VERY PRELIMINARY DRAFT

FDI and International Trade Relations: A Theoretical Approach

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Abstract

The mainstay theory provides arguments for both complementary and substitute links between FDI and international trade. In accordance to that, a number of empirical investigations indicate a replacement of trade flows by FDI, while other studies reveal a complementary effect between the two. An empirical paper, presented by Zarotiadis and Mylonidis in ETSG 2005, examines the relationship between FDI and trade in the UK with its primary trading partners. Overall, the reported findings provide support for complementary effects of FDI on trade, mainly at the highest level of aggregation.

The present study models autarky and trade between two countries in a manner that resembles the real world trade patterns. The objective is to provide the theoretical basis upon which one may introduce bilateral FDI flows. The model follows Fujita's *et al.* (1999) logic which is based on a spatial transformation of the Dixit-Stiglitz approach with monopolistic competition, increasing returns to scale and iceberg-type transport costs. We introduce capital as an additional production factor and assign marginally different capital intensity to each differentiated product. Letting capital be mobile will provide a framework that incorporates different relations between FDI and trade, at each level of aggregation, and will offer interesting theoretical conclusions.

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1. Introduction

The motivation for this paper is the contradictory empirical evidence as to whether FDI complements or substitutes trade. The goal for the present study is to provide a theoretical basis regarding the relationship between FDI and trade, which has been mainly investigated through empirical works. A range of contributions find a substitute relationship between the two; Ma et al (2000) and Bayoumi and Lipworth (1997) use for that purpose data from Japan, while Graham (1999) finds similar substitutability for the USA. Still, Helpman et al (2003) point out that this result may depend upon freight and tariff costs. In contrast, Brainard (1997) and Clausing (2000) for the U.S.A. and Co (1997) for Japan find evidence of FDI-trade complementarity. Pfaffermayer (1996) follows an atypical methodology starting from the argument that outward FDI and exports can have common determinants such as capital, labour, skill and R&D intensities. He estimates a simultaneous equation system using time series and cross-sectional industry-level data from Austrian manufacturing and finds a significant complementary relationship between FDI and exports in the 1980's and early 1990's. Liu et al (2001) also provide an interesting empirical study by applying a panel data approach using data from China. They conclude on a cyclical complementary relationship between trade flows (imports and exports) and FDI that generates a reinforcing tendency for both, which fits well to the experiences over the last two decades in the specific country. On the contrary, Swenson (2004), Head and Ries (2001), Blonigen (2001), Goldberg and Kein (1999) and Nakumara and Oyama (1998) find substantial evidence for the presence of both substitute and complementary relationships. Other recent empirical contributions focus on more restricted questions. Fukao et al (2003) for instance examine patterns of vertical intra-industry trade in East Asia and find that the FDI in the particular region plays a significant role in enhancing the specific type of trade.

One should not be surprised by the fact that the existing empirical literature is in some way inconclusive regarding the specific question. It simply addresses the complex reality, as well as a series of stylised facts regarding multinationals, trade and FDI, which are often inadequately explained by most trade theory. More specifically, multinationals undertake about two-thirds of international trade. In addition, around one third of world trade is intra-firm trade. Finally, the world pattern of FDI is remarkably similar to the world trade pattern. Yet the mainstay theory of FDI posits FDI as an explicit alternative to trade.

The present study models autarky and trade between two countries in a manner that resembles the real world trade patterns. The objective is to provide the theoretical basis upon which one may introduce, at a later stage, bilateral FDI flows. Before delineating the logic of our model, we briefly examine seminal papers that seek to integrate multinationals into models of international trade. The early attempts can be traced back in the 1980s. Batra and Ramachandran (1980) integrate multinationals into a Heckscher-Ohlin framework, but as Markusen (1984) points out, "formal trade theory has largely failed to provide a rationale as to why these corporations exist at all". Helpman (1984) develops a general equilibrium model of international trade that justifies the existence of vertical FDI motivated by differences in factor prices. Markusen's (1984) model allows, under certain conditions, the emergence of a multi-plant equilibrium with horizontal FDI. Brainard (1993) develops the proximity-versus-scale approach. In essence, she argues that a firm's location decision choice is based on the relevance of two factors, namely trade costs and economies of scale. If trade costs outweigh economies of scale the firm proceeds to FDI. If economies of scale outweigh trade costs the firm consolidates production at home. The problem with this approach is that firms either engage in trade, or in FDI, but not both. Hence, it struggles to justify the similarity between trade and FDI patterns. Markusen and Venables (1998, 2000) allow multinationals to arise endogenously. In their 1998 paper they use a Cournot oligopoly model of the firm with homogeneous goods and positive trade costs, whereas, in their 2000 paper they introduce trade costs to the Dixit-Stiglitz monopolistic competition model. In these models, horizontal multinationals arise for selected combinations of endowments as an alternative means of supplying the export market. Baldwin and Ottaviano (2001) provide a theoretical justification for the similarity in trade and FDI patterns. They posit a model where multiproduct, final goods firms simultaneously engage in intraindustry FDI and intraindustry trade. Multiproduct firms use trade costs to reduce inter-variety competition by placing production of some varieties abroad. Since the varieties are differentiated, all varieties are sold in all markets. Therefore, while FDI displaces some exports, it also creates trade via reverse imports.

The remainder of this paper is organised as follows. Section 2 presents the linkages between international trade flows and FDI according to the theory of multinational enterprises. Section 3 outlines the model and section 4 concludes the paper.

2. The theory of multinational enterprises and the linkages between trade and FDI flows.

The theory of Multinational Enterprises (MNEs) develops its argumentation by concentrating on two questions: First, is the issue of *internalization*, i.e., the replacement of firm's external contracts by direct ownership and internal hierarchies. Market imperfections are the key arguments in models that simulate such behaviour (Dunning 1981, Dunning and Rugman 1985, Hosseini 2005). Second, is the question of *location*, which is directly related to the links between flows of goods and flows of production factors (capital). In other words, taking internalization and the resulting horizontal or vertical structure of an MNE as given, the question that emerges is how to locate the different activities and organizational units in a specific region.

There are three fundamental justifications that explain the choice of the location and the resulting FDI flows: First, based on the tradition of standard trade theory, FDI flows from country *o* (origin country) to country *h* (host country) are due to less relative abundance of capital in *h*. The effects on trade are clearly negative: both imports from and exports to *o* (and to the rest of the world) are eroded (partially or fully) as the comparative advantage that stimulates this trade are suppressed. Second, FDI flows emerge from the existence of comparative advantages, other than capital, in country *h* (e.g., weather or culture). In this case, capital is needed to flow in country *h* in order to activate the specific underused comparative advantages. In this case of supply-driven FDI, exports from country *h* to the rest of the world (including country o) are increased[1]. These two cases provide the basis for vertical FDI flows between dissimilar regions (Markusen and Maskus, 2002). Third, one can identify the case of demand-driven FDI which appears when country *h* is characterised by a sufficient and secure demand surplus. Foreign firms choose either to export (low constant / high marginal cost) or to relocate their production facilities in *h* (high constant / low marginal cost). The size of *h* and the existence of trade barriers and transportation costs are decisive for the final choice.[2]

[1] See Greaney (2003) for an alternative justification of reverse importing, based on network effects.
[2] Vernon's (1966) product cycle hypothesis discusses also this trade-off between FDI and imports relating it to different phases of the development of the targeted market.

Demand-driven FDI substitutes country *h*'s imports, thus creating horizontally structured MNEs.

Tadesse and Ryan (2004) propose a further reasoning that combines the aforementioned cases. Country *h* may be an ideal export platform towards other foreign markets due to its location and/or to the political economy of the trade regime governing the country *h* and its neighbours. MNEs expand horizontally in their effort to optimize the logistic of satisfying the regionally segmented world demand, yet, the choice of locating their investments is clearly supply-driven and it complements country *h*'s exports to the rest of the world.

The picture completes with three additional arguments that can be combined with the above discussed cases. First, there is the case of increasing returns to scale which result in a complementary relationship between FDI and exports from the country *h*. Second, consumers' tastes in country *h* may change as they become more familiar with country *o*'s products due to the presence of multinationals (Swenson 2004). Finally, intermediate goods needed for the production of the affiliates located in *h* are preferably obtained from country *o*, either through the market (from other firms sited in *o*), or through internalized exchanges with the parent-company (intra-firm trade, see Tang and Madan 2003).[3]

Table 1 provides an overview of the aforementioned cases regarding the effects of FDI flows on bilateral trade.

[3] Blonigen (2001), Zeile (1998), Bergsten and Noland (1993) and Swenson (1997) argue that firms exhibit a home-bias in their input purchasing patterns. Yet, Swenson (2004) suggests that this bias declines as foreign investment activity increases in the country *h* , hence providing an additional reason for substituting imports from country *o*.

Table 1: Overview of the theoretically documented relations between bilateral trade - FDI flows

<table>
<tr><td rowspan="2"></td><td rowspan="2">**Case**</td><td colspan="2">**Effect on:**</td></tr>
<tr><td>**Imports of country *h* from country *o***</td><td>**Exports from country *h* to country *o***</td></tr>
<tr><td rowspan="6">**Case: FDI flow from country *o* to country *h***</td><td>**Standard Trade Theory**

Country *o* has a relative abundance of capital and *h* accordingly of labour.

Supply-driven FDI</td><td>decrease because…
country *o*'s comparative advantage is eroded (partially or fully)

Manufacturing level effect</td><td>decrease because…
country *h's* comparative advantage is eroded (partially or fully)

Manufacturing level effect</td></tr>
<tr><td rowspan="2">**Spatial Arguments**

Country *h* has a comparative advantage in specific productions, which is not related to the use of capital.

Supply-driven FDI</td><td>increase in case…
intermediate goods are imported from *o* for the needs of the affiliate

Primarily industry level effect</td><td>increase because…
affiliates' cheaper production is partly sold back in country *o* (reverse importing)

Industry level effect</td></tr>
<tr><td>increase in case …
there is a movement in country's *h* consumer tastes towards other *o*-originated products

Manufacturing level effect</td><td>increase in case …
industries exhibit increasing returns to scale

Industry level effect</td></tr>
<tr><td rowspan="3">**Standard MNE Theory**

Country *h* has a sufficient and (relative) secure demand surplus.

Demand-driven FDI</td><td>decrease because…
initial imports are substituted by the sales of the affiliate in *h* (proximity argument)

Industry level effect</td><td rowspan="3">increase in case …
production exhibits increasing returns to scale either at firm level (reverse importing) or industry level

Industry level effect</td></tr>
<tr><td>increase in case…
intermediate goods are imported from *o* for the needs of the affiliate

Primarily industry level effect</td></tr>
<tr><td>increase in case …
there is a movement in country's *h* consumer tastes towards other *o*-originated products

Manufacturing level effect</td></tr>
</table>

3. The Model

3.1. Autarky in a Dixit-Stiglitz Model with a production and a pseudo-production factor (labor and capital).

- **Demand**

Utility Function: $U=\prod_{i=1}^{m}(M_i)^{\mu} A^{1-m\mu}$,

M_i represents a composite of the consumption of differentiated goods from each manufacturing sector i (i=1,2,…,m) and A the consumption of the homogenous agricultural (non-traded) good.

Sub-Utility Function: $M_i=[\int x_{ij}^{\varrho}dj]^{1/\varrho}$, where x_{ij} is the consumption of variety j from manufacturing sector i and ∫ represents the integral over the whole range of varieties in that sector $[0,n_i]$. Further, $0<\varrho<1$ represents the intensity of the preference for variety in manufactured goods and $\sigma\equiv 1/(1-\varrho)$ is the elasticity of substitution between any two varieties.

Consumer decision[4]: 1st Step: minimize costs ($\int p_{ij}x_{ij}dj$) for attaining a given M_i (subject to the above expression of M_i), where p_{ij} is the price of variety j in manufacturing sector i.

From this minimization problem we get the compensated demand function:

$x_{ij}=(p_{ij}/G_i)^{1/\varrho-1}M_i$, where G_i is an expression for a price index of all the varieties of the manufactured varieties in sector i,

$G_i=[\int p_{ij}^{\varrho/\varrho-1}dj]^{\varrho-1/\varrho}$

2nd Step: maximize utility (U) subject to the overall income constrain of the whole economy,

$\sum_{i=1}^{m} G_iM_i + p_AA=Y$

We get the uncompensated aggregate demand functions:

$A=(1-\mu)Y/p_A$ and

$M_i=\mu Y/G_i$, or equally, $x_{ij}=\mu Y G_i^{(\sigma-1)}p_{ij}^{-\sigma}$.

- **Production**

Cost Function: The homogenous "agricultural" good is produced using a constant returns to scale technology under conditions of perfect competition.

[4] A two stage budgeting procedure is applicable because preferences are separable between agriculture and each sector of manufactures, M_i, the subutility function for manufacturers, is homothetic in the quantities m_{ij}. (Deaton A. and J. Muellbauer (1980)).

Manufacturing, however, involves economies of scale at the level of each variety, because of the fix (capital) costs. We assume the following cost function:

$C_{ij} = rk_i + w\gamma_i q_{ij}$, where q_{ij} is the produced quantity of variety j in sector i.

Note that all varieties of each sector i are produced using the same technology. Yet, marginal labor requisites, γ_i, and fix capital costs, k_i, are sector specific. We assume that there is an order of the different manufacturing sectors: $dk_i/di>0$ and $d\gamma_i/di<0$.[5]

Profit: The profit function for each variety is:

$\pi_{ij}=p_{ij}q_{ij}- rk_i - w\gamma_i q_{ij}$

Recall that in the expression of firm's revenues ($p_{ij}q_{ij}$) the sold quantity q_{ij} is given by the demand function $q_{ij}=x_{ij}=\mu \Upsilon G_i^{(\sigma-1)} p_{ij}^{-\sigma}$. If we assume that each firm takes the sector specific price index G_i as given, we can derive that perceived elasticity of demand σ (calculated as $p_{ij}\partial x_{ij}/x_{ij}\partial p_{ij}$). Thereafter, marginal revenues are $p_{ij}(1-1/\sigma)$, or equally $p_{ij}\varrho$. By applying profit maximization, which implies that each producer has to produce till the point where marginal revenues are equal to marginal costs, we derive the equilibrium prices:

$p_{ij}*=p_i*=w\gamma_i/\varrho$ eq. (1)

Eq. (1) gives the price at which each producer can sell the profit maximizing output. Note that the price for selling the profit maximizing output is the same for all varieties of a sector. Given eq. (1), the profit of each manufacturing firm in sector i is:

$\pi_{ij}= w\gamma_i q_{ij}/(\sigma-1) - rk_i$

We assume free entry or exit. Therefore, as soon as any firm producing a variety j in sector i makes positive profit, new firms producing a differentiated variety of sector i enter. In other words, as n_i increases, the sector specific price index decreases ($dG_i/dn_i<0$) and, hence the demand curve for each one variety in sector i shifts downwards. This continues till the maximum profit achieved by each firm in sector i equals zero.

The zero profit condition implies that the equilibrium output of any active firm in sector i is:

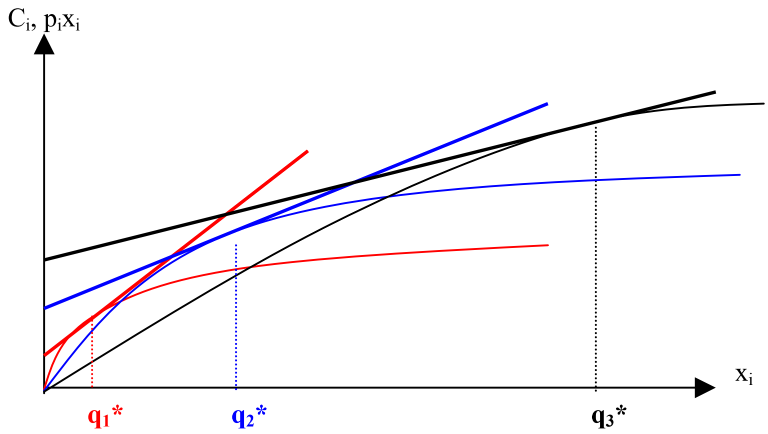
$q_{ij}*= q_i*= r(w\gamma_i)^{-1}\varrho(1-\varrho)^{-1} k_i$

Next, we calculate equilibrium labor input of any active firm in sector i as:

$l_{ij}*= l_i*=\gamma_i q_i*= r(w)^{-1}\varrho(1-\varrho)^{-1} k_i$

[5] For instance, the simplest way of doing that is by setting: $k_i=\varphi i$ and $\gamma_i=\varphi/i$, where $\varphi>0$.

Note that if $dk_i/di>0$ and $d\gamma_i/di<0$, sector specific equilibrium output (and employment) for each firm is higher in sectors with higher required fixed capital investment and labor productivity $(1/\gamma)$. This can be graphically depicted as follows:



The bold straight lines represent the cost functions for each sector, and the concave lines show the total revenue curves for each sector. While no firm makes positive profit, firms belonging in capital intensive sectors employ more labor and produce more ($q_1^*<q_2^*<q_3^*$).[6]

- **Factor Markets**

Factor Endowments: There is a constant endowment of capital and labor, K and L, respectively.

Use of Factors: Capital is needed as a constant fixed initial investment in order to facilitate production. Hence, the amount of invested capital is simply the integral of capital requirements over the whole range of the manufactured varieties (n_i) in all manufacturing sectors:

$$\sum_{i=1}^{m} \int k_i \, dj = \sum_{i=1}^{m} n_i k_i$$

In order to derive the inputs of manufacturing labor (employees), we need to consider the extent of production in each variety:

$$\sum_{i=1}^{m} \int l_i^* \, dj = \sum_{i=1}^{m} \int \gamma_i q_i^* \, dj = \sum_{i=1}^{m} n_i k_i \, r(w)^{-1} \varrho (1-\varrho)^{-1}$$

Full Employment:

$$\sum_{i=1}^{m} n_i k_i = K$$

$$\sum_{i=1}^{m} n_i k_i \, r(w)^{-1} \varrho (1-\varrho)^{-1} = L$$

[6] Note that output here is expressed in a common measure (for instance, measured in "units of utility" or "units of produced value-added"). If sector 1 produces clothes and sector 3 produces cars, it is not implied that a shirt is more expensive than a car. It means, however, that the value of a unit of utility (or of value-added) produced in the clothing industry is higher than the value of a unit of utility (or of value-added) produced in the automobile industry.

i=1

➢ Autarky Equilibrium

Product markets: Clearing of product markets implies: $q_i^*=x_{ij}$. Substituting the respective expressions from above yields:

$r(w\gamma_i)^{-1}\varrho(1-\varrho)^{-1} k_i = \mu Y G_i^{(\sigma-1)} p_{ij}^{-\sigma}$

G_i can be calculated, since all varieties in sector i face the same price p_i^*:

$G_i=[\int p_{ij}^{\varrho/\varrho-1}dj]^{\varrho-1/\varrho}=[\int (p_i^*)^{\varrho/\varrho-1}dj]^{\varrho-1/\varrho}=p_i^* n_i^{\varrho-1/\varrho}=p_i^* n_i^{1/(1-\sigma)}$.

Substituting G_i in the product market clearing condition, we derive:

$r(w\gamma_i)^{-1}\varrho(1-\varrho)^{-1} k_i = \mu Y(p_i^* n_i)^{-1}$

Substituting eq. (1) we find that:

$r(1-\varrho)^{-1} k_i = \mu Y(n_i)^{-1}$

Solving with respect to k_i:

$k_i = (1-\varrho)\mu Y(r\, n_i)^{-1}$ eq. (2)

Factors' rewards: Substituting eq. (2) in the full employment conditions for capital and labor we get:

$r^* = m(1-\varrho)\mu Y K^{-1}$ and

$w^*= m\varrho\mu Y L^{-1}$

Recall that economy's income is given by:

$\sum_{i=1}^{m} \int p_i^* q_i^*\, dj + p_A A=Y$, or equally:

$\sum_{i=1}^{m}(n_i p_i^* q_i^*) + p_A A=Y$ eq. (3)

If we substitute eq. (1) into eq. (3) we get:

$w/\varrho \sum_{i=1}^{m}(n_i\gamma_i^* q_i^*) + p_A A=Y$ eq. (4)

If we express manufactured output in terms of labor inputs ($q_i^*= l_i^*/\gamma$) eq. (4) becomes:

$w/\varrho \sum_{i=1}^{m}(n_i l_i^*) + p_A A=Y$, or equally:

$w/\varrho\, L + p_A A=Y$ eq. (5)

Substituting eq. (5) in the above derived equations for the factors' rewards and rearranging leads to:

$w^*= m\mu\, \varrho\, p_A A\, (1-m\mu)^{-1} L^{-1}$ eq. (6)

$r^* = m\mu\, (1-\varrho)\, p_A A\, [1+m\mu(1-\mu m)^{-1}]\, K^{-1}$ eq. (7)

Another interesting expression can be obtained if we substitute w* and r* in the derived expression for the equilibrium output of all firms in each sector i:

$$q_i^* = \{m\mu\,(1-\varrho)\,p_A A\,[1+m\mu(1-\mu m)^{-1}]\,K^{-1}\}$$
$$\{[m\mu\,\varrho\,p_A A\,(1-m\mu)^{-1}\,L^{-1}]\,\gamma_i\}^{-1}$$
$$\varrho(1-\varrho)^{-1}\,k_i$$

After rearranging the following expression is derived[7]:

$$q_i^* = (L/K)\,(k_i/\gamma_i)$$

Since $n_i = (1-\varrho)\mu\Upsilon(r\,k_i)^{-1}$ from eq. (2), the total output of sector i is given by:

$$n_i q_i^* = (L/K)(1-\varrho)\mu\Upsilon(r\gamma_i)^{-1} \qquad \text{eq. (8)}$$

Checking the behavior of the model:

We first substitute eq. (5) in eq. (2) to derive the capital cost:

$$k_i = (1-\varrho)\mu\,(w/\varrho\,L + p_A A)\,(r\,n_i)^{-1}$$

We replace w and r from eq. (6) and eq. (7) and by rearranging we obtain:

$$n_i = K\,(k_i)^{-1}\,m^{-1} \qquad \text{eq. (9)}$$

Using eq. (8) and eq. (9), we calculate again total output of sector i:

$$n_i q_i^* = K\,(k_i)^{-1}\,m^{-1}\,(L/K)\,(k_i/\gamma_i) = L\,(\gamma_i)^{-1}\,m^{-1}$$

The value of total output of sector i is given by:

$$p_i^* n_i q_i^* = (w\gamma_i/\varrho)\,L\,(\gamma_i)^{-1}\,m^{-1} = (w/\varrho)\,L\,m^{-1}$$

Comparative Statics:

As we move to sectors of higher capital intensity (higher i) we observe:

- less firms,
- less differentiated products,
- higher labor input,
- prices decrease
- total output increases,
- but the value of sector's total output does not depend on sector's order (i). It only depends on μ_i, in case it differs from sector to sector.

Real Factors' Income: We can derive the equilibrium real wage (ω*) and equilibrium real interest (ε*), by dividing w* and r* by the cost of living index (CLI):

[7] If we set $k_i=\varphi i$ and $\gamma_i=\varphi/i$, where φ should be greater than zero, the expression becomes: $q_i^* = (L/K)\,i^2$

Let us first explore this index:

$$CLI=\prod_{i=1}^{m}(G_i)^{\mu}\ p_A^{\ 1-m\mu} = \prod_{i=1}^{m}(p_i{*}n_i^{\ 1/(1-\sigma)})^{\mu}\ \ p_A^{\ 1-m\mu}$$

If we substitute $w\gamma_i/\varrho$ in place of price and K/mk_i in that of n_i and we set $\gamma_i=\varphi/i$ and $k_i=\varphi i$, we get:

$$CLI = (w/\varrho)^{m\mu}\ (K/m)^{m\mu/(1-\sigma)}\ \varphi^{m\mu\sigma/(\sigma-1)}\ p_A^{\ 1-m\mu}\ \Pi(i^{\mu(\sigma-2)/(1-\sigma)})$$

We can now use this expression to derive the real wage and interest, $\omega^*=w^*/CLI$ and $\varepsilon^*=r^*/CLI$.

$$\omega^* =(K^{m\mu/(\sigma-1)}/L^{1-m\mu})m^{m\mu/(1-\sigma)}A^{(1-m\mu)}\varphi^{m\mu\sigma(1-\sigma)}\Pi(i^{\mu(\sigma-2)/(\sigma-1)})\ \varrho[m\mu/(1-m\mu)]^{1-m\mu}$$

$$\varepsilon^* = (L^{m\mu}/K^{(\sigma-1-m\mu)/(\sigma-1)})\ m^{m\mu/(1-\sigma)}A^{(1-m\mu)}\varphi^{m\mu\sigma(1-\sigma)}\Pi(i^{\mu(\sigma-2)/(\sigma-1)})\ (1-\varrho)(1-m\mu)^{m\mu}m\mu^{1-m\mu}[1+m\mu(1-\mu m)^{-1}]^{-1}$$

The above expressions enable us to conclude that:

- An increase of L, other things equal, boosts real interest but reduces real wages.
- An increase of K leads always to higher real wages. If $1<\sigma<1+m\mu$, it will boost real interest too! Otherwise, if $\sigma>1+m\mu$, an increase of K will reduce real interest.
- Introduction of new sectors of higher order (increase of i) has also a non-monotone effect: if $\sigma>2$, it has positive consequences on both, real wage and real interest. Otherwise, if $\sigma<2$, it induces reductions in factors' real income.

3.2. The case of Bilateral Trade – two countries 1, 2

- **Basic Assumptions**

Technology: We assume that technology is the same in both countries (k_i and γ_i are the same, regardless the production site).

Consumer Tastes: We assume, for the moment, that consumers are indifferent regarding the origin of goods. Furthermore, we assume that in both countries consumers have the same ϱ.

Finally, we assume that each variety is produced in only one country. In other words, a good produced in a different region implies that consumers recognize it as a different variety.

Trade Barriers: We introduce in the model iceberg-type transport costs. Specifically, if a unit of a variety is shipped from one country to the other, only a fraction, $1/\tau$, of the original unit actually arrives. Constant τ represents the amount of good dispatched per unit received. Note that for goods produced and sold in the same country, $\tau=1$.

This type of transport costs implies that if f.o.b. price (price in the region of production) is p, c.i.f. price (price in the region of consumption) is: $p' = p\,\tau$.

- **Demand for each country**

Utility Function: The utility function remains the same as in the autarky case. Consumers cover their needs by consuming the homogenous agricultural (non-traded) good and the different varieties of goods from each manufacturing sector i (M_i).

Sub-Utility Function remains basically the same. Note, however, that in the expression $M_i=[\int x_{ij}^{\varrho}dj]^{1/\varrho}$, $\int$ now represents the sum of the number of varieties produced in that sector in each country ($n_i'=n_{i1}+n_{i2}$).

Consumer decision: The expressions for the uncompensated aggregate demand functions remain as in the autarky case. However, we need to redefine p and G that appear in those expressions, because many of the consumed goods are imported.

Recall that the price index for varieties in sector i is defined as $G_i=[\int p_{ij}^{\varrho/\varrho-1}dj]^{\varrho-1/\varrho}$. Yet, as some of the n_i come from the other country, their c.i.f. price is: $p_{ij}'=p_{ij}\tau$. Recall now that all varieties of sector i produced in a country have the same technology and face the same factor costs, therefore they have the same price. Consequently, G_i for each country can be written as follows[8]:

[8] Notice that τ represents the transport costs for both directions, i.e., from country 1 to 2 and vice versa.

$G_{i1}=[n_{i1}p_{i1}^{1-\sigma} + n_{i2}\,(p_{i2}\,\tau)^{1-\sigma}]^{1/(1-\sigma)}$ and

$G_{i2}=[n_{i1}(p_{i1}\,\tau)^{1-\sigma} + n_{i2}\,p_{i2}^{1-\sigma}]^{1/(1-\sigma)}$

Next, we can define world demand (demand in both countries) for any variety of each sector, produced in country 1 or 2.

$x_{i1}= p_{i1}^{-\sigma}\ \mu\ (\Upsilon_1 G_{i1}^{(\sigma-1)}+Y_2 G_{i2}^{(\sigma-1)}\tau^{-\sigma})$ and

$x_{i2}= p_{i2}^{-\sigma}\ \mu\ (\Upsilon_1 G_{i1}^{(\sigma-1)}\tau^{-\sigma}+\Upsilon_2 G_{i2}^{(\sigma-1)})$

➢ Production

Price setting: The cost functions remain the same. We simply have to rewrite them for each country by considering that we have country specific factor rewards (costs):

$C_{ij1} = r_1 k_i + w_1 \gamma_i q_{ij1}$ and $C_{ij2} = r_2 k_i + w_2 \gamma_i q_{ij2}$

Profits: Each firm, that belongs in a specific sector and is situated in a specific country, is facing the above defined respective sector/country-specific world demand[9]. As in the autarky, each firm is supposed to take the sector/country-specific price index G_{i1} and G_{i2} as given. Consequently, profit maximization leads again to the well known expression for the price at which each producer can sell the profit maximizing output[10]:

$p_{i1}^*=w_1\gamma_i/\varrho$ and $p_{i2}^*=w_2\gamma_i/\varrho$

Size of firms: Again, free entry and exit with and the associated zero profit condition define the equilibrium output of any active firm in sector i in each country,

$q_{i1}^*=r_1(w_1\gamma_i)^{-1}\varrho(1-\varrho)^{-1}k_i$ and

$q_{i2}^*=r_2(w_2\gamma_i)^{-1}\varrho(1-\varrho)^{-1}k_i$

and equilibrium labor input:

$l_{i1}^*=\gamma_i q_{i1}^*= r_1(w_1)^{-1}\varrho(1-\varrho)^{-1}\ k_i$ and

$l_{i2}^*=\gamma_i q_{i2}^*= r_2(w_2)^{-1}\varrho(1-\varrho)^{-1}\ k_i$

➢ Bilateral Trade Equilibrium

Wages: Firms' pricing behavior remains the same as in the autarky case. Therefore, the only channel that relates the two

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[9] Because of our "iceberg costs" assumption, in order to cover the world demand, it is not enough for each firm to produce x_{i1} (or x_{i2}). To supply the part of this consumption that responds to foreign demand (the demand of the other country) it has to ship τ times this part. Therefore, it has to produce more than x_{i1} (or x_{i2}): its production has to come up to $q_{i1} = p_{i1}^{-\sigma}\ \mu\ (\Upsilon_1 G_{i1}^{(\sigma-1)}+Y_2 G_{i2}^{(\sigma-1)}\tau^{1-\sigma})$ and respectively up to $q_{i2} = p_{i2}^{-\sigma}\ \mu\ (\Upsilon_1 G_{i1}^{(\sigma-1)}\tau^{1-\sigma}+\Upsilon_2 G_{i2}^{(\sigma-1)})$.

[10] Notice that the price for selling the profit maximizing output is not, at least directly, affected by the fact that the firm has to compete with foreign competitors when it distributes its output in both countries. Global conditions might affect prices set by domestic producers only indirectly, as far as they will affect domestic wages.

economies, under the assumption of iceberg transport costs, is the sector specific price index G_i that incorporates the prices and varieties of goods from both countries.

Because of trade, consumer's options and final prices tend to equalise in both countries, meaning that there is also a tendency for wage equalization. Nevertheless, this process is never completed: wages still differ because of the remaining differences in labor and capital endowments and because of trade costs. These limitations hinder the tendency towards equalization of consumers' option.

4. Conclusions

The well-documented stylized facts on the similarity of the FDI and international trade patterns pose several conundrums for the theory of multinational enterprises. This paper constitutes a preliminary attempt to present a model where firms engage in trade in a manner that resembles the real world trade patterns. The model follows Fujita's *et al.* (1999) logic which is based on a spatial transformation of the Dixit-Stiglitz approach with monopolistic competition, increasing returns to scale and iceberg-type transport costs. We introduce capital as an additional production factor and assign marginally different capital intensity to each differentiated product. The model, at its present level of analysis, cannot explain the trade and FDI correlation. It provides, however, an interesting theoretical framework upon which one may incorporate FDI flows in order to examine different relations between FDI and trade, at each level of aggregation.

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