and \( \sigma > 1 \) is elasticity of substitution between varieties. If total expenditure on manufacturing in the home country is \( E_h \), a home consumer maximizes (1) subject to the constraint

\[
\int_{i \in N} p(i)c(i)di \leq E_h
\]

where \( p(i) \) is the price of variety \( i \). The direct demand function for a generic variety \( j \) is

\[
c(j) = \frac{p(j)^{-\sigma} E_h}{\int_{i \in N} p(i)^{1-\sigma}di}
\]

and the inverse demand function is

\[
p(j) = \frac{c(j)^{-1/\sigma} E_h}{\int_{i \in N} c(i)^{1-1/\sigma}di}
\]

The demand for varieties in the foreign country is similarly derived substituting \( E_f \) to \( E_h \).

We now describe the profit functions. A slightly more complicated notation is needed to precisely track the origin-destination pattern of each commodity. The home and the foreign markets are segmented (resale of varieties by unrelated parties is assumed to be prohibitively expensive). Each MNC sets the quantity to be sold for each variety in each market, given consumers’ demand. I indicate the origin-destination pattern in the subscript. In the home market, for instance, the home MNC sets jointly \( c_{hh}^h(i) \) (the quantity produced by the home MNC at home and sold at home) and \( c_{fh}^h(i) \) (the quantity produced by the home MNC abroad and re-imported at home) to maximize profits in the home market. Profits made by the home MNC in the home market will descend from the set of home-made, \( \Omega_{hh}^h \), and foreign-made, \( \Omega_{fh}^h \), varieties. Home market’s profits, \( \pi_h^h \), and foreign market’s profits, \( \pi_h^f \), for the home MNC are

\[
\pi_h^h = \int_{i \in \Omega_{hh}^h} [p_{hh}^h(i) - \tau]c_{hh}^h(i)di + \int_{i \in \Omega_{fh}^h} [p_{fh}^h(i) - \tau]c_{fh}^h(i)di
\]

\[
\pi_h^f = \int_{i \in \Omega_{fh}^f} [p_{fh}^f(i) - \tau]c_{fh}^f(i)di + \int_{i \in \Omega_{ff}^f} [p_{ff}^f(i) - 1]c_{ff}^f(i)di
\]

The objective of the MNC is to maximize profits’ functions in the two segmented markets taking as given the quantities chosen by the other MNC that influence market prices.

### 3.1 Solving the model

Total manufacturing expenditures are different in the two countries; that is, \( E_h > E_f \). The fully-fledged solution involves calculus of variations, but I skip the calculations.\(^6\) The necessary conditions related to the optimality of quantities in the context of profit maximization yield an expression for equilibrium prices. In what follows we write the expressions for the equilibrium

\(^6\)The introduction of different markets’ sizes does not dramatically affect the solution of the model, which follows rather closely Baldwin and Ottaviano (1998).
prices faced by the home MNC:

\[ p_h^h \left( 1 - \frac{1}{\epsilon^h_h} \right) = 1, \quad p_f^h \left( 1 - \frac{1}{\epsilon^h_h} \right) = \tau; \quad \frac{1}{\epsilon^h_h} \equiv \frac{1}{\sigma} + \left( 1 - \frac{1}{\sigma} \right) S^h_h \]  

(5)

\[ p_h^f \left( 1 - \frac{1}{\epsilon^f_f} \right) = 1, \quad p_f^f \left( 1 - \frac{1}{\epsilon^f_f} \right) = \tau; \quad \frac{1}{\epsilon^f_f} \equiv \frac{1}{\sigma} + \left( 1 - \frac{1}{\sigma} \right) S^f_f \]  

(6)

Let us introduce and comment the results: \( \epsilon^h_h \) is the elasticity of demand perceived by the home MNC in the home market, while \( \epsilon^f_f \) is the elasticity in the foreign market. These elasticities depend on two elements: the substitutability parameter \( \sigma \), and the market shares of the home MNC, \( S^h_h \) and \( S^f_f \). The parameter \( \sigma \) in the Dixit-Stiglitz model is linked both to increasing returns to scale and to product differentiation. When \( \sigma = 1 \), each variety enjoys a perfect monopoly power. Substitutability among varieties is nil, the perceived demand elasticity is equal to one, and it is not affected by the market share enjoyed by the MNC. When each variety becomes a substitute to other varieties (\( \sigma > 1 \)), elasticity rises above 1. Just in this case, elasticity is inversely related to the market share of the MNC, because the higher the market share, the less elastic the demand will be perceived, since the MNC will control the sales of a wider range of differentiated products. Expressions (5) and (6) are identical in the case of small-group oligopolistic competition in quantities among different varieties. The hypothesis of multiproduct multinational companies controlling a whole range of varieties makes a difference to the extent that market shares entering (5) and (6) are now the sum of the individual varieties’ shares.

The mark-up of the home MNC on each home variety is

\[ \frac{1}{1 - 1/\epsilon^h_h} = \frac{1}{(1 - 1/\sigma)(1 - S^h_h)}, \]

a quantity rising in the market share \( S^h_h \). Similar expressions can be obtained for the optimal pricing rules of the MNC based in the foreign region.

From (2), the share over total expenditure of a single variety produced locally by the home MNC and sold locally, \( s^h_h \equiv p^h_h c^h_h / E_h \), is equal to

\[ s^h_h = \frac{(p^h_h)^{1-\sigma}}{n^h_h (p^h_h)^{1-\sigma} + n^h_f (p^f_h)^{1-\sigma} + n^f_h (p^h_h)^{1-\sigma} + n^f_f (p^f_h)^{1-\sigma}} \]

where \( n^h_h \) is the number of varieties of the home MNC located at home, \( n^f_h \) is the number of varieties by the home MNC located in the foreign market, \( n^h_f \) is the number of varieties belonging to the foreign MNC and located in the home market, and \( n^f_f \) is the number of varieties located in the foreign market and belonging to the foreign MNC. Using the optimal pricing rules, we get:

\[ s^h_h = \frac{(1 - S^h_h)^{\sigma-1}}{(n^h_h + n^f_h \phi)(1 - S^h_h)^{\sigma-1} + (n^h_h + n^f_h \phi)(1 - S^h_f)^{\sigma-1}} \]

\[ s^f_f = \frac{(1 - S^f_f)^{\sigma-1}}{(\phi n^h_h + n^f_f)(1 - S^f_f)^{\sigma-1} + (\phi n^h_h + n^f_f)(1 - S^f_f)^{\sigma-1}} \]

7 On the ambiguity of \( \sigma \) in the CES Dixit-Stiglitz specification see, among the others, Benassy (1996) and Neary (2001).
where $S_f^h$ is the total market share of the foreign MNC in the home region, and $\phi \equiv \tau^{1-\sigma}$ is a parameter inversely related to transport costs, usually called the “freeness of trade” parameter in the economic geography literature. The formulas for the other two market shares of individual varieties of the home MNC, $s_h^{fh}$ and $s_h^{hf}$, are:

$$s_h^{fh} = \phi s_h^{hh}, \quad s_h^{hf} = \phi s_h^{ff}$$

From the definition of total market shares, we get

$$S_h^h = n_h^h s_h^{hh} + n_f^h s_f^{fh}, \quad S_f^h = n_f^h s_h^{hf} + n_f^f s_f^{ff}$$

and the following equations are also true:

$$S_h^f = n_h^f s_f^{fh}, \quad S_f^f = n_f^f s_f^{ff}$$

The total share of the MNC in the domestic market and in the foreign market can be retrieved as a function of the number of varieties established in each market.

Let us concentrate for the moment on the profit functions related to the home MNC. Total profits are $\Pi^h \equiv \pi_h^h + \pi_f^h$, and, after algebraic manipulations, I obtain

$$\Pi^h = \frac{1}{\sigma} \left\{ E_h S_h^h [1 + (\sigma - 1) S_h^h] + E_f S_f^h [1 + (\sigma - 1) S_f^h] \right\} - (n_h^h + n_f^h) \Gamma F$$

The first order condition for the number of home-based varieties to be optimal is $\partial \Pi^h / \partial n_h^h = 0$, and leads to

$$\frac{1}{\sigma} \left\{ E_h [1 + 2(\sigma - 1) S_h^h] \frac{\partial S_h^h}{\partial n_h^h} + E_f [1 + 2(\sigma - 1) S_f^h] \frac{\partial S_f^h}{\partial n_h^h} \right\} = F$$

while the condition for the number of foreign-based varieties to be optimal is $\partial \Pi^h / \partial n_f^h = 0$, yielding

$$\frac{1}{\sigma} \left\{ E_h [1 + 2(\sigma - 1) S_f^h] \frac{\partial S_f^h}{\partial n_f^h} + E_f [1 + 2(\sigma - 1) S_f^h] \frac{\partial S_f^h}{\partial n_f^h} \right\} = \Gamma F$$

We can compute, given (7) and (9), the marginal effect of an increase in the number of varieties
belonging to the home MNC on total market shares, at home and abroad,

$$\frac{\partial S_h^h}{\partial n_h^h} = \frac{1}{\sigma} \frac{(n_h^h + \phi n_f^h)^{1/\sigma - 1} (n_f^h + \phi n_f^h)^{1/\sigma}}{[(n_h^h + \phi n_f^h)^{1/\sigma} + (n_f^h + \phi n_f^h)^{1/\sigma} ]^2} = \frac{S_h^h S_f^f}{\sigma (n_h^h + \phi n_f^h)} \quad (13)$$

$$\frac{\partial S_f^f}{\partial n_h^h} = \frac{\phi (n_h^h + n_f^h)^{1/\sigma - 1} (n_f^h + \phi n_f^h)^{1/\sigma}}{[(n_h^h + \phi n_f^h)^{1/\sigma} + (n_f^h + \phi n_f^h)^{1/\sigma} ]^2} = \frac{\phi S_h^h S_f^f}{\sigma (n_h^h + \phi n_f^h)} \quad (14)$$

$$\frac{\partial S_h^h}{\partial n_f^f} = \frac{\phi (n_h^h + \phi n_f^h)^{1/\sigma - 1} (n_f^h + n_f^h)^{1/\sigma}}{[(n_h^h + \phi n_f^h)^{1/\sigma} + (n_f^h + \phi n_f^h)^{1/\sigma} ]^2} = \frac{\phi S_h^h S_f^f}{\sigma (n_h^h + \phi n_f^h)} \quad (15)$$

$$\frac{\partial S_f^f}{\partial n_f^f} = \frac{1}{\sigma} \frac{(n_h^h + \phi n_f^h)^{1/\sigma - 1} (n_f^h + \phi n_f^h)^{1/\sigma}}{[(n_h^h + \phi n_f^h)^{1/\sigma} + (n_f^h + \phi n_f^h)^{1/\sigma} ]^2} = \frac{S_h^h S_f^f}{\sigma (n_h^h + \phi n_f^h)} \quad (16)$$

The marginal effect hinges upon markets’ shares themselves. For instance, in (13), the marginal effect of an increase in $n_h^h$ depends on both $S_h^h$ and $S_f^f$. Assume that $S_h^h$ is close to zero and $S_f^f$ is close to one. Then the marginal effect of rising $n_h^h$ will be small itself, and $S_h^h$ will be still close to zero. The same is true if $S_h^h$ is close to one and $S_f^f$ is close to zero. In this case, a marginal change in $n_h^h$ will leave $S_h^h$ almost unaltered and close to one. Partial derivatives from (13) to (16) show that incentives to introduce new varieties (measured in terms of gains in the market share) are the highest when the two firms equally share the country’s market. Substituting the partial derivatives back into (11) and (12) we get

$$\begin{cases} 
E_h[1 + 2(\sigma - 1)S_h^h] \frac{S_h^h S_f^f}{(n_h^h + \phi n_f^h)} + E_f[1 + 2(\sigma - 1)S_f^f] \frac{\phi S_h^h S_f^f}{(n_h^h + \phi n_f^h)} = \sigma^2 F \\
E_h[1 + 2(\sigma - 1)S_h^h] \frac{\phi S_h^h S_f^f}{(n_h^h + \phi n_f^h)} + E_f[1 + 2(\sigma - 1)S_f^f] \frac{S_h^h S_f^f}{(n_h^h + \phi n_f^h)} = \sigma^2 \Gamma F 
\end{cases}$$

This system can be solved to retrieve $Fn_h^h$ and $Fn_f^f$, the stock of capital belonging to the home multinational, invested at home and abroad. Applying Cramer’s rule, I obtain:

$$\begin{cases} 
n_h^h + \phi n_f^h = \frac{E_h[1 + 2(\sigma - 1)S_h^h] S_h^h S_f^f (1 - \phi^2)}{\sigma^2 F (1 - \Gamma \phi)} \equiv \eta \\
\phi n_h^h + n_f^f = \frac{E_f[1 + 2(\sigma - 1)S_f^f] S_h^h S_f^f (1 - \phi^2)}{\sigma^2 F (\Gamma - \phi)} \equiv \eta^* 
\end{cases} \quad (17)$$

where the system allows as admissible an interior solution ($n_h^h > 0$ and $n_f^f > 0$) if the iceberg investment cost is small enough, $\Gamma < 1/\phi$.

**Condition 1.** To have an interior solution, the necessary condition $\Gamma < 1/\phi$ has to be satisfied.

Solving in turn system (17), the solution is

$$n_h^h = \frac{\eta - \phi \eta^*}{1 - \phi^2}, \quad n_f^f = \frac{\eta^* - \phi \eta}{1 - \phi^2}$$

Let us substitute back all the parameters in order to get an explicit solution for the home and
foreign stocks of capital:

\[ n_h^h F = \frac{E_h[1 + 2(\sigma - 1)S_{h}^h]S_{h}^hS_{f}^h}{\sigma^2(1 - \Gamma \phi)} \frac{\phi}{(1 - \Gamma \phi)} \frac{E_f[1 + 2(\sigma - 1)S_{f}^h]S_{h}^hS_{f}^h}{\sigma^2} \]  \hspace{1cm} (18)

\[ n_f^h F = \frac{E_f[1 + 2(\sigma - 1)S_{f}^h]S_{f}^hS_{h}^h}{\sigma^2(1 - \Gamma \phi)} \frac{\phi}{(1 - \Gamma \phi)} \frac{E_h[1 + 2(\sigma - 1)S_{f}^h]S_{h}^hS_{f}^h}{\sigma^2} \]  \hspace{1cm} (19)

The model I presented implies necessarily that, in equilibrium, (18) and (19) holds, where the stock of investment at home and abroad is a function of market shares. These relations are the result of profit maximizing simultaneous choices on the mass of varieties to be located in each local market, \( n_h^h \) and \( n_f^h \). The number of varieties introduced by the MNCs is limited due to a cannibalization effect: new varieties decrease operating profits of existing ones. MNCs work out where it is more profitable to locate such a limited number of varieties.

Let us concentrate on (19), the foreign stock of capital hold by the home MNC. It is a gravity equation. The FDI stock by the home MNC in the foreign country is positively related to expenditure in the foreign region, \( E_f \), and inversely related to manufacturing expenditure in the home region, \( E_h \). It is positively related to total market share in the foreign region of the home MNC, \( S_f^h = (1 - S_f^f) \). There are two forces operating here. First, there is the role played by the partial derivative (16), stating that the marginal effect of the number of foreign affiliates on the market share \( S_f^h \) is increasing both in \( S_f^h \) and \( S_f^f \). Second, market share in the foreign market itself, \( S_f^h \), affects investment abroad through the term \( 2(\sigma - 1)S_f^h \) as well. This force operates only if varieties are substitutes among themselves, \( \sigma > 1 \). The economic interpretation is straightforward, provided that, when \( \sigma > 1 \), the MNC faces an increasingly inelastic demand the higher its market share is. This effect is stronger the higher is \( \sigma \); that is, the higher the substitutability among varieties. In this case the rise in the mark-up crucially depends on the overall market share the MNC enjoys in the market. The higher is the mark-up, the higher are operating profits, and the higher is the stock of foreign varieties located in equilibrium abroad.

The stock of foreign capital negatively depends on market shares in the home market of the home MNC, \( S_h^h \), and of the foreign MNC, \( S_f^f \), because these variables are positively associated to the profitability of the home market, and the FDI stock by the home MNC is inversely related to the attractiveness of the home market.

The investment stocks of the foreign MNC are symmetric to (18) and (19). I write down an explicit expression for \( n_f^h F \) only:

\[ n_f^h F = \frac{E_h[1 + 2(\sigma - 1)S_{h}^h]S_{h}^hS_{f}^h}{\sigma^2(1 - \Gamma \phi)} \frac{\phi}{(1 - \Gamma \phi)} \frac{E_f[1 + 2(\sigma - 1)S_{f}^h]S_{h}^hS_{f}^h}{\sigma^2} \]  \hspace{1cm} (20)

Both sides of equations (19) and (20) can be normalized with respect to the total expenditure in the two countries, \( E_h + E_f \). The FDI stock by the foreign MNCs in the home country is then

\[ \text{fdi}_h^f = \frac{1}{\sigma^2(1 - \Gamma \phi)} \lambda_h[1 + 2(\sigma - 1)S_{h}^h]S_{h}^hS_{f}^h - \frac{\phi}{\sigma^2(1 - \Gamma \phi)} (1 - \lambda_h)[1 + 2(\sigma - 1)S_{f}^h]S_{f}^hS_{f}^h \]  \hspace{1cm} (21)
where \( \lambda_h = E_h/(E_h + E_f) \). The equation can be written more compactly as

\[
fdi_h^f = \beta_{host} \lambda_h [1 + 2(\sigma - 1)S_f^h S_h^n] S_f^h = \beta_{source} (1 - \lambda_h) [1 + 2(\sigma - 1)S_f^h S_f^h].
\] (22)

3.2 The Market Share Effect

The world amount of FDI stock in the economy as a share of world expenditure predicted by the model is the sum of (19) and (20):

\[
\frac{(n_f^h + n_f^f)F}{E_h + E_f} = \lambda_f S_h^f \left( 1 - S_f^f \right) \frac{1 - 2\Gamma\phi + \phi^2}{\sigma^2 (1 - 1)} \left( 1 + 2(\sigma - 1) \frac{(1 + \phi)(1 - \phi)}{1 - 2\Gamma\phi + \phi^2} \left( S_f^h - \frac{1}{2} \right) + \frac{1}{2} \right)
\]

\[
+ \lambda_h S_f^f \left( 1 - S_f^f \right) \frac{1 - 2\Gamma\phi + \phi^2}{(1 - \phi)(1 - 1)\phi} \left( 1 + 2(\sigma - 1) \frac{(1 + \phi)(1 - \phi)}{1 - 2\Gamma\phi + \phi^2} \left( S_f^h - \frac{1}{2} \right) + \frac{1}{2} \right)
\]

\[
\frac{(n_f^h + n_f^f)F}{E_h + E_f} = \lambda_f S_h^f \left( 1 - S_f^f \right) \frac{1 - 2\Gamma\phi + \phi^2}{\sigma^2 (1 - 1)} \left( 1 + 2(\sigma - 1) \frac{(1 + \phi)(1 - \phi)}{1 - 2\Gamma\phi + \phi^2} \left( S_f^h - \frac{1}{2} \right) + \frac{1}{2} \right)
\]

(23)

where \( \lambda_f \equiv E_f/(E_h + E_f) \) is the foreign share of world total expenditure, and \( \lambda_h \equiv E_h/(E_h + E_f) \) is the home share of world expenditure. The expression (23) was obtained employing the relations \( S_f^f = 1 - S_f^h \), and \( S_f^h = 1 - S_f^f \).

The share of total FDI to total expenditure in the two countries is positively related to the term

\[
\Delta(\Gamma, \phi) \equiv \frac{1 - 2\Gamma\phi + \phi^2}{(1 - \phi)(1 - 1)\phi}
\]

representing trade and FDI frictions. It can be easily proved that \( \partial \Delta(\Gamma, \phi)/\partial \phi < 0 \), so that when \( \phi \) goes down (higher trade barriers) the stock of world FDI grows accordingly. This is a standard result in the horizontal FDI literature. Additionally, \( \partial \Delta(\Gamma, \phi)/\partial \Gamma < 0 \), which means that the world stock of FDI is decreasing in the barriers to foreign investment. Finally notice that variations in \( S_f^h \) and \( S_f^h \) provoke a more than proportional variation in what we call the Market Share Effect terms, MSE hereafter. The more than proportional variation originates from the fact that

\[
\frac{(1 + \phi)(1 - \phi)}{1 - 2\Gamma\phi + \phi^2} > 1
\]

The MSE is stronger the higher \( \sigma \) is; that is, the lower the market power of each variety produced by the multinational. The economic intuition behind the MSE term is the following. A rise in the foreign market share by the home MNC, \( S_f^h \), rises the stock of FDI belonging to the home MNC through the term \( 2(\sigma - 1)S_f^h \) in (19). But as \( S_f^h \) rises, the foreign market share of the foreign MNC, \( S_f^f \), goes down. A fall in \( S_f^f \) puts pressure on the foreign MNC to increase its stock of foreign capital (see what happens to \( n_f^h F \) through the term \( 2(\sigma - 1)S_f^f \) in (20)). In other terms,

\[\text{To prove this result, decompose } \Delta(\cdot) \text{ in two separate terms: } (1 - 2\Gamma\phi + \phi^2)/(1 - \Gamma\phi) \text{ and } 1/(1 - \phi). \text{ It is then easy to check that they are both decreasing in } \Gamma.\]
market penetration by the home MNC in market $f$, will make the foreign MNC more aggressive on market $h$, in response to the home MNC’s action. The interaction among these reciprocal effects will determine a more than proportional rise in the world FDI stock in response to an initial rise of $S^h_f$. This constitutes the Market Share Effect.

Let us derive the FDI stock of the home MNC in the foreign country net of the reciprocal investment stock of the foreign MNC in the home country, as a share of world expenditure. It is equal to

\[
\left(\frac{v^h_f - v^f_h}{E_h + E_f}\right)F = \frac{\lambda_f S^h_f (1 - S^h_f)}{\sigma^2} \frac{(1 + \phi)(1 - \phi)}{(1 - \phi)(1 - \Gamma)} \left\{1 + 2(\sigma - 1) \frac{1 - 2\Gamma \phi + \phi^2}{(1 + \phi)(1 - \phi)} \left(S^h_f - \frac{1}{2}\right) + \frac{1}{2}\right\}
\]

\[
- \frac{\lambda_h (1 - S^f_h) S^f_f}{\sigma^2} \frac{(1 + \phi)(1 - \phi)}{(1 - \phi)(1 - \Gamma)} \left\{1 + 2(\sigma - 1) \frac{1 - 2\Gamma \phi + \phi^2}{(1 + \phi)(1 - \phi)} \left(S^f_f - \frac{1}{2}\right) + \frac{1}{2}\right\}
\]

Results are just symmetric to those for total FDI stocks. Since

\[
1 - 2\Gamma \phi + \phi^2 < 1
\]

an increase in $S^h_f$ will lead to a less than proportional increase in the net FDI stock of the home MNC with respect to foreign MNC’s FDI holdings, since the foreign MNC will increase its FDI stock in the home region in response to home MNC’s foreign investment.

4 Empirical implementation

Equation (22), and the symmetric expression for $f_{di}^f$, can be applied to our data, pooling together the observations for US and Japan. The equation should not be interpreted in a causal manner. It is not correct to say that market shares’ variables on the right-hand side “cause” in an economic sense the FDI variable, since they are rather simultaneously determined. In other terms, market shares and FDI stocks are endogenous. What equation (22) does is to present a necessary condition that has to hold in equilibrium.

I apply the nonlinear least squares estimator, given the functional shape of the equation, where the parameters to be estimated are $\beta_{host}$, $\beta_{source}$, and $\sigma$, while $\lambda_h$ and the market shares are the right-hand side variables. In the empirical estimation I also try to add a constant, so that equation (22) becomes

\[
\begin{align*}
\text{fdi}^f_h & = \text{const} + \beta_{host}\lambda_h[1 + 2(\sigma - 1)S^f_f S^h_h - \beta_{source}(1 - \lambda_h)] + 2(\sigma - 1)S^f_f S^h_h, \\
\end{align*}
\]

In place of the constant, I also estimate a specification with a linear trend in the regression. Results are presented in Table 3, under different specifications explained in the table’s note.
The key points are that, while the coefficients on the host and source countries’ market shares have the expected sign, the coefficient on the substitutability parameter is less than 1, and not in accordance with the theory.

5 Conclusion

This paper builds a theoretical relation predicting FDI stocks in the presence of two multiproducts multinational firms. In particular, the stock of FDI in a certain country is expected to be related to MNCs’ market shares, both at home and abroad. I also described why we could expect a more than proportional rise in the total stock of FDI after an initial rise in the foreign market share by a MNC. I termed this feature of the model the Market Share Effect.

Although the relations derived in the paper should not to be interpreted in a causal manner (FDI stocks and MNCs’ market shares are simultaneously determined in the framework of the same maximization choice by the MNCs, so that they are both endogenous), I estimated whether the necessary equilibrium conditions I identified holds when applied to real data, in the case of Japan and US, over the period 1983-2004. The econometric implementation offers at the moment only limited support to the theory, but, given the preliminary nature of the paper, I take these results as a starting point, rather than a rejection of the theory. In the future, I plan to refine the econometric analysis, given the times-series dimension of data.

Tables

The tables of the paper follow.
Table 1: Correlation matrix among variables

<table>
<thead>
<tr>
<th></th>
<th>$S_h^f$</th>
<th>$S_h^b$</th>
<th>$S_f^h$</th>
<th>$S_f^f$</th>
<th>fdi$_h^f$</th>
<th>fdi$_f^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_h^f$</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_h^b$</td>
<td>-0.63</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>$S_f^h$</td>
<td>-0.81</td>
<td>0.67</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$S_f^f$</td>
<td>0.34</td>
<td>-0.56</td>
<td>-0.19</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fdi$_h^f$</td>
<td>0.78</td>
<td>-0.64</td>
<td>-0.59</td>
<td>0.54</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>fdi$_f^b$</td>
<td>-0.34</td>
<td>0.41</td>
<td>0.45</td>
<td>-0.51</td>
<td>-0.12</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: The table reports pairwise correlation coefficients among selected variables.

Table 2: Dependent variable: Outward FDI stock as a share of host country GDP

<table>
<thead>
<tr>
<th></th>
<th>[1]</th>
<th>[2]</th>
<th>[3]</th>
<th>[4]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FDI to Japan (fdi$_f^b$)</td>
<td>FDI to Japan (fdi$_f^b$)</td>
<td>FDI to US (fdi$_h^f$)</td>
<td>FDI to US (fdi$_h^f$)</td>
</tr>
<tr>
<td>$S_f^h$</td>
<td>0.207*</td>
<td>0.169***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.106)</td>
<td>(0.022)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_f^f$</td>
<td>-0.024***</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.004)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_h^f$</td>
<td></td>
<td></td>
<td>0.581***</td>
<td>0.533***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.153)</td>
<td>(0.137)</td>
</tr>
<tr>
<td>$S_h^b$</td>
<td></td>
<td></td>
<td>-0.037*</td>
<td>-0.045**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.018)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Linear trend</td>
<td>0.001***</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.51</td>
<td>0.93</td>
<td>0.65</td>
<td>0.67</td>
</tr>
<tr>
<td>no. obs.</td>
<td>19</td>
<td>19</td>
<td>21</td>
<td>21</td>
</tr>
</tbody>
</table>

Note: The table reports the results of OLS regressions which include a constant. The dependent variable is the ratio of outward FDI to host country GDP. Robust standard errors are in parentheses. ***, ** and * denote significance at the 1, 5 and 10 per cent level.
Table 3: Dependent variable: Outward FDI stock as a share of the sum of GDPs in Japan and US

<table>
<thead>
<tr>
<th></th>
<th>[1]</th>
<th>[2]</th>
<th>[3]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host country shares ($\beta_{host}$)</td>
<td>0.679***</td>
<td>0.517**</td>
<td>0.622***</td>
</tr>
<tr>
<td></td>
<td>(0.069)</td>
<td>(0.243)</td>
<td>(0.076)</td>
</tr>
<tr>
<td>Source country shares ($\beta_{source}$)</td>
<td>1.410***</td>
<td>1.605***</td>
<td>1.523***</td>
</tr>
<tr>
<td></td>
<td>(0.274)</td>
<td>(0.396)</td>
<td>(0.276)</td>
</tr>
<tr>
<td>Substitutability ($\sigma$)</td>
<td>0.225***</td>
<td>0.295***</td>
<td>0.246***</td>
</tr>
<tr>
<td></td>
<td>(0.043)</td>
<td>(0.098)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear trend ($\gamma$)</td>
<td></td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.000)</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.89</td>
<td>0.67</td>
<td>0.90</td>
</tr>
<tr>
<td>no. obs.</td>
<td>37</td>
<td>37</td>
<td>37</td>
</tr>
</tbody>
</table>

Note: The table reports the results of nonlinear least squares regressions. The dependent variable is the ratio of outward FDI to the sum of the GDPs of Japan and US. Column [1] is the baseline regression. In column [2] an additive constant is included in the baseline equation. In column [3] an additive linear trend is included. Standard errors are in parentheses. ***, ** and * denote significance at the 1, 5 and 10 per cent level.
References


