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Abstract:

This paper attempts to clarify the reasons for the rapid growth of FDI in developing countries, particularly East Asian countries, compared with that of FDI in developed countries. To do this, we will examine the mechanics of HFDI and VFDI with a view toward shedding light on the role of trade costs. Our empirical analysis by estimation of a multinomial logit model of Japanese firms' FDI choices reveals that the reduction of tariff rates attracts even less productive VFDI firms. In contrast, their rise attracts even less productive HFDI firms. Since developing countries, particularly East Asian countries, have seen a relatively rapid decline in tariff rates, our results indicate that the increase of VFDI through reductions in tariff rates has led to the recent relative surge of FDIs in developing countries.

***Keywords*:** multinational firm, firm heterogeneity, and productivity.
***JEL Classification*:** D24; F23

1. Introduction

Recently, foreign direct investments (FDIs) from developed countries to developing countries have experienced a remarkable increase, compared with FDIs between developed countries. Navaretti and Venables (2004) report the fact that *although FDI goes predominantly to advanced countries, the share of developing countries has been rising*. They show that "the share of worldwide FDI received by the developing and transition economies jumped from 24.6% in the period 1988-93, to more than 40% in the period 1992-97". Also, in Japan, there have of late, been few investors in developed countries. Almost all investment goes to developing countries, particularly East Asian countries. Furthermore, the recent investors are relatively low productive firms (see, for example, Obashi et al., 2009; Wakasugi and Tanaka, 2009). Why have FDIs in developing countries particularly by low productive firms grown so rapidly compared with those to developed countries?

This paper attempts to clarify the reasons for this relatively rapid growth of low productive firms' FDIs to developing countries by shedding light on the role of trade costs. It is obvious that trade liberalization has proceeded all over the world, particularly in developing countries. Due to the prohibitively high trade costs in the initial period, developing countries have achieved a much greater extent of trade liberalization. A large part of the opening of domestic economies can be attributed to unilateral decisions, as in China and India, but regional and multilateral reductions under the guise of the World Trade Organization are also important in promoting global trade. Since 1990 there has also been an explosion in regional trade agreement notifications, many involving the new transition economies (World Bank, 2006). Such significant trade liberalization would be one of the driving forces for the rapid increase of FDIs to developing countries.

However, the relationship between trade costs and FDI is not so simple. In the FDI literature, many types of FDI classification have been proposed. One of the most common is horizontal FDI (HFDI). HFDI is a market-seeking investment and thus is likely to be directed towards developed countries. In order to avoid high trade costs when supplying products to the market, the HFDI firms locate their affiliates in the market country and directly supply their products from that country. In other words, it is generally acknowledged as a proximity-concentration hypothesis that firms invest in countries with large markets and substantial trade costs with their home country (Brainard, 1997). Indeed, Chen and Moore (2010) found that French firms are likely to invest in countries located geographically far from France. Therefore, a rise in trade costs will be expected to result in an increase of HFDI. However, as mentioned above,

trade liberalization has occurred in the world. In this simple framework of HFDI, the trade liberalization cannot solve for the recent increase of FDIs to developing countries.

Furthermore, incorporating firm heterogeneity in terms of productivity into the HFDI model, Helpman et al. (2004) shows the presence of a sorting effect according to firms' productivity: only firms with productivity beyond a cutoff can afford to pay the entry costs involved in investing abroad, and thus are able to become multinationals. This indicates that the increase of investing can occur if firms' productivity rises or if the productivity cutoff for investing *per se* decreases. As Chen and Moore (2010) demonstrate, the productivity cutoff is a function on several host country characteristics. In particular, the rise of trade costs lowers the productivity cutoff and thus enables even less productive firms to invest abroad. Therefore, this extended version of HFDI cannot demonstrate that the trade liberalization plays a crucial role in increasing low productive firms' FDIs to developing countries, either.

One candidate for models attempting to clarify the reasons for the relative increase of FDIs to developing countries by low productive firms is the vertical FDI (VFDI) model.[1] VFDI is an investment the aim of which is to relocate a part of the production process to cheap-labor countries and to engage, insofar as their production processes are concerned, in a vertical division of labor between host and home countries. Therefore, VFDI is likely to be directed towards developing countries rather than developed countries. Furthermore, the production cost reduction by the division of labor needs to outweigh the additional cost burden incurred in linking remotely-located production blocks. The main costs are obviously trade costs between host and home countries. Thus, it is apparent that VFDI is likely to be conducted in countries with a large gap in wages and a low level of trade costs between home and host countries. Therefore, it is expected that trade cost reduction should lead to an increase of VFDI. In other words, the mechanics of VFDI seem to be consistently able to explain the recent increase of FDIs in developing countries. Furthermore, as in the extended version of HFDI, the productivity cutoff may play an important role also in the case of VFDI. In particular, if the trade cost reduction lowers the productivity cutoff for VFDI, the recent decrease of trade costs increases the VFDI by the less productive firms.

Our research strategy is as follows. We first extend the Helpman et al. (2004) model so as to allow firms to choose another option, VFDI. In other words, we explicitly integrate the HFDI and VFDI models into a single framework. Subsequently,

[1] In addition, more specific types of FDI are also proposed. In particular, to explore the mechanics of setting up multiple affiliates, FDI theories have been reconstructed in the framework of a three-country, not the traditional two-country, setting (Yeaple 2003; Grossman, Helpman, and Szeidl 2006; Baltagi, Egger, and Pfaffermayr 2007; Ekholm, Forslid, and Markusen 2007).

we derive some propositions regarding the relationship between trade cost reduction and firms' FDI choice. More specifically, we examine how changes in host country characteristics affect the productivity cutoffs separating firms' FDI choice. Next, we empirically examine those propositions for Japanese FDIs around the world by employing firm-level data. We estimate the multinomial logit model regarding firms' choice among three options: domestic production, HFDI, and VFDI. In the classification of HFDI and VFDI, we adopt the criterion that the HFDI affiliates are those in which the ratio of exports to total sales is less than the world average by sector, and the VFDI is the inverse. As a result, our estimation reveals that the reduction of tariff rates in host countries has different impacts between HFDI and VFDI. Their reduction attracts comparatively less productive VFDI firms in contrast to HFDI firms. Since developing countries, particularly East Asian countries, have experienced a relatively rapid decrease of tariff rates, our findings imply that the increase of VFDI through tariff rate reduction has resulted in the recent relative surge of FDIs to developing countries.

Our paper complements the recent empirical studies that examine the decision of heterogeneous firms to participate in international markets by extending the Helpman et al. (2004) model: Aw and Lee (2008), Yeaple (2009), and Chen and Moore (2010). Aw and Lee (2008) consider Taiwanese HFDI as the investment of firms of middle country in terms of wage levels and have four options: domestic production, investment in a lower wage country (China), investment in a higher wage country (U.S.), and investment in both higher and lower wage countries. Then, they examine the ranking of firms' productivity according to their chosen option and found it to be as follows: domestic production, FDI to China, FDI to the U.S., and both FDI to China and the U.S. Yeaple (2009) and Chen and Moore (2010) examine the relationship of productivity cutoff with several host country characteristics in HFDI of the U.S. and French, respectively. For example, they show that the cutoff for investing is lower in countries with larger market. As in Yeaple (2009) and Chen and Moore (2010), our paper examine the productivity cutoff for investing but incorporate not only HFDI but also VFDI into firms' options.

The rest of this paper is organized as follows: The next section lays out a model to motivate our empirical analysis. Empirical analyses and their results are reported in Sections 3 and 4, respectively. Lastly, we conclude the paper in Section 5.

2. Theoretical Framework

This section examines the problem of selecting an FDI pattern, i.e. HFDI or VFDI.

It should be noted that the aim of this section is not to provide a general equilibrium model of multi-production-stages and multi-country settings. Instead, under the simplified settings (e.g., a two-country setting or a partial equilibrium model), we focus on the examination on how the changes in various parameters affect firms' FDI pattern.

2.1. Profit Functions in Each Strategy

Suppose that there are two countries: country 1 (home country) and country 2 (foreign country). In this supposition we consider finished products that are horizontally differentiated. Each of a continuum of firms manufactures a different brand with zero measure. The finished products are consumed in both countries. A representative consumer in country i has a constant elasticity of substitution utility function over varieties. As usual in the literature, utility maximization yields:

$$x_{ji}(k) = p_{ji}(k)^{-\sigma} A_i ,$$

where $x_{ji}(k)$ is the demand of country i for the variety k produced in country j. $p_{ji}(k)$ is the price in country i for the variety k produced in country j. σ is the elasticity of substitution between varieties and is assumed to be greater than unity. The brand name k is omitted from this point onwards for brevity. $A_i \equiv P_i^{\sigma-1} Y_i$, where P_i is the price index in country i and Y_i is total income in country i. Although the demand level A is endogenous to the industry, it is treated as exogenous by producers because every producer is of negligible size relative to the size of the industry. There are ice-berg costs t_{ji} (≥ 1) for the shipment of products between countries j and i: $t_{ji} = t$ for $j \neq i$ and $t_{ji} = 1$ for $j = i$.

The market structure of the finished goods sector can be regarded as monopolistic competition. Each firm knows its cost efficiency θ only after its entry into the market. Finished products are produced in two stages of production. The production function in each stage is kept as simple as possible in order to highlight the nature of interdependence of production stages. Our Leontief-type production structure is as follows: A first-stage product is produced inputting θ units of skilled-labor; a second-stage product is produced inputting one unit of the first-stage product and θ units of unskilled-labour. In other words, our production structure implies each stage product is used in fixed proportions, as there is no substitutability between both stages of products. Furthermore, the improvement of cost efficiency decreases production factors necessary for producing each stage product at the same proportion. These settings in the production technology simplify our analysis greatly.[2]

[2] Our two-country setting implies that we do not consider the sales of the second stage product to and the inputs of the first stage product from the "third country", as in Yeaple (2009) and Chen and

Factor prices for skilled-labor and unskilled-labor are represented by r and w, respectively. Once again, there are ice-berg trade costs t for the shipment of the first stage product between countries 1 and 2. For the sake of simplicity, it is assumed that trade costs are identical between the first and second stage products.[3] Although firms with headquarters in country 1 do not need to pay any fixed costs if they produce both two-stage products in only country 1, they must incur plant set-up costs f if they locate plants in country 2.

We consider the production pattern of firms with headquarters in country 1. It is assumed for the sake of simplicity that the headquarters cannot be relocated. Furthermore, we restrict the considerations to firms with at least one production stage in country 1. This restriction rules out the pattern of complete specialization in headquartered services at home. Our interest in the production pattern is devoted to three specific patterns: domestic production (D), VFDI (V), and HFDI (H). Domestic production indicates that firms locate both stages in the home country and supply their finished products from home to both countries. In VFDI, firms locate the first stage of production at home and the second stage abroad. Since the finished products are completed abroad, firms supply their finished products from the foreign plant to both countries. Lastly, HFDI firms locate both production stages in both countries and supply their finished products domestically[4].

Among these three patterns, firms choose the pattern which yields the highest total profit. Let c^M_{ji} be a marginal cost in producing products in country j for the country i market in the production pattern M, then respective marginal costs are given by:

$$c^D_{11} = (r_1\theta + w_1\theta), \qquad c^D_{12} = (r_1\theta + w_1\theta)\, t,$$
$$c^V_{21} = (t\, r_1\theta + w_2\theta)\, t, \qquad c^V_{22} = (t\, r_1\theta + w_2\theta),$$
$$c^H_{11} = (r_1\theta + w_1\theta), \qquad c^H_{22} = (r_2\theta + w_2\theta).$$

The profit-maximizing strategy yields $p_{ji}=\sigma c^M_{ji}/(\sigma\text{-}1)$, so that profit functions are represented by:

$$\pi_1^D = (r_1+w_1)^{1-\sigma}\,(A_1+A_2 t^{1-\sigma})\,\Theta$$

Moore (2010). Also see footnote 1 and the second empirical issue in Section 3.

[3] Distinguishing trade costs between two stages makes the analysis quite complicated. The examination of such a model is beyond our scope to motivate our empirical analysis. See, for example, Grossman et al. (2006).

[4] There are obviously other possible production patterns for firms. For example, firms conduct the first-stage production only in home, but the second-stage production for supplying finished products to home and foreign countries may be done in home and foreign countries, respectively. This type of production pattern is likely to be dominant in the medium level of trade costs. In this paper, we do not consider this pattern because we focus later on the cases of high and low trade costs. Besides, this pattern is hard to identify by firm-level data.

$$\pi_1^V = (tr_1+w_2)^{1-\sigma}(A_1 t^{1-\sigma}+A_2)\,\Theta - f,$$
$$\pi_1^H = \{(r_1+w_1)^{1-\sigma}A_1 + (r_2+w_2)^{1-\sigma}A_2\}\,\Theta - f.$$

where $\Theta \equiv \sigma^{-\sigma}(\sigma\text{-}1)^{\sigma-1}\,\theta^{1-\sigma}$. We call Θ the productivity measure. Since $\sigma > 1$, the smaller the cost efficiency θ is, the larger the measure Θ is.

2.2. FDI Choice

This subsection examines which production pattern the firms in country 1 choose according to their productivity levels. Let S_i^M to be a slope of the profit function of country i's firm in production type M. Then the three slopes are represented by:

$$S_1^D = (r_1+w_1)^{1-\sigma}(A_1+A_2 t^{1-\sigma}),$$
$$S_1^V = (tr_1+w_2)^{1-\sigma}(A_1 t^{1-\sigma}+A_2),$$
$$S_1^H = (r_1+w_1)^{1-\sigma}A_1 + (r_2+w_2)^{1-\sigma}A_2.$$

For simplicity, it is assumed that $w_1 \geq w_2$ and $r_2 \geq r_1$, which indicate that country 1 (the home country) has higher wages for unskilled labor while country 2 (the potential host country) has higher wages for skilled labor.[5]

Assumption 1: $w_1 = a\,w_2$ *and* $r_2 = b\,r_1$, *where* $a \geq 1$ *and* $b \geq 1$.

Furthermore, we assume that the home country has as large as or larger demand than any potential host country.

Assumption 2: $A_1 \geq A_2$.

Our assumption of identical plant set-up costs between VFDI and HFDI assures that firms choosing VFDI and those choosing HFDI do not coexist. In other words, in our model setting, firms tend to choose between VFDI and Domestic or between HFDI and Domestic production patterns. The case of the different plant set-up costs will be considered later. In this subsection, we present only theoretical results with describing profits as a function of the productivity measure Θ. For more details, see Appendix 1.

We can confirm the well-known conditions for the dominance of each FDI. First, we consider how the differences in wages affect the choice of production type. Given

[5] You may think that the assumption of lower wages for skilled labor in home country than, for example, in developing countries is unrealistic in the empirical analysis. But, you should interpret this assumption under the condition on the same labor quality between developing and developed countries. That is, if firms try to hire in developing countries an enough number of skilled labors with the same education level as those in developed countries, they must pay expensive costs for searching those labors, and thus the whole cost per skilled labor, i.e. substantial wages for skilled-labors, becomes expensive.

trade costs between countries, the lower the wages for unskilled-labor abroad, VFDI (S_1^V) is likely to have the steeper slope in the profit line than domestic production (S_1^D) (Corollary 2). One of the crucial differences between VFDI and Domestic is the location of the second-stage production, which uses intensively unskilled-labor. Thus, the lower the wages for unskilled-labor abroad are, the cheaper the second-stage production abroad is. In contrast, the lower the wages for skilled-labor abroad, the steeper slope is likely to be in HFDI (S_1^H), compared with domestic production (S_1^D) (Corollary 8). One difference between HFDI and Domestic is the production location of products designed for a foreign market. That is, unlike in the case of VFDI, HFDI locates both the first and second stages and thus employs both two kinds of labors abroad. Hence, the lower the wages for both kinds of labors abroad, the cheaper the production of the products for the foreign market is.

As a result, because both HFDI and VFDI firms must incur fixed set-up costs f for the plant in country 2, a profit line in each production type can be drawn as in figures 1 and 2. Figure 1 shows the productivity-cutoff which divides firms between into domestic and VFDI categories, in the case of the lower wages for unskilled labors abroad. This figure shows that in the case of low wages for unskilled labors abroad, the more productive firms choose VFDI while the less productive firms concentrate on production activity at home. Similarly, we can depict the productivity-cutoff which divides firms between into domestic and HFDI categories in the case of the lower wages for skilled labors abroad, as in Figure 2, and obtain: in the case of low wages for skilled labors abroad, the more productive firms choose HFDI while the less productive firms concentrate on production activity at home.

=== Figures 1&2 ===

Secondly, we take the differences in wages for both types of labor as a given. Then, the lower the trade costs between countries, the slope in VFDI (S_1^V) becomes steeper than that of domestic production (S_1^D) (Corollary 3). This is because the low trade costs reduce the shipment costs of the first-stage product from home to abroad. In contrast, the larger the trade costs, the slope in HFDI (S_1^H) becomes steeper than that of domestic production (S_1^D) (Corollary 9) because the high trade costs increase the shipment costs of the second-stage product from home to abroad in the case of domestic production. Thus, we can again draw two kinds of figures similar to Figures 1 and 2, according to the magnitude of trade costs. In the case of low trade costs, as in Figure 1, more productive firms choose vertical FDI while less productive firms focus on

domestic production. On the other hand, in the case of high trade costs, more productive firms choose horizontal FDI while less productive ones focus on domestic production, as in Figure 2.

Next, we consider how the above cutoffs change according to host country characteristics. As shown above, VFDI is likely to be chosen in the case of low trade costs and lower wages for unskilled-labor abroad. Then, a further reduction in trade costs (Corollary 4), fixed costs (Corollary 5), or their wages (Corollary 7) or a market-size expansion (Corollary 6) abroad reduces the cutoff which divides firms into domestic and VFDI categories. In other words, these changes in potential host countries succeed in attracting less productive VFDI firms. The underlying mechanics are basically similar to the above-mentioned ones. On the other hand, as confirmed before, HFDI is likely to be chosen in cases of the lower wages for skilled-labor abroad and the higher trade costs. Then, except for trade-cost reduction, similar kinds of changes in host country characteristics also lead to the attraction of the less productive HFDI firms (Corollaries 10 and 11). However, trade cost reduction requires HFDI firms to be more productive. As a result, these results can be summarized as follows:

Hypothesis 1: *In the cases of low trade costs and low wages for unskilled labors abroad, the reduction in fixed entry costs or wages for unskilled labors or the expansion of the foreign market attracts even less productive VFDI firms.*

Hypothesis 2: *In the cases of high trade costs and low wages for skilled labors abroad, the reduction in fixed entry costs or wages for skilled labors or the expansion of the foreign market attracts even less productive HFDI firms.*

Hypothesis 3: *While trade cost reduction attracts even less productive VFDI firms, the rise of trade costs attracts even less productive HFDI firms.*

Last, we examine simply how the above results change if we assume the different plant set-up costs between VFDI and HFDI. Then, domestic firms, VFDI firms, and HFDI firms can coexist. For example, there are combinations of wages for skilled and unskilled labors in which $S_1^H > S_1^D$ and $S_1^V > S_1^D$. In such a combination, if $S_1^H > S_1^V$ and plant set-up costs are cheaper in VFDI than HFDI, firms with high levels of productivity choose HFDI, those with medium levels choose VFDI, and those with low levels choose Domestic (Figure 3). But, if $S_1^H > S_1^V$ and plant set-up costs are cheaper in HFDI than VFDI, VFDI firms do not exist (Figure 4). As above, the productive firms

choose HFDI while less productive firms choose domestic production. In sum, the production strategy by both a group of the most productive firms and a group of the least productive firms does not change if the difference in plant setup costs between HFDI and VFDI is not so large. However, the strategy by firms with the middle level of productivity is more complicated and depends on their magnitude in addition to the above-discussed parameters. Since we do not have any evidences indicating which type of FDIs need more expensive plant setup costs, we examine empirically how the above host country characteristics affect firms' decision on choosing FDI types.

=== Figures 3&4 ===

3. Empirical Framework

This section explains our empirical method to investigate empirically the above-derived Hypotheses 1-3. We estimate the multinomial logit model for firms' decisions on investing. The use of a discrete choice model is appropriate because our model has multiple choices (i.e. Domestic, HFDI, and VFDI), and firms in the model choose the one with the highest profit margins. Let Y_{if} be a random variable that indicates the choice made by firm f in country i: 0 = Domestic, 1 = Horizontal FDI, 2 = Vertical FDI. A firm f in country i has characteristics $\boldsymbol{x}_{if}$, which do not vary across choices and are specific to the individual. If we assume that all disturbances are independent and identically distributed in the form of type I extreme value distribution, the probability that it chooses option j can be shown as:

$$Prob(Y_{if} = j \mid \boldsymbol{x}_{if}) = \frac{e^{\boldsymbol{x}_{if}\boldsymbol{\beta}_j}}{\sum_{k=0}^{2} e^{\boldsymbol{x}_{if}\boldsymbol{\beta}_k}}, \quad j = 0, 1, 2, \boldsymbol{\beta}_0 = \mathbf{0}.$$

$\boldsymbol{\beta}_j$ is a vector of coefficients to be estimated using the maximum likelihood estimation technique. Time script t is dropped for the sake of brevity, although it should be noted that our sample years are 1995-2003. The information of firms' investing abroad is drawn from the *Survey of Overseas Business Activities*, which is an affiliate-level survey conducted by the Ministry of Economy, Trade and Industry (METI).[6] Table 1 reports

[6] The aim of this survey is to obtain basic information on the activities of foreign affiliates of Japanese firms. The survey covers all Japanese foreign affiliates. The survey consists of two parts. One is the Basic Survey, which is more detailed and is carried out every 3 years. The other is the Trend Survey, which is less comprehensive and carried out between the Basic Surveys. A foreign affiliate of a Japanese firm is defined as an overseas subsidiary in which a Japanese firm holds 10 percent or more of the invested capital. The survey provides, for example, the establishment year of a foreign affiliate, a breakdown of its sales and purchases, its employment, cost of labor, research and development expenditures, etc.

the number of overseas affiliates in new investors by entry year, indicating that most of the Japanese MNEs invest in Asia.[7]

=== Table 1 ===

Our explanatory variables based on the theoretical framework in the previous section are as follows: we introduce firms' total factor productivity (TFP) as the measurement of their productivity. We use two types of productivity measures. The one is the TFP estimates derived from production function estimation. One sensitive issue of production function estimation is how to deal with unobserved productivity shocks. If they are correlated with unobservable input variables, simple OLS estimates will be biased. To address this endogeneity issue, we apply the method proposed by Levinsohn and Petrin (2003). This method uses intermediate inputs as a proxy for unobservable productivity shocks and obtains the consistent estimator of TFP.

The other productivity measure is the TFP index based on Caves et al. (1982, 1983) and Good et al. (1983). The TFP index is calculated as follows:

$$TFP_{it} = \left(\ln Q_{it} - \overline{\ln Q_t}\right) - \sum_f \frac{1}{2}\left(s_{ift} + \overline{s_{ft}}\right)\left(\ln X_{ift} + \overline{\ln X_{ft}}\right)$$

$$+ \sum_s \left(\overline{\ln Q_s} - \overline{\ln Q_{s-t}}\right) - \sum_s \sum_f \left(\overline{s_{fs}} - \overline{s_{fs-t}}\right)\left(\overline{\ln X_{fs}} - \overline{\ln X_{fs-t}}\right),$$

where Q_{it}, s_{ift} and X_{ift} denote the shipments of firm i in year t, the cost share of input f for firm i in year t, and input of factor f for firm i in year t, respectively. The inputs are labor, capital, and intermediates. Variables with an upper bar denote the industry average for that variable. The firm-level data for its calculation are drawn from METI's *Results of the Basic Survey of Japanese Business Structure and Activities*.[8]

We interact several country-specific variables to firms' TFP in order to examine the heterogeneous effects of host country characteristics across firms.[9] The first one is related to labor costs. In the previous section, we categorized labor into skilled and unskilled. However, since this is somewhat difficult to achieve through empirical analysis, we simply introduce the average manufacturing wages in the host country. To

[7] In this paper, Asia includes not only East Asian countries but also South Asian countries. While North America consists of the U.S. and Canada, Europe includes not only Western European countries but also Eastern European countries.

[8] This survey was first conducted in 1991, then again in 1994, and annually thereafter. The survey covers all firms, both manufacturing and non-manufacturing, with more than 50 employees and capitalized at more than 30 million yen.

[9] Due to avoiding the introduction of many variables with high correlation one another, our explanatory variables do not include country-specific variables themselves.

control labors' skill structure to some extent, we instead introduce firms' total employment and share of production workers at home. The second variable is aimed to control the market size in possible host countries. As its proxy, we use the market potential measure which is proposed by Head and Mayer (2004).[10] The third one is related to plant setup costs: host countries' credibility index. The higher the index is, the smaller the risk of default in the country is. Fourth, as a proxy for trade costs, we use the following two measures: geographical distance from Japan and host country's sector-level tariff rates (the simple average of most favored nation tariff rates). Finally, we introduce sector and year dummy variables.

Our data sources of explanatory variables are as follows. The data on firm-level variables, i.e. total employment and a share of production workers, are drawn from *the Basic Survey of Japanese Business Structure and Activities*.[11] The data on bilateral distance and those on the manufacturing wages are from the CEPII website[12] and the International Yearbook of Industrial Statistics (United Nations Industrial Development Organization), respectively. The index is drawn from "Institutional Investor" and is the aggregate of bankers' evaluation of risk of default. The sector-level tariff rates can be obtained from the World Bank website.[13] It is worth showing the changes in tariff rates (their weighted-average in manufacturing sectors), which are depicted in Figure 5. From this figure, we can see that tariff rates in regions other than Asia have remained almost unchanged during our sample period, but those in Asia have gradually decreased. In other words, Asia has achieved a greater extent of trade liberalization in terms of tariff rate reduction than other regions.

=== Figure 5 ===

There are two points that should be borne in mind. The first is how to differentiate between overseas affiliates opting for HFDI and those choosing VFDI. In fact, there are a number of ways to do this. Among them, this paper sheds light on the main sales destinations in affiliates. Since the aim of HFDI is to supply products within the market country, the main sales destination is the host country in the case of HFDI affiliates. On the other hand, it is not necessarily the host country in the case of VFDI. Thus, we define an HFDI affiliate as an affiliate whose share of exports in total sales is less than

[10] For more details, see Mayer (2009).
[11] These firm-level variables are one year-lagged behind the dependent variable in order to mitigate possible reverse causality to some extent.
[12] http://www.cepii.fr/francgraph/bdd/distances.htm
[13] http://go.worldbank.org/EQW3W5UTP0

the industry average in all sampled affiliates, which is not the case with VFDI affiliates. One shortcoming of this classification is the underestimation of VFDI affiliates. As is clear in our model provided in Section 3, if home and foreign countries have almost similar size of market, a share of finished products sold abroad becomes larger even in the case of VFDI. Thus, some of the VFDI affiliates may be misclassified as HFDI affiliates. We can say that our classification method is a strict one for VFDI. As a result, the share of VFDI affiliates is reported in Table 2. In line with our expectations in the introductory section, affiliates in Asia are more likely to fall into the category of VFDI than those in developed countries.

=== Table 2 ===

The second issue is consistency of the theoretical and empirical frameworks with the real economy. In the theoretical framework, given one candidate for the host country (it should be remembered that our model is a two-country setting), firms choose their operation type from among three production types. As is consistent with this setting, the empirical framework examines the multinomial logit model, in which firms choose a production strategy with the highest profit in *each* country. On the other hand, in reality, firms seem to choose their *location* and production strategy simultaneously. In other words, there is some gap between firms' real decision and our theoretical/empirical setting. However, in order to examine theoretically such simultaneous decision, we need to extend our theoretical model to a multiple-country setting and take into consideration various kinds of interaction among overseas affiliates. For example, the first VFDI affiliate in a country may stop supplying to the home country after setting up the second VFDI affiliate in another country closer to the home country. In order to ensure as much consistency with firm's real decision as possible, we restrict sample firms to some special firms rather than modify our theoretical and empirical settings. Specifically, we restrict investing firms to "first investors": firms who have never had overseas affiliates in the focus sector at time t-1. At least such firms would not take interaction among affiliates into consideration because they do not have any existing affiliates in advance.[14] Furthermore, in order to incorporate the multi-country nature in firms' decision on production strategy to some extent, we will use a market-potential measure rather than the simple GDP as a proxy for the market size in a foreign country.

[14] In addition, in order to keep the consistency in domestic production strategy between theoretical and empirical frameworks, sample firms are restricted only to those who became involved in exporting activities at time t-1.

4. Empirical Results

In this section, we report our estimation results. The estimation results using Levinsohn-Petrin index are found in Table 3. There are some points to be noted. First, the results in non-interaction terms are as follows. Firms' employment and share of production workers are positively and negatively associated with firms' investing abroad, respectively. These results indicate that the larger the firms' size in terms of employment is, or the higher the firms' intensity on non-production activities, the more likely the firms are to invest abroad. The coefficients for TFP are significantly positive in both types of FDI. These results of MNEs' high productivity are consistent with the one in a large number of previous studies such as Kimura and Kiyota (2006). That is, the MNEs are productive firms compared with domestic firms.

=== Table 3 ===

Second, the results in the interaction terms other than those of trade costs-related variables are estimated to be consistent with our expectation. The coefficients for the interaction term of wages with TFP are negative and significant in both equations. Similarly, the interaction term of the Country Credibility Index has significantly positive coefficients in both equations. The coefficients for that of market potential are positive in both equations but significant only in VFDI. These results indicate that the lower wages and plant setup costs and the larger market size in host countries decrease the productivity cutoff for both HFDI and VFDI for such countries. In other words, even less productive firms can invest in countries with such preferable investment environment. These results are completely consistent with our theoretical predictions provided in Section 2, i.e. Hypotheses 1 and 2.

Third, the results in the interaction terms of trade cost-related variables, i.e. Distance and Tariff, are as follows. The coefficient for Distance is estimated to be significantly negative in VFDI, which is consistent with our expectation. Countries close to home country, i.e. Japan, are able to attract even less productive firms. However, the coefficient for the interaction term of Distance in HFDI is also negatively significant though we expect its positive sign. One possible reason is that, as mentioned in Chen and Moore (2010), geographical distance to home country is partly related to fixed-entry costs. For example, long distance leads to increased monitoring costs for firms. Since the low fixed costs encourage firms to conduct HFDI, the distance to home

exhibits opposing forces in the case of HFDI. As a result, our significantly negative result in the interaction term of Distance may indicate that its negative effect in fixed entry costs is stronger than its positive effect in trade costs. On the other hand, the results in the interaction term of Tariff with TFP show a clear contrast; positive in HFDI and negative in VFDI, and both coefficients are significant. From this result, we can say that lower tariffs attract even less productive firms in a form of VFDI but do not attract productive firms in a form of HFDI.

The results using the TFP index proposed by Caves (1982, 1983) and Good et al. (1999) are found in Table 4. All results are qualitatively unchanged with those in Table 2. The larger firms in terms of employment and the more non-production activity-intensive firms are more likely to invest abroad. Even less productive firms can invest in countries with the lower wages and country risks. The coefficients for the interaction terms of market potential turn out to be significantly positive in both HFDI and VFDI, indicating that the larger market size attracts even less productive HFDI and VFDI firms. The geographical distance is again negatively associated with firms' investing abroad not only in VFDI but also in HFDI. Last, we again obtain the contrasting result in the interaction term of TFP with tariffs: positive in HFDI and negative in VFDI. Thus, we conclude that the reduction of trade costs in terms of tariffs leads to the attraction of even the less productive firms in a form of VFDI, not in a form of HFDI.

=== Table 4 ===

5. Concluding Remarks

This paper has attempted to clarify the reasons for the relatively rapid growth of FDIs in developing countries by examining the mechanics of HFDI and VFDI with shedding light on the role of trade costs. We first extend the Helpman et al. (2004) model so as to allow firms to choose another option, i.e. VFDI, and derive some propositions regarding the relationship between trade cost reduction and firms' FDI choices. Next, we have empirically examined these propositions in relation to Japanese FDIs around the world by estimating the multinomial logit model of firms' choices among three options: domestic production, HFDI, and VFDI. As a result, our estimation reveals that the reduction of tariff rates in host countries is impacted differently depending on which form of investment firms choose: HFDI or VFDI. Their reduction attracts less productive VFDI firms but does not attract HFDI firms. Since developing countries, particularly East Asian countries, have experienced a relatively rapid decrease

in tariff rates, we conclude that the increase of VFDI through the tariff rate reduction has led to the recent relative surge of FDIs in developing countries.

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Appendix 1. Slope of Profit Function

In this appendix, we examine differences in slopes of profit function among production types.

A1.1. Domestic vs. VFDI

The condition that the slope in VFDI is greater than the slope in domestic production is as follows:

$$S_1^V > S_1^D \Leftrightarrow r_1 < \frac{(Ba-1)w_2}{t-B}, \quad B \equiv \left(\frac{A_1 + A_2 t^{1-\sigma}}{A_1 t^{1-\sigma} + A_2} \right)^{\frac{1}{1-\sigma}}.$$

Assumption 2 gives us the following corollary.

Corollary 1: $0 < B \leq 1$.

Proof. It is obvious that $B > 0$. $(A_1+A_2t^{1-\sigma})$ - $(A_1t^{1-\sigma}+A_2)$ = (A_1-A_2) $(1-t^{1-\sigma})$. Since $1 \geq t^{1-\sigma}$, $A_1+A_2t^{1-\sigma} > A_1t^{1-\sigma}+A_2$ with Assumption 2. Then, since $\sigma > 1$, $B \leq 1$. ■

We define function $g(a,t)$:

$$g(a,t) = \frac{(Ba-1)w_2}{t-B}.$$

Then, we can easily show (remember that $t \geq 1$):

$$\frac{\partial g(a,t)}{\partial a} = \frac{Bw_2}{t-B} > 0, \quad g(1,t) = \frac{(B-1)w_2}{t-B} < 0.$$

Also, denoting a^* so that $S_1^V = S_1^D$,

$$r_1 = \frac{(Ba^*-1)w_2}{t-B} \Leftrightarrow a^* = \frac{(t-B)r_1 + w_2}{Bw_2} > \frac{1}{B}.$$

By employing these relationships and results, we can draw Figure A1 and obtain the following result:

Corollary 2: *If $a \geq a^*$, then $S_1^V \geq S_1^D$. Otherwise, $S_1^V < S_1^D$.*

In other words, the lower the wages for unskilled-labors in a foreign, the more likely the slope in VFDI is to be larger than that in Domestic.

=== Figure A1 ===

On the other hand, the condition can be also rewritten as:

$$S_1^V > S_1^D \Leftrightarrow 1+\left(\frac{r_1}{w_2}\right)t < \left(a+\frac{r_1}{w_2}\right)B .$$

Due to Assumption 2, we have:

$$\frac{\partial B}{\partial t} = -t^{-\sigma}\left(A_1 + A_2 t^{1-\sigma}\right)^{\frac{\sigma}{1-\sigma}}\left(A_1 t^{1-\sigma} + A_2\right)^{\frac{2-\sigma}{1-\sigma}}\left(A_1 + A_2\right)\left(A_1 - A_2\right) < 0 .$$

Using the sign of this derivative, we can draw the above condition as in Figure A2 and find t so that RHS = LHS, which is denoted by t^*. As a result, we obtain the following result:

Corollary 3: *If $t \le t^*$, then $S_1{}^V \ge S_1{}^D$. Otherwise, $S_1{}^V < S_1{}^D$.*

The lower the trade costs, the more likely the slope in VFDI is to be larger than that in Domestic.

=== Figure A2 ===

Last, let $\Theta_k{}^{VD}$ be the productivity in which Domestic and VFDI have equal profits for firms in country k. Namely, $\Theta_1{}^{VD}$ can be expressed as:

$$\Theta_1{}^{VD} = f / (S_1{}^V - S_1{}^D) = f / [(tr_1+w_2)^{1-\sigma}(A_1 t^{1-\sigma}+A_2) - (r_1+w_1)^{1-\sigma}(A_1+A_2 t^{1-\sigma})].$$

Its derivatives with respect to various parameters are examined. The derivative with respect to trade cost is as follows:

$$\frac{\partial \Theta_1^{VD}}{\partial t} = \frac{f(1-\sigma)}{\left(S_1^V - S_1^D\right)^2}\left\{t^{-\sigma}\left[\left(tr_1 + w_2\right)^{1-\sigma} A_1 - \left(r_1 + w_1\right)^{1-\sigma} A_2\right] + r_1\left(tr_1 + w_2\right)^{1-\sigma}\left(A_1 t^{1-\sigma} + A_2\right)\right\}.$$

With the Assumption 2,

$$\left(tr_1 + w_2\right)^{1-\sigma} A_1 - \left(r_1 + w_1\right)^{1-\sigma} A_2 \ge \left[\left(tr_1 + w_2\right)^{1-\sigma} - \left(r_1 + w_1\right)^{1-\sigma}\right]A_2 .$$

As a result, the sufficient condition for the positive derivative can be written as:

Corollary 4: $(t-1)r_1 < (a-1)w_2 \Rightarrow \dfrac{\partial \Theta_1^{VD}}{\partial t} > 0.$

In other words, if the wages for unskilled-labors in a foreign are low enough, the productivity cutoff becomes low in decreasing the trade costs.

Its derivative with respect to fixed entry cost is given by:

$$\frac{\partial \Theta_1^{VD}}{\partial f} = \frac{1}{S_1^V - S_1^D}.$$

Due to the corollaries 2 and 3, we obtain:

Corollary 5: *If* $a \geq a^*$ *or* $t \leq t^*$, *then* $\partial \Theta_1{}^{VD}/\partial f > 0$.

With respect to the size of foreign market,

$$\frac{\partial \Theta_1^{VD}}{\partial A_2} = \frac{f}{\left(S_1^V - S_1^D\right)^2}\left[\left(tr_1 + w_2\right)^{1-\sigma} - \left(tr_1 + taw_2\right)^{1-\sigma}\right]$$

The following corollary is obtained:

Corollary 6: *If* $ta \leq 1$, *then* $\partial \Theta_1{}^{VD}/\partial A_2 \leq 0$. *Otherwise,* $\partial \Theta_1{}^{VD}/\partial A_2 > 0$.

That is, if the wages for unskilled-labors in a foreign or the trade costs are low enough, the productivity cutoff becomes low in decreasing the plant setup costs or expanding the market size in a foreign country.

The derivatives with respect to the other parameters are summarized as:

Corollary 7: $\dfrac{\partial \Theta_1^{VD}}{\partial a} = \dfrac{f(1-\sigma)w_2\left(r_1 + aw_2\right)^{-\sigma}\left(A_1 + A_2 t^{1-\sigma}\right)}{\left(S_1^V - S_1^D\right)^2} < 0, \qquad \dfrac{\partial \Theta_1^{VD}}{\partial b} = 0.$

While the wages for skilled labors do not affect the productivity cutoff, the lower wages for unskilled labors in a foreign country reduces the productivity cutoff.

A1.2. Domestic vs. HFDI

The condition that the slope in HFDI is greater than the slope in domestic production can be simplified as follows:

$$(tr_1 - r_2) + (tw_1 - w_2) > 0.$$

This condition can be expressed as follows:

Corollary 8: $b < \left(\dfrac{w_2 t}{r_1}\right)a + \left(t - \dfrac{w_2}{r_1}\right) \Leftrightarrow S_1^H > S_1^D$.

Corollary 9: $t > \dfrac{r_2 + w_2}{r_1 + w_1} \Leftrightarrow S_1^H > S_1^D$

Figure A3 shows corollary 8, meaning that, given the trade costs, the lower the wages for skilled or unskilled labors in a foreign, the more likely the slope in HFDI is to be greater than the slope in Domestic. Corollary 9 indicates that, given wages for skilled and unskilled labor, larger trade costs also lead to a similar relationship of slopes in HFDI and Domestic.

=== Figure A3 ===

Let Θ_k^{HD} be the productivity in which Domestic and HFDI yield equal profits for firms in country k. Namely, Θ_1^{HD} can be expressed as:

$$\Theta_1^{HD} = f / (S_1^H - S_1^D) = f / [\{(r_1+w_1)^{1-\sigma}A_1 + (r_2+w_2)^{1-\sigma}A_2\} - (r_1+w_1)^{1-\sigma}(A_1+A_2t^{1-\sigma})].$$

Its derivatives with respect to fixed entry cost and the size of foreign market are given by:

$$\frac{\partial\Theta_1^{HD}}{\partial f} = \frac{1}{S_1^H - S_1^D}, \qquad \frac{\partial\Theta_1^{HD}}{\partial A_2} = \frac{f}{\left(S_1^V - S_1^D\right)^2}\left[t^{1-\sigma}\left(r_1 + w_1\right)^{1-\sigma} - \left(r_2 + w_2\right)^{1-\sigma}\right]$$

Since the latter becomes negative if $t > (r_2+w_2)/(r_1+w_1)$, with corollaries 8 and 9, these two derivatives can be summarized as follows.

Corollary 10: $S_1^H > S_1^D \Leftrightarrow \dfrac{\partial\Theta_1^{HD}}{\partial f} > 0 \Leftrightarrow \dfrac{\partial\Theta_1^{HD}}{\partial A_2} < 0.$

In other words, if the wages for skilled/unskilled labors in a foreign or the trade costs are low enough, the productivity cutoff becomes low in decreasing the plant setup costs or expanding the market size in a foreign country.

The derivatives with respect to the other parameters are summarized as:

Corollary 11: $\dfrac{\partial\Theta_1^{HD}}{\partial t} = \dfrac{-f(\sigma-1)(r_1+w_1)^{1-\sigma}A_2t^{-\sigma}}{\left(S_1^V - S_1^D\right)^2} < 0,$

$$\frac{\partial\Theta_1^{HD}}{\partial a} = \frac{f(1-\sigma)w_2A_2t^{1-\sigma}\left(r_1 + aw_2\right)^{-\sigma}}{\left(S_1^H - S_1^D\right)^2} < 0, \quad \frac{\partial\Theta_1^{HD}}{\partial b} = \frac{f(\sigma-1)r_1A_2\left(br_1 + w_2\right)^{-\sigma}}{\left(S_1^H - S_1^D\right)^2} > 0.$$

The rise of trade costs or the lower wages for skilled/unskilled labors in a foreign country reduces the productivity cutoff.

A1.3. VFDI vs. HFDI

Our assumption of identical plant set-up costs between VFDI and HFDI assures that firms choosing VFDI and those choosing HFDI do not coexist. In other words, in our model setting, firms select their production patterns from a choice of either VFDI or Domestic or between HFDI and Domestic. If we assume the different plant set-up costs between these two FDIs, however, we can show that by integrating Figures A1 and A3 there are situations in which firms choosing VFDI, HFDI, and Domestic production patterns can coexist. From Figure A4, we can see that there are combinations of a and b in which $S_I^H > S_I^D$ and $S_I^V > S_I^D$. For example, if $S_I^H > S_I^V$ in these combinations, by assuming that plant set-up costs are cheaper in VFDI than HFDI, firms with high levels of productivity choose HFDI, those with medium levels choose VFDI, and those with low levels choose Domestic.

=== Figure A4 ===

Table 1. New Investors by Region

	North America	Europe	Asia	Others	Total
1995	24	10	238	5	277
1996	32	6	181		219
1997	17	10	61	3	91
1998	14	3	23	1	41
1999	6	3	29		38
2000	4	2	53	2	61
2001	9	6	70	1	86
2002	12	2	90		104
2003	5	6	64		75

Source: Authors' calculation based on the Survey of Overseas Business Activities

Table 2. The Share of VFDI-type Affiliates: 2000

	North America	Europe	Asia	World
Textile	15%	10%	59%	43%
Chemical	29%	34%	46%	48%
General Machinery	23%	29%	54%	29%
Electric Machinery	18%	17%	51%	27%
Information and Communication devices	27%	23%	58%	20%
Transport Equipment	23%	22%	39%	46%
Precision Instrument	30%	33%	65%	17%
Other manufacturing	27%	25%	48%	50%

Source: Authors' calculation based on the Survey of Overseas Business Activities

Table 3. Results of Multinomial Logit: Levinsohn-Petrin TFP

	HFDI				VFDI			
	Coef.	S.D.	z-ratio		Coef.	S.D.	z-ratio	
Total employment	0.587	0.055	10.69	***	0.471	0.074	6.34	***
Share of production workers	-0.869	0.259	-3.36	***	-0.630	0.337	-1.87	*
TFP	2.656	0.665	4.00	***	5.332	1.008	5.29	***
x Wage	-0.314	0.037	-8.49	***	-0.480	0.057	-8.45	***
x Credility	0.021	0.003	7.26	***	0.017	0.004	4.47	***
x Market potential	0.036	0.023	1.57		0.061	0.035	1.75	*
x Distance	-0.270	0.046	-5.89	***	-0.242	0.069	-3.50	***
x Tariff	0.601	0.306	1.96	**	-0.898	0.488	-1.84	*
Log-likelihood	908.59							
Observations	387,000							

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 4. Results of Multinomial Logit: TFP Index

	HFDI				VFDI			
	Coef.	S.D.	z-ratio		Coef.	S.D.	z-ratio	
Total employment	0.664	0.046	14.31	***	0.572	0.064	8.93	***
Share of production workers	-0.901	0.258	-3.49	***	-0.683	0.338	-2.02	***
TFP	6.273	1.759	3.57	***	13.070	2.549	5.13	***
x Wage	-0.837	0.096	-8.77	***	-1.199	0.142	-8.45	***
x Credility	0.056	0.007	7.55	***	0.039	0.009	4.22	***
x Market potential	0.097	0.059	1.65	*	0.160	0.089	1.80	*
x Distance	-0.695	0.118	-5.89	***	-0.637	0.170	-3.74	***
x Tariff	1.671	0.819	2.04	**	-2.064	1.250	-1.65	*
Log-likelihood	939.56							
Observations	390,504							

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Figure 1: The Medium Trade Cost and the Low Wages for Unskilled Labors

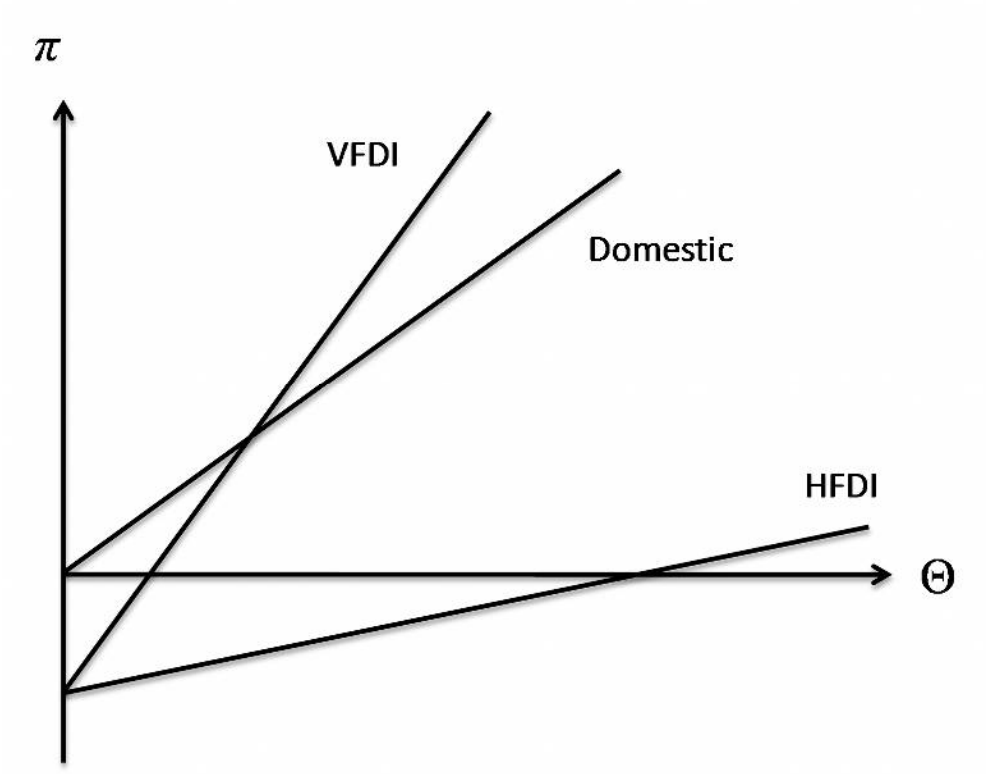


Figure 2: The Medium Trade Cost and the Low Wages for Skilled Labors

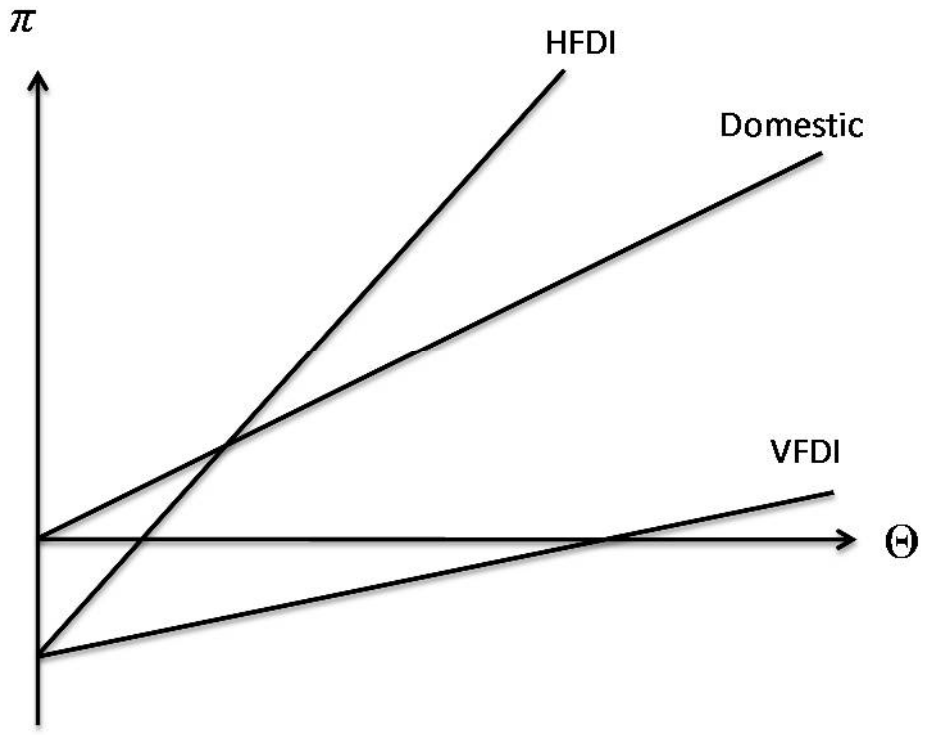


Figure 3: Different Plant Setup Costs: Three Kinds of Firms

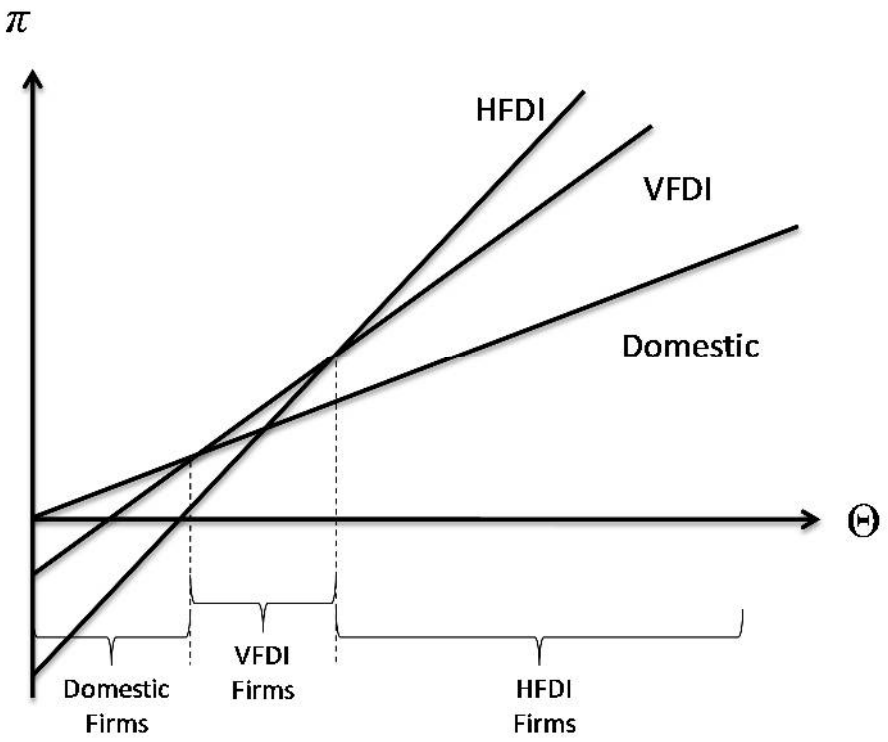


Figure 4: Different Plant Setup Costs: Two Kinds of Firms

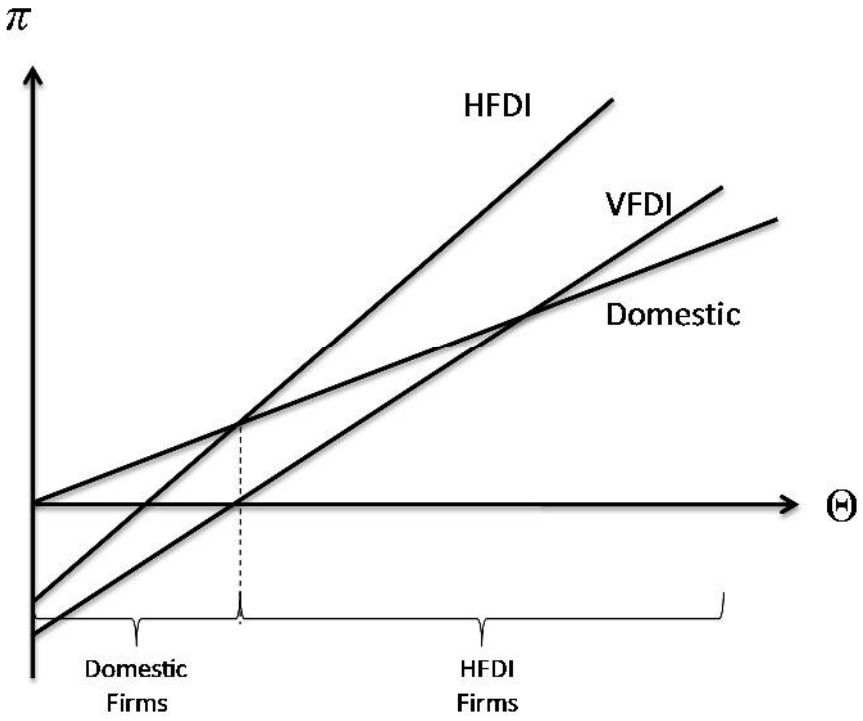
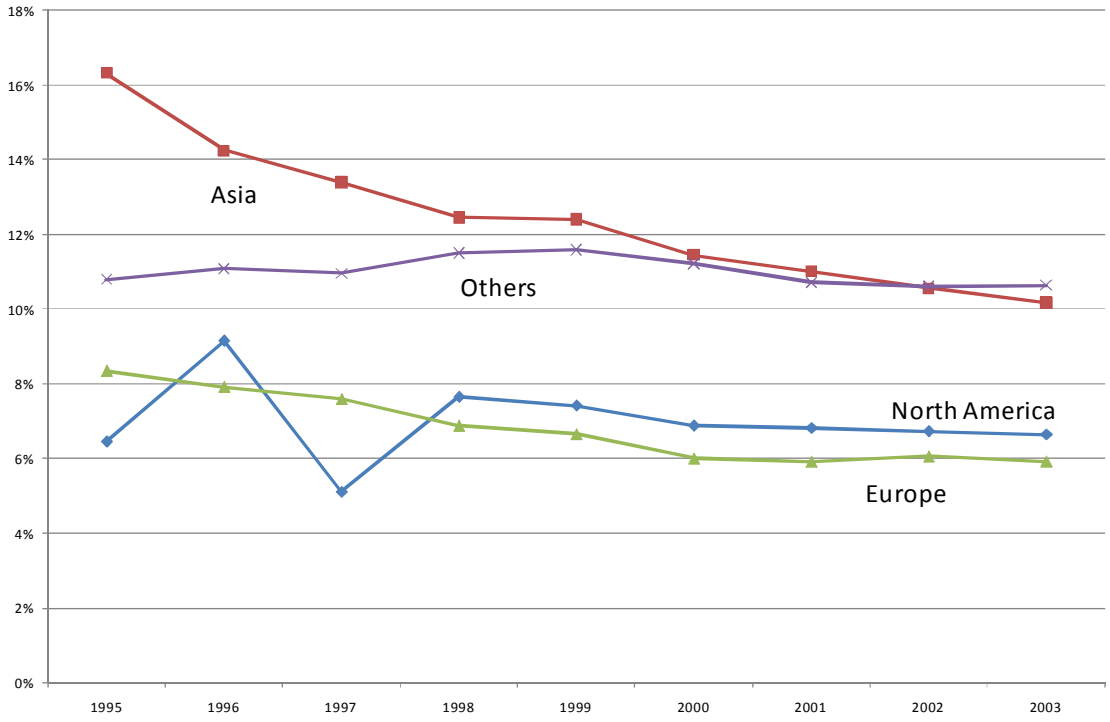


Figure 5: Changes in Tariff Rates



Note: The World Bank website

Figure A1: The relationship between S_1^V and S_1^D: the role of a

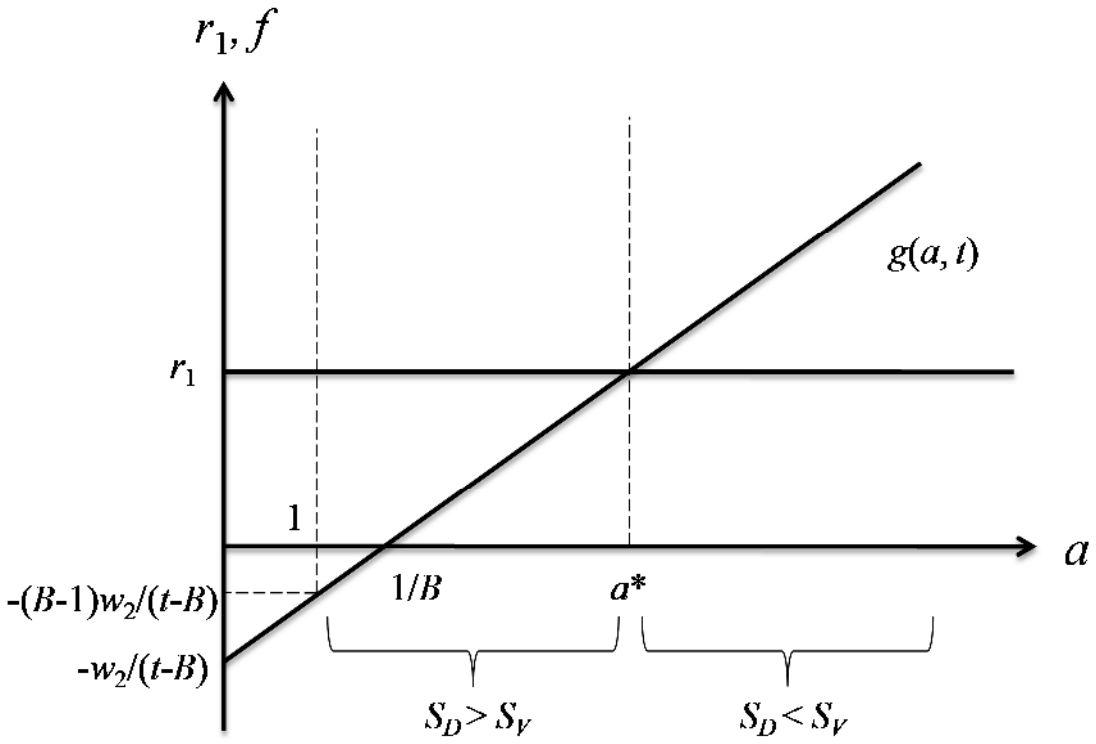


Figure A2: The relationship between S_1^V and S_1^D: the role of t

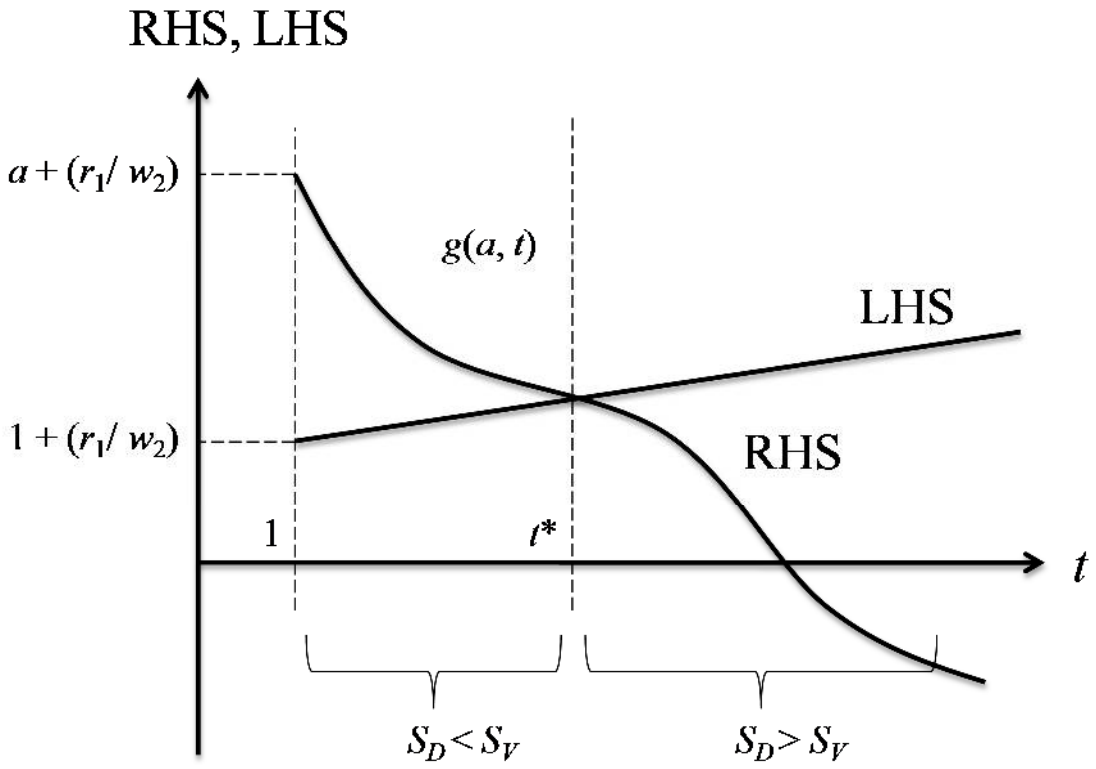


Figure A3: The relationship between S_1^H and S_1^D: the role of a and b

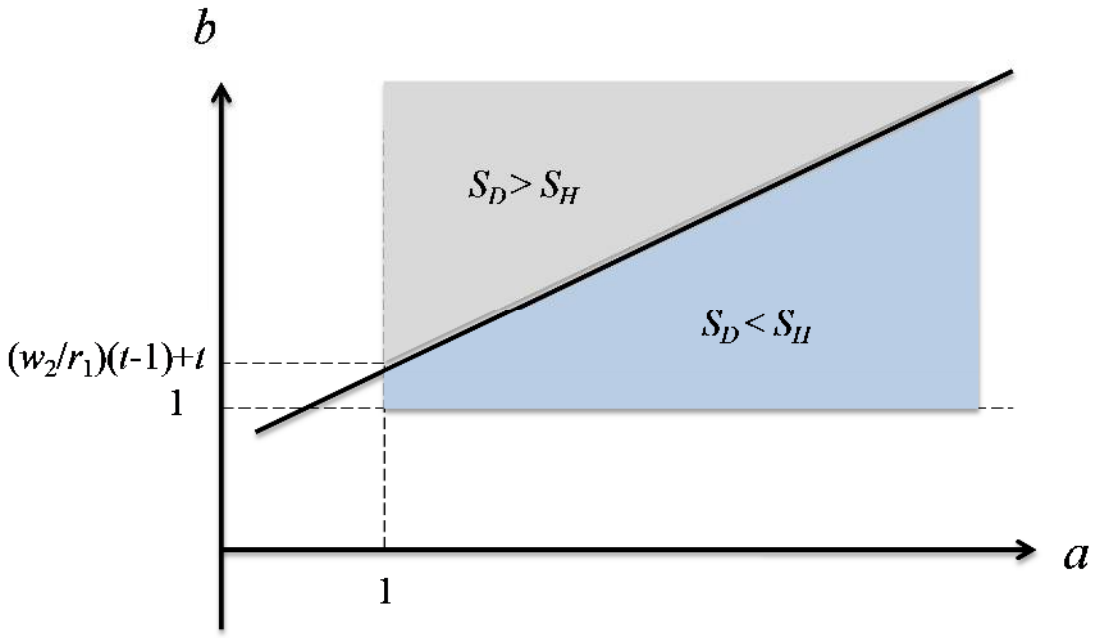


Figure A4: The relationship between S_1^V, S_1^H, and S_1^D: the role of a and b