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Sebastian Krautheim**

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Abstract

Wholesale trade affiliates account for a considerable fraction of the sales of Multinational Companies (MNCs). However, this and similar types of FDI, aiming at facilitating export activities, have received little attention in the literature. In this paper export-supporting FDI (ESFDI) which is characterized by destination-market specific export-supporting distribution and service activities in the foreign market, keeping production in the home country, is introduced as a theoretical concept. It is included into a model of international trade and FDI with heterogeneous firms. In equilibrium lower trade costs increase ESFDI. This implies that both FDI activities and trade volumes increase at the same time. The model thus provides a rationale for the positive correlation between trade and FDI activity observed in the 1990s and the prevalence of intra Euro-area investments in the FDI activities of Euro-area MNCs, which are both at odds with the 'proximity-concentration trade-off' governing standard models of horizontal FDI.

JEL: *F12, F23*

Keywords: *exports, horizontal FDI, multinational companies, wholesale trade*

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1 Introduction

The theoretical literature on (and the way most economists think about) Foreign Direct Investment (FDI) and multinational enterprizes (MNEs) is dominated by the distinction between horizontal FDI (HFDI) and vertical FDI (VFDI). There is substantial empirical evidence that, when FDI is measured by number of affiliates and affiliate sales, the horizontal type dominates in the data.[1] The predictions of models of HFDI are governed by the famous 'proximity-concentration trade-off' (PCTO): when exporting, firms benefit from scale economies at home (concentration) but have to pay trade costs. When producing directly in the destination market, firms avoid trade costs (proximity) but loose in terms of forgone scale economies. A direct and very simple implication of this trade-off is that lower trade cost should lead to more trade and less FDI. As pointed out e.g. by Neary (2007), this prediction is clearly at odds with the data: the 1990s have been characterized by substantial falls in trade cost and a simultaneous increase in both exports and FDI. In addition, Geishecker, Görg, and Taglioni (2006) show that by far most FDI activity of Euro-area MNCs actually goes to other Euro-area countries. Both observations cannot be explained by FDI activity that is motivated by 'getting around' variable trade costs which are falling over time and are arguably very low within the Euro-area.

This paper argues that these seemingly puzzling empirical features can be rationalized by taking into account a type of FDI that has, to the best of my knowledge (despite its proven empirical relevance), not been considered in theoretical work on exports and horizontal FDI before. I label it 'export-supporting FDI' (ESFDI). The crucial distinctive feature of ESFDI is that it involves destination-market specific 'export-supporting' activities in the foreign market while production remains in the headquarters. In the spirit of Grossman and Rossi-Hansberg (2006) one can think of production and distribution related tasks where the latter (importing, marketing, distribution etc.) may be outsourced to the destination market where, at the expense of setting up a service or wholesale affiliate, they can be performed more efficiently than from the headquarters at home. For firms choosing ESFDI, exports and FDI are not mutually exclusive alternatives: they open an affiliate in the foreign market because this enables them to export *more*. The introduction of ESFDI thus relaxes the strong implication of exports and FDI being substitutes and introduces some degree of complementarity between FDI and exports in a very natural way.

ESFDI is introduced into a model of trade and FDI with heterogeneous firms along the lines of Helpman, Melitz, and Yeaple (2004).[2] Firms may choose between three ways of serving foreign

[1] see e.g. Brainard (1997), Carr, Markusen, and Maskus (2001) or Yeaple (2003)).

[2] Technically, the modeling is also closely related to Chaney (2006) and Melitz (2003).

markets: 'classic' exporting (production and marketing/distribution from the headquarters), export-supporting FDI in the destination country (still producing at home but providing the market-specific, non-production services directly in the destination market) and horizontal FDI (carrying out production and distribution for the foreign market on-site). It turns out that, under appropriate assumptions, in equilibrium the most productive firms do HFDI, the least productive firms (that are still productive enough to serve the foreign market) choose 'classic' exporting and the firms in between support their exporting activities by transferring market-specific services to the destination market.

The Model is used to determine the impact of variable trade costs (and other variables) on trade and FDI. The central result is that lower variable trade costs lead unambiguously to more ESFDI (measured both in terms of the number of affiliates and in terms of affiliate sales). Since ESFDI activity is both trade and FDI at the same time, lower trade costs turn out to lead to an increase in both trade *and* FDI activity. The intuition is the following. Consider the effects of a fall in variable trade costs.[3] The impact on the number of firms choosing ESFDI is twofold: on the one hand, the incentive to avoid variable trade costs by producing in the destination market (HFDI) decreases which leads more of the productive firms to switch to ESFDI. On the other hand, the volume of exports per exporter increases. The larger volume makes it profitable for firms that were doing 'classic' exporting before, to invest the larger fixed cost of doing ESFDI in order to improve their export-efficiency. Due to this unambiguous increase in ESFDI and the fact that ESFDI involves exporting and FDI at the same time, the model predicts a simultaneous increase in exports and in the number of affiliates (and their aggregate sales volumes) in the foreign market.

The model with ESFDI can thus provide a very simple rationale for the two seemingly puzzling empirical features outlined above. Neary (2007) points out the inconsistency of the simultaneous rise of trade an FDI in the 1990s with the standard theory of HFDI. He proposes two directions of research to address this positive correlation over time: export-platform FDI (which he argues is particularly important for cases like Ireland and the European market) and oligopolistic competition where considerations of market power lead to takeovers. A major advantage of the ESFDI approach that it does not depend on historic particularities in European integration and does not require additional forces like market power to generate the result. On the contrary, ESFDI provides a parsimonious mechanism of generating the empirically relevant effects

[3]The mechanism is exactly the same for the comparison of two destinations one with high and and with low variable trade costs or two sectors with different variable trade costs.

within the framework of one of the most successful models of trade and FDI of the recent years. ESFDI fits neatly into the literature by providing a very simple and intuitive expansion of models with HFDI preserving the existing mechanisms but adding new ones in order to explain the data.

Although the literature on FDI has almost exploded in recent years, non-production FDI which is undertaken to support the parent company's export activities has received little empirical and almost no theoretical attention.[4] There are, however, some empirical studies which indicate that this type of activities are actually of considerable magnitude.

An early study in the field is Zeile (1997). He delivers a set of stylized facts about US intrafirm trade (i.e. trade between US-based MNEs and their foreign affiliates and trade between foreign based MNEs and their US affiliates). He finds that about one fifth of overall US imports goes via a wholesale affiliate of the exporting foreign firm which points at a considerable importance of ESFDI for US imports. In a later study, Zeile (1997) provides more details about these flows: the intrafirm imports of wholesale affiliates mainly consist of heterogeneous manufactured products such as machinery products or road vehicles and parts. In most years, the imports from the parent groups account for more than three-fourth of the total imports by wholesale affiliates. He also refers to the benchmark survey of the Bureau of Ecomomic Analysis (BEA) of foreign direct investment in the US. In all survey years more than 90% of the imports of US wholesale affiliates from their parent groups were goods for resale. This shows that the US wholesale affiliates of foreign firms predominantly import for resale of final goods from their parent groups.[5]

More recently, studies using firm-level data also find evidence for the quantitative importance of ESFDI. Hanson, Mataloni, and Slaughter (2001) use data for majority-owned, non-bank affiliates of U.S.-headquartered corporations provided by the U.S. Bureau of Economic Analysis

[4] A notable exception is parallel and independent work by Felbermayr and Jung (2007). They introduce an additional way of exporting into the Melitz (2003) model: exporting in co-operation with a general importer. Observing the empirical relevance of wholesale trade affiliates, they interpret the fixed cost of exporting in Melitz (2003) as the cost of setting up a wholesale trade affiliate, thereby justifying a larger fixed cost of this way of 'exporting on your own' compared to exporting in co-operation with a generalized importer. The focus of their work is on the introduction and theoretical comparison of two ways of exporting with different fixed and variable cost structures. All their results would go through if the higher fixed cost of 'exporting on your own' were motivated differently. They do not consider setting up production capacities in the foreign market as possible strategy of serving it, do not address any issues related to trade-offs between different types of FDI and do not address the issues of correlation between exports and FDI which are the focus of this paper.

[5] Note that the sales volumes of wholesale trade affiliates can be considered a lower bound of ESFDI activity. Zeile (1997) points out that about one third of imports of affiliates that are in the data as manufacturing affiliates are goods for resale. In addition, affiliates which are set up mainly in order to provide ESFDI services might also carry out minor market-specific adjustments to the products before selling them in the foreign market. These ESFDI affiliates would then appear as manufacturing affiliates in the data. Similarly, multi product firms may have an affiliate involved in some manufacturing of a subset of their products in the foreign country, but do ESFDI activities for the other products. In these cases looking at wholesale trade affiliates and their sales as proxy for ESFDI would underestimate its actual importance.

(BEA). They find that 20% of worldwide total sales by affiliates of U.S. multinationals were accounted for by affiliates in wholesale trade. They show that the largest part of affiliate sales is by affiliates in the same sector as the parent company. However, the share of wholesale trade affiliates in total affiliate sales in manufacturing is considerable and reaches from 9.7% for transport equipment, over 28% in electrical equipment up to 38% in industrial machinery (see Table 9 in their paper). Another interesting feature in their data is that only a very small number of multinationals has both a manufacturing and a wholesale affiliate in the same country. So that parent companies seem to opt for one form of FDI or the other but hardly both. Some additional evidence is provided in the analysis of firm-level data on FDI of German companies in Buch, Kleinert, Lipponer, and Toubal (2005). Their Table 3 reports the number of affiliates in a given industry by industry of the parent company. The pattern is quite clear: almost all affiliates are either in the same industry as the parent firm or in wholesale and retail trade. For most parent company industries, the two numbers are of the same order of magnitude and in many industries the number of affiliates in wholesale and retail is even larger. Although the authors do not provide data on sales volume, this pattern points at an important role of wholesale and retail affiliates in German FDI.

The rest of the paper is structured as follows. In the following section the model with ESFDI is presented and the general equilibrium is derived. In section three,the main theoretical results are discussed and applied to the correlation between trade and FDI in the 1990s and the patterns of Euro-area FDI. Section 5 concludes.

2 The Model

In this section the model is presented and the general equilibrium is derived.

2.1 The Economy

Basic structure: The world economy consists of N countries with L_n denoting the population in country n. There are $H+1$ sectors, H of which are producing differentiated products, while sector zero produces a homogeneous good with a constant returns to scale technology. The homogeneous good is freely traded and is used as the numeraire with its price normalized to one. As is standard in such a setting (see, for example, Helpman, Melitz, and Yeaple (2004)) only those equilibria are considered where all countries produce the homogeneous good implying that wages are equalized across countries and can be normalized to one. Labor is the only input

in the production process. Each worker holds a share of a perfectly diversified portfolio of all firms in the world.

Preferences: The workers are all identical. They share the same preferences over consumption of the goods produced in the $H+1$ sectors:

$$U = q_0^{\mu_0} \prod_{h=1}^{H} \left(\int_{X_h} (q_h^x)^{\frac{\sigma_h - 1}{\sigma_h}} dx \right)^{\frac{\sigma_h}{\sigma_h - 1} \mu_h}$$

where q_h^x is the quantity of variety x of good (sector) h, q_0 is the quantity of the homogeneous good consumed, $\mu_0 + \sum_{h=1}^{H} \mu_h = 1$ and σ_h is the elasticity of substitution between varieties of sector h. In the subsequent analysis, sectoral indices will be dropped where this causes no confusion.

Firms The number of firms in each sector is assumed to be fixed and proportional to country size. No firm entry and exit takes place on the national level. Production in the differentiated good sectors takes place according to a standard increasing returns to scale technology. The cost for a firm with productivity φ in country i of producing q units of output and to sell q units in the local market is given by $c(q) = \frac{q}{\varphi} + f_{ii}$.
Firms differ in their productivity levels which are assumed to be drawn from a Pareto distribution with parameter γ i.e. $P(\tilde{\varphi} < \varphi) = F(\varphi) = 1 - \varphi^{-\gamma}$. Without loss of generality the minimum productivity level is normalized to one ($\varphi_{min} \equiv 1$). In order to have a finite second moment it is standard to assume $\gamma > 2$. Furthermore, we have to impose $\gamma > (\sigma - 1)$. This assumption assures that the mean of the productivity distribution is finite.[6]

Tasks, location choices and the cost structure: The business of a firm consists of two tasks: production and distribution. To serve a foreign market, firms have three different location choices for performing these tasks. Firms choosing 'classic' exporting have to pay a fixed cost of exporting f_{ij}^x and a variable trade cost τ_{ij} which takes the standard iceberg form: in order for one unit of the good to arrive at the border of the destination country, τ_{ij} goods have to be shipped, where $\tau_{ij} > 1 \; \forall \; j \neq i$ and $\tau_{ii} = 1$. Organizing the distribution of the exported goods from the headquarters comes along with a 'managerial inefficiency' cost which is also of

[6] To see the importance of the last condition note the following: the lower γ, the higher is the mass of firms with high productivities. If σ is high, goods are close substitutes. The closer γ and $(\sigma - 1)$ get, the larger the mass of firms with a very high productivity with some of them being so productive that they sell at a price close to zero. But if then substitutability was too high (the above condition is violated) these firms would take over the whole market and the equilibrium breaks down.

the iceberg type: for every good to be provided to the consumers in the destination market δ_{ij} goods have to arrive at the border of country j. Similar to transportation costs $\delta_{ij} > 1 \; \forall \; j \neq i$ and $\delta_{ii} = 1$.

When firms choose ESFDI and transfer the distribution activities into the foreign market, they face a fixed cost of setting up a service affiliate in the destination country f_{ij}^d. Using this affiliate for distribution activities they have the same managerial efficiency as the local firms, namely $\delta_{jj} = 1$.

The third alternative is to opt for 'classic' FDI transferring both production and distribution for the foreign market into the foreign country. This requires a fixed cost f_{ij}^f of 'replicating' the firm in the foreign market. These firms then face the same managerial efficiency and the same variable trade costs as local firms: $\delta_{jj} = 1$ and $\tau_{jj} = 1$.[7]

Thus, a firm in country i willing to serve market j has to choose among three different cost structures:

$$c_x(q) \;\; = \;\; q \; \frac{\tau_{ij}\delta_{ij}}{\varphi} + f_{ij}^x \qquad\qquad c_d(q) = q \; \frac{\tau_{ij}}{\varphi} + f_{ij}^d \qquad\qquad c_f(q) = q \; \frac{1}{\varphi} + f_{ij}^f$$

The indices stand for 'classic' exporting (x), transferring distribution management only (d) and 'classic' FDI where both tasks are carried out in the foreign market (f).

To determine what type of firms will choose which strategy to serve the foreign market, the structure of fixed and variable cost plays a crucial role. Like Helpman, Melitz, and Yeaple (2004), I will focus on cost structures which allow the three alternative ways to co-exist in equilibrium. For this to be the case, the following condition has to be satisfied:

$$f_{ij}^x \; \tau_{ij}^{\sigma-1} \; \delta_{ij}^{\sigma-1} < \tau_{ij}^{\sigma-1} \; \frac{f_{ij}^d - f_{ij}^x}{1 - \delta_{ij}^{1-\sigma}} < \frac{f_{ij}^f - f_{ij}^d}{1 - \tau_{ij}^{1-\sigma}} \tag{1}$$

This is a generalization of equation (1) in Helpman, Melitz, and Yeaple (2004) which assures that each strategy strictly dominates the others for some productivity levels. The role and origin of this condition will become clear in the subsequent analysis.

[7] One could also think of the possibility of transferring production activities but keeping the distribution services in the headquarters. I disregard this possibility for analytical convenience. It is straight forward to derive a condition on the cost structure that assures that either 'classic' exports, ESFDI or HFDI dominate this fourth possibility for all productivity levels. Intuitively, the fixed cost of doing ESFDI relative to the efficiency gains it implies needs to be smaller than the fixed cost of building production capacities relative to the benefits of saving transportation costs. If this holds, any firm building up production capacity will always also perform the distribution and service tasks in the foreign market. Provided that the fixed cost of setting up a production plant is sufficiently high compared to setting up a sales or distribution affiliate, this assumption is not very restrictive.

Demand: With the wages in all countries normalized to one, the total labor income in j is given by L_j. Since firms make positive profits the second component of income consists of dividends paid on the shares of the global fund holding all firms. Dividends received by workers in country j are given by $(L_j/L)\Pi$ where Π are world profits and L stands for world population. Demand in j for a given variety imported from i is given by

$$q_{ij} = A_j \, p_{ij}(\varphi)^{-\sigma} \qquad \text{with} \qquad A_j = \mu \left(1 + \frac{\Pi}{L}\right) L_j \, (P_j)^{\sigma-1}$$

where P_j is the welfare based price index and Π stands for aggregate world profits.

Prices, profits and productivity cutoffs: Facing isoelastic demand curves, firms charge a constant mark-up over marginal costs in each market they choose to serve: $p_{ij}(\varphi) = \frac{\sigma}{\sigma-1} \, mc(\varphi)$. Marginal costs are given by $\frac{1}{\varphi}$ for serving the domestic market, and by $\frac{\tau_{ij}\delta_{ij}}{\varphi}$, $\frac{\tau_{ij}}{\varphi}$ and $\frac{1}{\varphi}$ for the respective strategies x, d, and f of serving the foreign market. A firm serving the domestic market only, generates profits of $\pi_{ii}(\varphi) = B_i \, \varphi^{\sigma-1} - f_{ii}$. With $B_i = \frac{A_i}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}$. In addition to profits from sales at home, firms can make profits by serving one or more foreign markets (j). These depend on the way the foreign market is served. If 'classic' exporting is chosen, profits are given by:

$$\pi_{ij}^{x}(\varphi) = B_j \left(\frac{\varphi}{\tau_{ij}\delta_{ij}}\right)^{\sigma-1} - f_{ij}^{x}.$$

Profits from export-supporting FDI are given by

$$\pi_{ij}^{d}(\varphi) = B_j \left(\frac{\varphi}{\tau_{ij}}\right)^{\sigma-1} - f_{ij}^{d}.$$

And firms doing 'classic' FDI make profits of

$$\pi_{ij}^{f}(\varphi) = B_j \, \varphi^{\sigma-1} - f_{ij}^{f}.$$

The profitability of the different options can be easily compared using Figure 1. The profits implied by the three different strategies are plotted as a function of the productivity ($\varphi^{\sigma-1}$) of the firms. The functions have a slope of $\left(\frac{B_j}{\tau_{ij}\delta_{ij}}\right)$, $\left(\frac{B_j}{\tau_{ij}}\right)$ and B_j respectively. Note that for any of the three strategies, more productive firms have higher profits. The productivity levels for which firms are indifferent between two strategies and no third strategy leads to higher profits are denoted by $\bar{\varphi}_{ij}^{x}$, $\bar{\varphi}_{ij}^{d}$ and $\bar{\varphi}_{ij}^{f}$. Clearly, the most productive firms ($\varphi > \bar{\varphi}_{ij}^{f}$) maximize profits from

sales in the foreign market by carrying out distribution and production in the foreign market, firms with an intermediate level of productivity ($\bar{\varphi}_{ij}^{d} < \varphi < \bar{\varphi}_{ij}^{f}$) produce at home but do the distribution locally, while the least productive firms which still choose to serve the foreign market ($\bar{\varphi}_{ij}^{x} < \varphi < \bar{\varphi}_{ij}^{d}$) optimally choose 'classic' exporting. The fact that each of the three strategies is optimal for some of the firms is guaranteed by the condition on the fixed and variable costs above.

Figure 2 illustrates how the masses of firms engaging in the different internationalization patterns depend on the cutoff productivity levels under the assumption that firm productivities are distributed Pareto. Only firms above a productivity level of $\bar{\varphi}_{ij}^{x}$ serve the foreign market. Note that those firms that engage in ESFDI can be considered both exporters and multinationals for market j at the same time: they have set up a distribution affiliate in country j (FDI) in order to support their export activities.

2.2 The general Equilibrium

In order to derive the central equilibrium objects of the model, the equilibrium price index P_j and aggregate world profits Π are needed.[8] Later in the analysis it will turn out that aggregate world profits only depend on exogenous parameters of the model, Π will thus be treated as a constant from now on, which later on will turn out to be justified. Under the assumption that firm productivities are distributed Pareto, a closed form expression for the price index can be derived:[9]

$$P_j = E_j \theta_j. \tag{2}$$

Where θ_j is to be interpreted as an index of aggregate remoteness of country j and E_j collects constant terms. It is - along with all the other terms collecting constants in the following equations - reported in the appendix.

[8] The price index of varieties in a given sector in country j is defined as

$$P_j = \left(\sum_{k=1}^{N} L_k \left[\int_{\bar{\varphi}_{kj}^{x}}^{\bar{\varphi}_{kj}^{d}} \left(\frac{\sigma}{\sigma-1} \frac{\tau_{kj}\delta_{kj}}{\varphi} \right)^{1-\sigma} dF(\varphi) \;+\; \int_{\bar{\varphi}_{kj}^{d}}^{\bar{\varphi}_{kj}^{f}} \left(\frac{\sigma}{\sigma-1} \frac{\tau_{kj}}{\varphi} \right)^{1-\sigma} dF(\varphi) \;+\; \int_{\bar{\varphi}_{kj}^{f}}^{\infty} \left(\frac{\sigma}{\sigma-1} \frac{1}{\varphi} \right)^{1-\sigma} dF(\varphi) \right] \right)^{\frac{1}{1-\sigma}}.$$

[9] Where $\theta_j^{-\gamma} \equiv \sum_{k=1}^{N} L_k \left[\tau_{kj}^{-\gamma} \delta_{kj}^{-\gamma} \left(f_{kj}^{x} \right)^{-\frac{\gamma-(\sigma-1)}{\sigma-1}} + \tau_{kj}^{-\gamma} \left(1 - \delta_{kj}^{1-\sigma} \right)^{\frac{\gamma}{\sigma-1}} \left(f_{kj}^{d} - f_{kj}^{x} \right)^{-\frac{\gamma-(\sigma-1)}{\sigma-1}} + \left(1 - \tau_{kj}^{1-\sigma} \right)^{\frac{\gamma}{\sigma-1}} \left(f_{kj}^{f} - f_{kj}^{d} \right)^{-\frac{\gamma-(\sigma-1)}{\sigma-1}} \right].$

The profit functions for firms choosing different strategies to serve the foreign market that were spelled out above can be used together with (2) to derive the equilibrium cutoff productivity levels associated with the three possible strategies:

$$\bar{\varphi}_{ij}^{x} = G_j \, \theta_j^{-1} \, \tau_{ij} \, \delta_{ij} \, \left(f_{ij}^{x}\right)^{\frac{1}{\sigma-1}} \tag{3}$$

$$\bar{\varphi}_{ij}^{d} = G_j \, \theta_j^{-1} \, \tau_{ij} \, \left(\frac{f_{ij}^{d} - f_{ij}^{x}}{1 - \delta_{ij}^{1-\sigma}}\right)^{\frac{1}{\sigma-1}} \tag{4}$$

$$\bar{\varphi}_{ij}^{f} = G_j \, \theta_j^{-1} \, \left(\frac{f_{ij}^{f} - f_{ij}^{d}}{1 - \tau_{ij}^{1-\sigma}}\right)^{\frac{1}{\sigma-1}}. \tag{5}$$

Under condition (1), one has $\bar{\varphi}_{ij}^{x} < \bar{\varphi}_{ij}^{d} < \bar{\varphi}_{ij}^{f}$ which assures that all three strategies of serving the foreign market are chosen by some firms.

With the general equilibrium price index in (2) and the cutoff productivity levels, it is now possible to derive the relevant equilibrium objects of the analysis. Before, note that it is now also possible to derive general equilibrium firm profits and to use these to derive an expression for equilibrium aggregate profits. This is done in appendix C. It turns out that aggregate world profits Π are indeed constant.

The two most frequently used measures of FDI are the number of affiliates of firms from country i in country j and their sales. By construction, it will never be optimal for a firm to have two affiliates in the same country (i.e. to engage in ESFDI and HFDI at the same time. This is because the ESFDI activities are already included in the HFDI step). Thus the number of firms opting for some type of FDI maps one-to-one into the number of affiliates.

The mass of firms choosing strategy a to serve the foreign market is given by: $n_{ij}^{a} = \int_{\bar{\varphi}_{ij}^{a}}^{\bar{\varphi}_{ij}^{(a+1)}} dF(\varphi)$ where $\bar{\varphi}_{ij}^{a}$ is the cutoff productivity of for firms to choose strategy a and $\bar{\varphi}_{ij}^{(a+1)}$ is the next higher cutoff level above which firms optimally choose strategy $(a+1)$. Using the cutoff productivities (3)-(5) the masses of firms choosing 'classic' exports, ESFDI or HFDI to serve market j are given by:

$$n_{ij}^x = K_j\ \theta_j^\gamma\ \tau_{ij}^{-\gamma}\ \left[\delta_{ij}^{-\gamma}\ \left(f_{ij}^x\right)^{-\frac{\gamma}{\sigma-1}} - \left(\frac{f_{ij}^d - f_{ij}^x}{1-\delta_{ij}^{1-\sigma}}\right)^{-\frac{\gamma}{\sigma-1}}\right] \tag{6}$$

$$n_{ij}^d = K_j\ \theta_j^\gamma\ \left[\left(\tau^{\sigma-1}\left[\frac{f_{ij}^d - f_{ij}^x}{1-\delta_{ij}^{1-\sigma}}\right]\right)^{-\frac{\gamma}{\sigma-1}} - \left(\frac{f_{ij}^f - f_{ij}^d}{1-\tau_{ij}^{1-\sigma}}\right)^{-\frac{\gamma}{\sigma-1}}\right] \tag{7}$$

$$n_{ij}^f = K_j\ \theta_j^\gamma\ \left(\frac{f_{ij}^f - f_{ij}^d}{1-\tau_{ij}^{1-\sigma}}\right)^{-\frac{\gamma}{\sigma-1}}. \tag{8}$$

Given the assumptions on the cost structure in (1) all these measures are positive i.e. in equilibrium each option to serve the foreign market is chosen by some firms. Note that the mass of exporting firms is given by $(n_{ij}^x + n_{ij}^d)$ and the mass of multinationals having some type of affiliate in j is given by $(n_{ij}^d + n_{ij}^f)$. Importantly, the measure of firms choosing ESFDI n_{ij}^d counts for both: the number of exporters and the number of foreign affiliates.

In order to compute aggregate affiliate sales, the second standard measure of FDI in empirical studies, the sales volume of an individual firm as a function of its productivity needs to be determined. Sales of a firm from country i with productivity φ in the foreign market j are given by $s_{ij}(\varphi) = p_{ij}(\varphi)\ q_{ij}(\varphi)$. The optimal price setting of the firm, the demand function and the equilibrium price index in (2) can be used to find the equilibrium sales of a firm conditioned on its productivity level:

$$\begin{aligned}
s_{ij}(\varphi \mid 1 < \varphi < \bar{\varphi}_{ij}^x) &= 0 \\
s_{ij}^x(\varphi) &= J_j\ \theta_j^{\sigma-1}\ \tau_{ij}^{1-\sigma}\ \delta_{ij}^{1-\sigma}\ \varphi^{\sigma-1} \\
s_{ij}^d(\varphi) &= J_j\ \theta_j^{\sigma-1}\ \tau_{ij}^{1-\sigma}\ \varphi^{\sigma-1} \\
s_{ij}^f(\varphi) &= J_j\ \theta_j^{\sigma-1}\ \varphi^{\sigma-1}
\end{aligned}$$

Where J_j collects constants and is reported in the appendix. The aggregate sales volume in market j of firms choosing strategy a is given by $s_{ij}^a = \int_{\bar{\varphi}_{ij}^a}^{\bar{\varphi}_{ij}^{(a+1)}} s_{ij}(\varphi \mid \bar{\varphi}_{ij}^a < \varphi < \bar{\varphi}_{ij}^{(a+1)})\ dF(\varphi)$.

This implies:

$$S_{ij}^{x} = M_j\, \theta_j^{\gamma}\, \tau_{ij}^{-\gamma}\, \delta^{1-\sigma} \left[\delta_{ij}^{\sigma-1-\gamma}\, \left(f_{ij}^{x}\right)^{\frac{\sigma-1-\gamma}{\sigma-1}} - \left(\frac{f_{ij}^{d} - f_{ij}^{x}}{1-\delta_{ij}^{1-\sigma}} \right)^{\frac{\sigma-1-\gamma}{\sigma-1}} \right] \tag{9}$$

$$S_{ij}^{d} = M_j\, \theta_j^{\gamma}\, \tau_{ij}^{1-\sigma} \left[\left(\tau^{\sigma-1} \left[\frac{f_{ij}^{d} - f_{ij}^{x}}{1-\delta_{ij}^{1-\sigma}} \right] \right)^{\frac{\sigma-1-\gamma}{\sigma-1}} - \left(\frac{f_{ij}^{f} - f_{ij}^{d}}{1-\tau_{ij}^{1-\sigma}} \right)^{\frac{\sigma-1-\gamma}{\sigma-1}} \right] \tag{10}$$

$$S_{ij}^{f} = M_j\, \theta_j^{\gamma} \left(\frac{f_{ij}^{f} - f_{ij}^{d}}{1-\tau_{ij}^{1-\sigma}} \right)^{\frac{\sigma-1-\gamma}{\sigma-1}}. \tag{11}$$

The constant M_j is reported in the appendix. By (1) aggregate sales of all three strategies are positive. Aggregate export sales are given by $(S_{ij}^{x} + S_{ij}^{d})$ and aggregate sales of MNC affiliates are given by $(S_{ij}^{d} + S_{ij}^{f})$. Again the sales of export-supporting affiliates S_{ij}^{d} fall in both categories.

3 The Role of Variable Trade Costs

The main results of the model are summarized in the following two propositions which describe the effect of variable trade costs τ_{ij} on the measure of firms choosing the respective strategies and their sales to the foreign market.

Proposition 1 *Under the cost structure in* (1)*, the impact of variable trade costs on the measure of firms choosing a particular way of serving the foreign market is given by:*

(i) $\frac{\partial n_{ij}^{x}}{\partial \tau_{ij}} < 0$, $\frac{\partial n_{ij}^{d}}{\partial \tau_{ij}} < 0$ *and* $\frac{\partial n_{ij}^{f}}{\partial \tau_{ij}} > 0$

(ii) $\frac{\partial (n_{ij}^{x} + n_{ij}^{d})}{\partial \tau_{ij}} < 0$ *and* $\frac{\partial (n_{ij}^{d} + n_{ij}^{f})}{\partial \tau_{ij}} < 0$

(iii) $\frac{\partial [(n_{ij}^{d} + n_{ij}^{f})/(n_{ij}^{x} + n_{ij}^{d})]}{\partial \tau_{ij}} > 0$ *and* $\frac{\partial [(n_{ij}^{d} + n_{ij}^{f})/(n_{ij}^{d} + n_{ij}^{f} + n_{ij}^{x} + n_{ij}^{d})]}{\partial \tau_{ij}} > 0$

Proof: Proposition 1 follows directly from taking partial derivatives with respect to τ_{ij} of equations (6) - (8) and their respective combinations.[10] End of proof.

Proposition 1 includes some of the most important results of the theoretical analysis. The results are illustrated graphically in Figure 3. One of the central features is that the measure of firms choosing ESFDI unambiguously increases when trade costs fall. Interestingly, ESFDI

[10] Note that for the derivations it is assumed that no country is large compared to the other countries and the number of countries is sufficiently large to assure that changes in the variable cost of trade with one of the trading partners have no first-order effect on the index of overall remoteness of the importing country θ_j.

gains on both possible margins: firms that were below the cutoff level $\bar{\varphi}_{ij}^{d}$ (doing exporting with distribution from the headquarters) now choose to engage in ESFDI. This effect is due to the fact that when trade costs fall the firms just below the cutoff level wish to increase their export volume, but for the increased volume it now is optimal to transfer the distribution activities to the destination country. On the other side of the productivity distribution, firms just above the cutoff level $\bar{\varphi}_{ij}^{f}$ that were choosing to carry out both distribution and production in the destination country in order to avoid variable trade costs, now have a lower incentive of doing so. Some of them choose ESFDI instead. While the measure of firms choosing HFDI unambiguously decreases, the number of firms choosing 'classic' exporting increases because the measure of firms on the lower end of the productivity distribution, which were not serving the foreign market before and now, facing lower variable trade costs, decide to start exporting, is larger than the measure of firms switching from 'classic' exporting to ESFDI.

Another crucial result in Proposition 1 is the impact of a change in variable trade costs on the number of firms that are exporting to the destination market and on the number of firms that have an affiliate in the foreign country. The standard theory of HFDI implies that a fall in trade cost would increase the number of exporters and *decrease* the number of firms having an affiliate in the foreign market. The introduction of ESFDI changes this prediction. The crucial feature is that firms doing ESFDI are both exporters and multinational firms with an affiliate in the foreign market. The overall measure of exporters is thus given by $(n_{ij}^{x} + n_{ij}^{d})$ while the overall number of firms doing FDI in the destination market is given by $(n_{ij}^{d} + n_{ij}^{f})$. Proposition 1 *(ii)* shows that in contrast to the predictions of standard theory, a decrease in variable trade costs leads to an increase in both the number of exporters and the number of firms engaging in FDI activities. It will be shown later, that this feature of the model is nicely in line with the empirical evidence which seemed to be contradicting models of 'market access' FDI.

The model also has implications for another measure of FDI that is very popular in the empirical analysis of FDI: sales of foreign affiliates. The impact of variable trade costs on aggregate sales of firms opting for a particular way to serve the foreign market are summarized in Proposition 2.

Proposition 2 *Under the cost structure in* (1)*, the impact of variable trade costs on the aggregate sales volume of firms choosing a particular way of serving the foreign market is given by:*

(i) $\frac{\partial S_{ij}^x}{\partial \tau_{ij}} < 0$, $\frac{\partial S_{ij}^d}{\partial \tau_{ij}} < 0$ *and* $\frac{\partial S_{ij}^f}{\partial \tau_{ij}} > 0$

(ii) $\frac{\partial (S_{ij}^x + S_{ij}^d)}{\partial \tau_{ij}} < 0$ *and* $\frac{\partial (S_{ij}^d + S_{ij}^f)}{\partial \tau_{ij}} < 0$

Proof: Proposition 2 follows directly from taking partial derivatives with respect to τ_{ij} of equations (9) - (11) and their respective combinations.[11] End of proof.

Proposition 2 shows that the important statements on the measures of firms in Proposition 1 *(i)* and *(ii)* also hold for the aggregate sales volume of these firms: a decrease in variable trade costs increases aggregate sales of ESFDI affiliates in the foreign market, increases the aggregate sales of 'classic' exporters and decreases aggregate sales of production affiliates in the foreign market. Also the predictions for export sales to - and affiliate sales in - the foreign market are the same as for the number of firms: both exports *and* foreign affiliate sales rise. Just like for the measure of firms, an increase in variable trade costs implies a simultaneous increase in exports and FDI. These results can be used to rationalize some empirical patterns on FDI and exporting that are difficult to understand based on traditional models.

3.1 Falling Variable Trade Costs and the Rise of FDI and Exports

As pointed out e.g. by Neary (2007), HFDI clearly dominates VFDI in the data. However, the 1990s have been characterized by a fall in trade costs and a simultaneous increase in both export *and* FDI activities. He argues that this pattern contradicts the models of HFDI and their underlying mechanism, the proximity-concentration trade-off according to which decreasing trade costs should increase exports but decrease FDI.[12]

Interestingly, empirical results in papers that test the HFDI model suggest that the positive correlation over time of export and FDI activity might be related to decreasing variable trade costs. For example Brainard (1993) provides empirical evidence suggesting that falling trade costs are indeed associated with rising export *and* FDI activity. She finds that when trade and transportation costs fall, US export sales and US affiliate sales in the foreign market both rise

[11] Again, for the derivations it is assumed that no country is large compared to the other countries and the number of countries is sufficiently large to assure that changes in the variable cost of trade with one of the trading partners have no first-order effect on the index of overall remoteness of the importing country θ_j.

[12] In a survey paper Head and Ries (2004) point out that the positive cross-sectional correlation between exports and FDI found in the data does not contradict models of HFDI in which the two ways of serving the foreign market are substitutes. E.g. in the model with heterogeneous firms and FDI of Helpman, Melitz, and Yeaple (2004), large markets will attract both a large number of foreign affiliates and a large amount of exports. In order to account for a positive correlation *over time*, however, one would *ceteris paribus* need variations in market size. When variable trade costs fall this increase in market size would have to be so strong that it more than compensates the negative effect of the fall in variable trade costs on FDI. Though theoretically possible, this seems not to be a convincing explanation for the observed positive correlation of trade and FDI over time.

(table 3 in her paper). This finding seems to be in stark contrast to models of HFDI. Related empirical studies are Yeaple (2003) and Carr, Markusen, and Maskus (2001). Their results are in line with the finding of falling trade costs increasing both export and FDI activity. Possibly due to the different focus of their work, the authors do not interpret their results in this way.[13] The model including ESFDI provides a very natural mechanism explaining this empirical pattern: when variable trade costs fall, both exports and FDI increase. From Proposition 1 (ii) and Proposition 2 (ii) it follows that this holds true for both standard measures of FDI: the number of firms engaged in the respective activities and the aggregate volume of their sales. Thus, in contrast to the model of HFDI, the model of ESFDI can account for this important empirical pattern: falling trade costs simultaneously increase export and FDI activity.

It has been argued that the share of affiliate sales in overall sales (export sales + affiliate sales) should be considered in order to test the HFDI model. Brainard (1993) finds that the share of affiliate sales in overall sales increases when trade costs rise. Neary (2007), however, points out that this is not necessarily the case when bilateral distance (as standard in Gravity models of international trade) is used to proxy for trade costs: both affiliate sales and exports fall in distance but the impact on the share of affiliate sales on total sales varies with the specification used. Although this finding is empirically less robust than the direct positive correlation over time, it is of interest to look at the predictions of the model on the relative importance of exports as a fraction of overall activity. It follows from Proposition 1 (iii) that a fall in variable trade costs unambiguously increases the number of firms with affiliates in the foreign market relative to the overall number of firms serving the foreign market. For the relative number of firms engaging in the different possible activities the model thus correctly matches the empirical result. The theoretical results for the case of aggregate sales are less clear-cut because there is an ambiguous effect of falling trade costs on affiliate sales: on the one hand, affiliate sales rise because firms that were exporters before, now engage in ESFDI. In addition, each firm that continues to do ESFDI

[13] Yeaple (2003), analyzing US outward FDI, finds a negative effect of freight costs on foreign affiliate sales which is in line with the findings of Brainard (1993). The effect vanishes when industry and country fixed effects are introduced, which he interprets as supportive for the HFDI models. If freight costs, however, are correlated with bilateral distance (which is not included as an independent variable) the country fixed effects pick up this effect and the insignificance of the freight cost term is not surprising, because the 'real' freight costs are captured by the fixed effects. Carr, Markusen, and Maskus (2001) also claim to find support for the proximity-concentration trade-off because their trade cost variable increases affiliate sales. But the 'trade cost' variable they use is an index of protectionist measures, which captures only a very particular type of trade costs. As opposed to Yeaple (2003) and Brainard (1993) they do not consider freight costs. They do, however, incorporate bilateral distance (which in the trade literature is usually used as a proxy for trade - and freight - costs). The negative effect of distance on affiliate sales is both statistically and economically significant. Thus, even if the authors do not read their own results like this, their findings are consistent with the finding of Brainard (1993) that both export and FDI activities increase when variable trade costs fall.

increases its sales. These effects are positive. But some firms switch from HFDI to the lower fixed cost ESFDI alternative which *ceteris paribus* leads them to reduce their sales volume. This effect is not necessarily offset by the fact that lower variable trade costs imply higher sales of ESFDI firms. A condition can be derived under which the analogous inequalities of Proposition 1 (iii) also hold for aggregate sales. This condition, however, is not straight forward to interpret, so I refrain from doing so. This seems justified by the fact that the number of firms as a measure of FDI delivers the 'right' result and the empirical evidence on the pattern is not conclusive.

Overall, the model of ESFDI does very well in explaining the correlation of exports, FDI and variable trade costs, which had been left unexplained by the theory of HFDI. The framework provides a very simple and intuitive mechanism without relying on historical particularities of the European Union or on oligopolistic competition as in Neary (2007).[14]

3.2 Euro-Area FDI

As outlined by Geishecker, Görg, and Taglioni (2006), by far the most popular host countries for FDI (measured by the number of affiliates) originating from Euro-area countries are other Euro-area countries. In particular, the most popular destination markets are France and Germany. The U.S. rank only third, followed by Spain, Great Britain and the Netherlands. This pattern contradicts the predictions the theory of HFDI: if avoiding trade costs is the main motive for FDI, one would expect only little FDI in other EU countries because trade costs are arguably low, while the fixed cost of setting up a production facility are rather high. FDI should actually be concentrated in destination markets with higher trade costs like the United States.[15] It can, however, be seen from Proposition 1 and Proposition 2 that this pattern is exactly in line with the predictions of the model with ESFDI. Taking the number of affiliates as a proxy for FDI activity, by Proposition 1 *(ii)*, lower trade costs imply a larger number of affiliates in the destination market, while higher trade costs reduce the number of affiliates. The pattern can again be illustrated using Figure 3. Instead of two points in time, consider two destination markets 0 (US) and 1 (Euro area) for which $\tau_{i1} < \tau_{i0}$. Furthermore, assume that the two markets only differ in variable trade costs. All firms with productivity levels above $\bar{\varphi}_{d,1}$ have an affiliate in

[14]Note however, that the empirical studies cited above do not incorporate wholesale trade affiliates and their sales. As argued in footnote 5, however, the fact that an affiliate appears in the data as 'manufacturing' does not imply that its main purpose is not ESFDI. Based on this argument, one would expect the findings of the cited empirical studies to be more pronounced when when wholesale trade affiliates are included in the analysis. Empirical work is needed here.

[15]Although it is not the focus of this paper, note that the theory of vertical FDI does not offer a convincing explanation for this pattern neither: if factor price differences are the driving force FDI in Europe should flow from high-wage to low-wage countries. The contrary is observed.

market 1, those firms whose productivity exceeds $\bar{\varphi}_{d,0}$ also have an affiliate in market 0. Clearly, since $\bar{\varphi}_{d,1} < \bar{\varphi}_{d,0}$, more firms have affiliates in the destination with the lower variable trade costs. The same pattern holds for affiliate sales as a measure of FDI. It follows from Proposition 2 *(ii)* that affiliate sales are larger in the destination market with the lower variable trade costs.

Thus, the model including ESFDI gives a very simple and straight forward explanation for the otherwise puzzling dominance of intra Euro-area FDI in overall Euro-area FDI: low variable trade costs discourage HFDI and many firms wish to export. But because variable trade costs are low, these firms choose to export large quantities. For large quantities, however, it is optimal for many firms to pay the higher fixed costs of creating an export-supporting affiliate in the destination market in order to facilitate their exporting activities.

Geishecker, Görg, and Taglioni (2006) also investigate how the picture is changing when only the more productive firms in the sample are considered. In this case, the U.S. play a more important role as destination market than before. This is perfectly consistent with the model of ESFDI: the less productive firms with productivity between $\bar{\varphi}_{d,1}$ and $\bar{\varphi}_{d,0}$ are the ones that account for most of the difference in FDI (both affiliates and their sales) between the two markets. If these firms with relatively low productivity are left out of the sample, the higher trade cost market becomes more important as a destination market.

4 Conclusions

In this paper the theoretical concept of export-supporting FDI was introduced and included into a model of international trade and FDI with heterogeneous firms. It turned out that the concept of ESFDI can be very useful to understand some patterns of the data which are at odds with standard theories of horizontal FDI. In particular, the model successfully accounts for the simultaneous increase in trade and FDI activity observed in the 1990s and the dominance of Euro area countries as host countries for affiliates of Euro-area MNCs.

Future work will address the role of ESFDI in sectors which differ in trade costs, market structure and firm heterogeneity. On the empirical front, the implications of the model e.g. regarding the productivity ranking of firms, the correlation of exports and FDI over time, particularities of highly integrated regions, the impact of firm heterogeneity and the role of market structure should be tested in the data. Another interesting issue to look at would be the question of whether the omission of ESFDI in the existing studies might have created an overestimation of the role of HFDI compared to VFDI.

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Appendix

A Figures

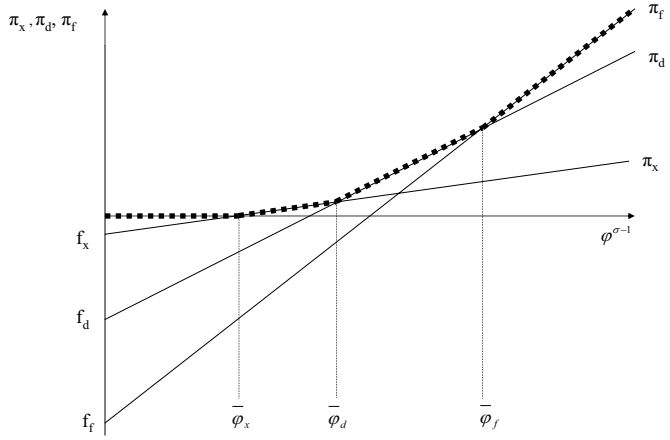

Figure 1: Profits from 'classic' exporting, FDI-supported exporting and 'classic' FDI with production and distribution in the foreign market.

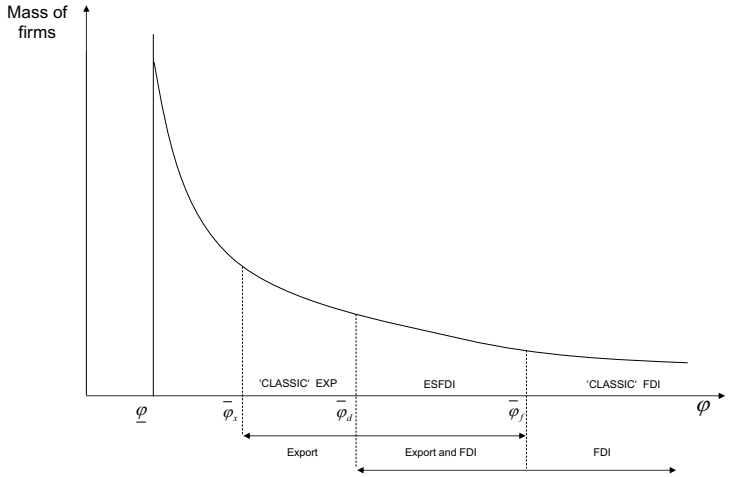

Figure 2: Productivity ranking of strategies chosen to serve the foreign market under the Pareto assumption. Those firms choosing ESFDI are both exporters *and* multinationals with affiliates in the destination market. Different to standard theory on horizontal FDI, the model does not imply a mutual exclusion of FDI and exporting activities in order to serve one and the same foreign market.

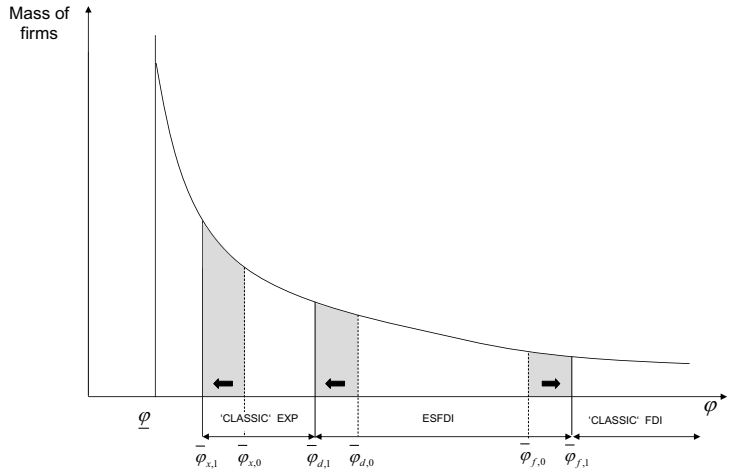

Figure 3: A decrease in variable trade costs leads some additional firms to enter the export market. More importantly, some firms switch from 'classic' exporting to ESFDI and on the other side of the distribution it becomes optimal for a larger number of firms to do ESFDI compared to HFDI. Thus, as trade costs fall, ESFDI becomes more and more important as a way of serving the foreign market substituting both 'classic' exporting and HFDI.

B Constant terms:

Wherever possible, sectoral subscripts are omitted.

$$
\begin{aligned}
E_j &= \left[\frac{\mu}{\sigma}\left(1+\frac{\Pi}{L}\right)L_j\right]^{\frac{1}{\gamma}-\frac{1}{\sigma-1}} \left(\frac{\gamma}{\gamma-(\sigma-1)}\right)^{-\frac{1}{\gamma}} \frac{\sigma}{\sigma-1} \\
G_j &= \left[\frac{\mu}{\sigma}\left(1+\frac{\Pi}{L}\right)L_j\right]^{-\frac{1}{\gamma}} \left(\frac{\gamma}{\gamma-(\sigma-1)}\right)^{\frac{1}{\gamma}} \\
I_j &= \left[\frac{\mu}{\sigma}\left(1+\frac{\Pi}{L}\right)L_j\right]^{\frac{\sigma-1}{\gamma}} \left(\frac{\gamma}{\gamma-(\sigma-1)}\right)^{-\frac{\sigma-1}{\gamma}} \\
J_j &= \left[\frac{\mu}{\sigma}\left(1+\frac{\Pi}{L}\right)L_j\right]^{\frac{\sigma-1}{\gamma}} \left(\frac{\gamma}{\gamma-(\sigma-1)}\right)^{-\frac{\sigma-1}{\gamma}} \sigma \\
K_j &= \left[\frac{\mu}{\sigma}\left(1+\frac{\Pi}{L}\right)L_j\right] \left(\frac{\gamma}{\gamma-(\sigma-1)}\right)^{-1} \\
M_j &= \mu\left(1+\frac{\Pi}{L}\right)L_j \\
\text{With} \quad \Pi &= \frac{\sum_{h=1}^{H}\left(\frac{\sigma_h-1}{\gamma_h}\right)\frac{\mu_h}{\sigma_h}}{1-\sum_{h=1}^{H}\left(\frac{\sigma_h-1}{\gamma_h}\right)\frac{\mu_h}{\sigma_h}}L.
\end{aligned}
$$

C Aggregate world profits:

World profits are defined as the sum of the profits any firm makes in any market

$$\Pi = \sum_{h=1}^{H} \sum_{k,l=1}^{N} L_k \left[\int_{\bar{\varphi}_{kj}^{h,x}}^{\bar{\varphi}_{kj}^{h,d}} \pi_{kl}^{h,x}(\varphi)\, dF_h(\varphi) \; + \; \int_{\bar{\varphi}_{kj}^{h,d}}^{\bar{\varphi}_{kj}^{h,f}} \pi_{kl}^{h,d}(\varphi)\, dF_h(\varphi) \; + \; \int_{\bar{\varphi}_{kj}^{h,f}}^{\infty} \pi_{kl}^{h,f}(\varphi)\, dF_h(\varphi) \right]$$

where $\pi_{kl}^{h,x}(\varphi)$, $\pi_{kl}^{h,d}(\varphi)$ and $\pi_{kl}^{h,f}(\varphi)$ are net profits a firm with productivity φ in sector h of country k makes by serving market l by 'classic' exporting, ESFDI and 'classic' FDI respectively. These individual firm profits as a function of productivity (and thus the strategy of serving markets) can be obtained using the definition of firm profits and the equilibrium price index from equation (2), which gives (again, sectoral indices are dropped)

$$\pi_{ij}^{x}(\varphi) = I_j \; \theta_j^{\sigma-1} \; \tau_{ij}^{1-\sigma} \; \delta_{ij}^{1-\sigma} \; \varphi^{\sigma-1} - f_{ij}^{x}.$$

Profits from export-supporting FDI are given by

$$\pi_{ij}^{d}(\varphi) = I_j \; \theta_j^{\sigma-1} \; \tau_{ij}^{1-\sigma} \; \varphi^{\sigma-1} - f_{ij}^{d}.$$

And firms transferring both distribution and production to j, make profits of

$$\pi_{ij}^{f}(\varphi) = I_j \; \theta_j^{\sigma-1} \; \varphi^{\sigma-1} - f_{ij}^{f}.$$

The constant I_j is defined in appendix B. Evaluating the integrals and using the definition of θ_j, leads to the expression for aggregate world profits:

$$\Pi = \frac{\sum_{h=1}^{H} \left(\frac{\sigma_h - 1}{\gamma_h} \right) \frac{\mu_h}{\sigma_h}}{1 - \sum_{h=1}^{H} \left(\frac{\sigma_h - 1}{\gamma_h} \right) \frac{\mu_h}{\sigma_h}} L.$$

It is important to note that in equilibrium aggregate world profits depend on exogenous parameters and constants only.