The Role of the Foreign Affiliate Productivity for the Integration Strategies of the Multinational Firm

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August 2011

Abstract

The literature often takes that the intangible asset (e.g. productivity) can be shared without any loss inside the multinational firm. We challenge this view and the affiliate productivity, not parent, affects the integration strategies of the multinational firm. Our model shows that, if the affiliate productivity is low(high), the MNC pursues a partial(complete) globlization. Empirical implications are, in the case of the partial globalization, the affiliate tends to export more back to the parent firm while the affiliate tends to export less to the parent firm and sell more to other unaffiliated entities in the case of complete globalization. Our empirical analysis using detailed Korean multinational corporations data supports these hypotheses.

JEL classification: F2

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1 Introduction

Multinationals play an important role in the current wave of globalization. Foreign direct investment (FDI) has mostly grown faster than international trade for the last two decades. Multinationals also play an important role in international trade. According to the data published by UNCTAD, one third of the world's trade is intra-firm trade between a multinational parent and its affiliate. Offshoring and fragmentation of production have been playing a central role in the recent rapid growth of international trade.[1]. Moreover, the firm-level data on multinationals challenges the commonly used distinction between horizontal and vertical multinationals.[2] As Helpman (2006) puts it, it is increasingly clear that firms pursue complex integration strategies in the global economy, and the most recent literature tries to understand why multinationals perform their operations the way they do.

At the same time, a rapidly growing area of research has been incorporating firm heterogeneity in the literature on FDI in recent years. In particular, building on Yeaple (2003), Grossman, Helpman and Szeidl (2006) develop a model incorporating firm heterogeneity to explain the complex integration strategies of multinationals. Grossman et al. (2006) theoretically show that the most productive multinational would pursue the complete globalization, which implies the headquarter service only remains in the home country and all production stages are offshored. The rationale is that the optimal strategy for the high productive firm is to offshore all production works to take full advantage of lower production costs though it has to bear high fixed costs. The literature, however, often takes that the intangible asset such as productivity can be shared without any loss inside the multinational firm. This paper challenges this view and investigates how foreign affiliate productivity, not parent, matters for the integration strategies.[3]

Figure 1 shows the relationship between the labor productivity of the parent and the average share of the exports back to the parent based on Korean multinational data.[4] As it shows, we do not see any clear relationship between the variables. Assuming that the high share of exports back to the parent relative to the total sales tends to represent the partial

[1] See Yi (2003)

[2] Markusen (1984) and Brainard (1997) are classic examples of the first type, whereas Helpman (1984) illustrates the second type.

[3] A few recent papers address the limit of the intangible asset inside the firm. For example, Keller and Yeaple (2009) introduces technology transfer costs.

[4] The dataset is based on the affiliate level. We take the average share when a parent have multiple affiliates. The details about data is in data section.

globalization in the sense that the affiliate still rely on the parent while the low share the complete globalization in the sense that the affiliate are relatively more independent, Figure 1 shows that the parent productivity does not seem to matter for the integration forms. The simple correlation is 0.005 and not significant. Note that the most productive firm should have pursued the complete globalization and that the less productive one should have pursued the partial globalization according to the theoretical work by Grossman et al. (2006).[5] On the other hand, Figure 2 and 3 changes the perspective and shows the relationship between the labor productivity of the affiliate and the share of the exports back to the parent. Figure 2 takes a specific multinational firm who has 20 foreign affiliates abroad and show the relationship. Obviously, the labor productivity is not the same across the affiliates even inside the same firm and the share of exports back to the parent varies by productivity. Figure 3 plots the relationship using all affiliates data. It clearly shows the negative relationship.

The three figures nicely sketch what we will do in this paper. We give a particular attention to affiliate productivity and consider its role for the multinational's integration strategies. Our model is similar to the characteristics of Grossman et al. (2006) with some modifications. There exist two countries, North and South. The production costs is lower in South. Having a foreign affiliate in South brings a fixed setup cost, however. Hence, the headquarter located in North has a decision problem where to locate the production lines. The production lines are composed of the component line and the assembly line.[6] Locating the production line abroad will be beneficial due to the lower production cost but costly due to the fixed cost. Hence, there are four possible integration strategies: (H,H) (H,S) (S,H) (S,S), where the left letter represents the location of the component line and the right letter is the location of the assembly line. The complete globalization, (S,S), can fully take advantage of the low production cost, but brings the highest fixed cost. Unlike Grossman et al. (2006), however, our production function has a special feature. Each production line functions according to its own productivity. This production function enables affiliate productivity to matter for the multinationals' integration strategies. In the end, for the complete globalization to be the viable outcome, the affiliate productivity

[5]They additionally showed that the least productive firm would not invest aborad. Since our focus is on the affiliate productivity, we ignore the pure domestic firm case.

[6]In our study, we assume away the decision problem regarding the boundaries of the firm such as Antras (2003). In other words, the firm already decided to carry out overseas activities within the boundary of the firm.

should be high enough to cover the fixed cost. The affiliate productivity in the case of the partial globalization, (S,H) or (H,S), is in the intermediate range. Certainly, the affiliate productivity does not exist in the pure domestic case, (H,H).

Some empirical implications can be drawn from the model. Theoretically, (S,H) implies that all components will be produced in the foreign affiliate and shipped back to the parent to be assembled. It implies that the share of the foreign affiliate's exports back to the parent relative to the affiliate total sales will be 1 because the foreign affiliate manufactures components only and ships all to the parent. On the other hand, (S,S) can be interpreted as the foreign affiliate finalizes the final good using components which are made by itself. Then, assuming the Home and the Foreign country are the same in terms of economic size and preferences and no trade costs, 1/2 of the final good will be sent to the parent. One can also interpret (S,S) in the similar fashion in the case of multiple foreign affiliates. If a multinational slices up the supply chain across multiple foreign affiliates, components are produced in an affiliate and shipped to a different affiliate to be assembled. In this case, the exports back to the parent of each affiliate is either 0 or 1/2. In sum, as the affiliate productivity is higher, the multinational tends to take the form of the complete globalization, which implies less exports back to the parent.[7]

Our empirical analysis based on 2006 Korean Multinationals supports the model. The more productive affiliate has the low share of the exports back to the parent out of total sales while the less productive affiliate has the high share of the exports back to the parent. The case of Korea is of particular interest. Since 1990s, Korean Multinationals started to venture abroad. Especially after 1992 in which Korea made an official diplomatic relation with China, Korean Multinationals established many affiliates in China as well as other Asian countries to take advantage of cheap labor costs. Further, critical to our analysis, the significant share of products made in the Korean foreign affiliates were either exported back to the parent firm or sold in the host country. As such, Korean multinationals provide an

[7]One may think the similar pattern in terms of sourcing, i.e. the comparison between (H,S) and (S,S): (H,S) implies the affiliate receives all components from the parent while (S,S) implies no components from the parent. In terms of empirical analysis, however, it is not straightforward unlike the sales activity. In reality, the foreign affiliate has three options to source components, (1) from the parent, (2) for itself, and (3) from other unaffiliate entities, in which (1) and (2) corresponds to (H,S) and (S,S), respectively. Because this paper assumes away the concern on the boundary of the firm, however, we don't have the matching case with (3). In fact, according to the literature on incomplete contract like Antras and Helpman (2004), insourcing(1 and 2) requires higher productivity than outsourcing(3), which makes the empirical analysis impossible with the multinational firm data only like ours. For this reason, we don't consider the sourcing behavior in this paper.

appropriate setting in investigating the relation between foreign affiliate's various activities and its productivity.

Thus, our paper challenges the view that the intangible asset such as productivity is fully shared inside the firm. Specifically, our paper contributes to the current literature on a multinational's integration strategies by incorporating the affiliate productivity. We are able to take one step further from Yeaple (2003) who firstly documents the multinationals' complex integration strategies and Grossman et al. (2006) who add the firm(parent) heterogeneity. There are also some research relating the multinationals' heterogeneous productivity with the foreign affiliate sales activities such as Yeaple (2009) and Chen and Moore (2010). Again, they consider the parent productivity only. Yeaple (2009) particularly suggests in its conclusion the necessity of technology transfer costs between the parent and the affiliate to challenge the prefect mobility of technology. Also, our findings are consistent with the recent work by Lu, Lu and Tao (2010). They find that foreign affiliates exporters located in China are less productive than foreign affiliate non-exporters, i.e. the affiliate productivity has negative relationship with the exports. Our analysis is different from theirs, however, in that we take the foreign affiliate as the outcome of the multinational's integration strategy while they consider it the stand-alone individual firm. Hence, their conceptual framework is based on the final goods alone while the distinction between exporters and non-exporters in our analysis is through intermediate goods vs. final goods. Accordingly, the exports in their empirical analysis are not necessarily bound for the parent.

The structure of this paper is following. A theoretical model is presented in the next section. The introduction of data will be in the section 3 and the section 4 reports the empirical findings. The final section concludes.

2 Model

To guide our empirical analysis, we develop a model in which a multinational firm faces a choice regarding where to locate each of their production activities between Home and South (low-wage country). To capture the fact that the bulk of Korean multinational firms conduct different levels of production activities across South, we construct a model to analyze the determinant of the off-shoring choices. Our concerns are similar to those of Grossman et al. (2006), but we aim to focus on a varying productivity level of the foreign affiliate as the

key factor of off-shoring decision and then, consequent trading pattern between the foreign affiliate in South and the parent at Home.

Unlike other models in this area, we allow productivity level of the foreign affiliate to vary. By introducing such heterogeneity, we are able to characterize different extent of Korean Multinational's off-shoring strategies. In our model, there exist two countries where the multinational firm offers their final goods: Home country(H), where the multinational headquarter is located, a South country(S) with lower wage.

The multinational firm producing differentiated products needs two production activities to produce its final product: first activity is for producing intermediates and second activity is for assembling these intermediates into its final product. Either production of intermediate goods or assembly, or both may be separated(off-shored) from Home into South country. Equation (1) describes the production technology of a Korean multinational j:

$$q_j = \left(\frac{\rho_i^I \times I_i}{1-\beta}\right)^{1-\beta} \left(\frac{\rho_{i'}^A \times A_{i'}}{\beta}\right)^{\beta} \equiv q \tag{1}$$

, where $j \in \{1, 2, ..n\}$, $i, i' \in \{H, S\}$ and i could be different from i'

Here ρ_i^I and $\rho_i'^A$ represent the productivity levels per unit of intermediate good(I_i) and assembly(A_i') located in i and i', respectively. i or i' could be either Home or South. Index H and S represent Home and South. For example, if off-shoring into South happens for intermediates, then the multinational can utilize the productivity of a foreign affiliate located in South(ρ_S^I). β represents an intensity of intermediate good input in the production. This production technology in Equation (1) incurs constant MC(Marginal Cost) function. When we denote variable cost(wage) of two activities as w_i^I and w_i^A in a country i, MC is written such that:

$$\text{MC}_{i,i'} = \left(\frac{w_i^I}{\rho_i^I}\right)^{1-\beta} \left(\frac{w_{i'}^A}{\rho_{i'}^A}\right)^{\beta} \tag{2}$$

, where $i, i' \in \{H, S\}$

In equation (2), MC level decreases either when wage in one or both activities is lower or when the productivity of a foreign affiliate increases. We assume that wage of South is lower than in Home in both activities. Home wage is assumed to be one for normalization. Thus, $w_H^I = w_H^A = 1 > w_S^I = w_S^A$. The relatively low wage of South is one of reasons for off-shoring. In summary, the intention of off-shoring decision arises from utilizing the

combination of productivity and lower wage of South. Instead, the multinational must bear a fixed cost for the separation from the parent. In particular, g and f represent one-time fixed cost of intermediate good or assembly, respectively. We assume that g is smaller than f. It implies that a fixed cost of off-shoring intermediate activity is lower than that of assembly. Additionally, we introduce symmetry into production intensity parameter. Thus β, the intensity of intermediate good input, is assumed to be $\frac{1}{2}$.[8]

Now, to capture demand environment the multinational firm is facing, consumers in all countries is assumed to have the same CES utility function in the consumption of product variety j, q_j such that:

$$U = \left(\sum_{n}^{j=1} q_j^{\alpha} \right)^{\frac{1}{\alpha}}, 0 < \alpha < 1 \tag{3}$$

With this utility function, we can derive the world-wide demand function of product j as: $q_j = Y p_j^{-\sigma}$, where $j \in \{1, 2, ..n\}, \sigma = \frac{1}{1-\alpha} > 1, Y = \frac{E}{\tilde{P}}, \tilde{P} = \left(\sum_{j=1}^{n} p_j^{1-\sigma} \right)$

Here $\sigma > 1$ is the elasticity of substitution between any pair of goods. E is the worldwide total expenditure on all the variety. The whole world is captured by H and S. $\tilde{P}$ is the world-wide price index for all differentiated products, where $j \in \{1, 2, ..n\}$. For notational simplicity, we ignore the subscript j under the assumption of symmetry among all varieties. Then the expression of q_j, a production amount of a particular multinational in Equation (1), is simplified as q. The optimal pricing rule for a CES-induced demand function is $p = \frac{MC_{i,i'}}{\alpha}$, where $MC_{i,i'}$ is from Equation (2). Now for the profit function of a multinational firm before we consider the associated fixed cost, we obtain

$$\pi_{i,i'}^{B} = (1-\alpha)\alpha^{\sigma-1} E \times MC_{i,i'}^{1-\sigma} = D \times MC_{i,i'}^{1-\sigma} \tag{4}$$

, where $i, i' \in H, S$, superscript B stands for before the subtraction of fixed cost and D represents $(1-\alpha)\alpha^{\sigma-1}E$ which captures the world-wide demand for the product.

This simple set-up is useful to examine the trade-off consideration. Now we describe all the available off-shoring choices of multinationals on activity dimension as (H,H), (H,S), (S,H) and (S,S).[9]

[8] The assumptions of $g < f$ and $\beta = \frac{1}{2}$ do not have significant meanings. These assumptions are simply for our empirical analysis. As it will be clear, based on these assumptions, we can rule out the case of (H,S). The reason why we do not consider (H,S) is stated in footnote 6.

[9] We do not consider the transportation cost for simplicity. In the empirical analysis, however, we included the tariff rate and the distance to control it with the country fixed effects.

Intermediates	Assembly	Fixed costs	Profit
H	H	0	π_{HH}
S	H	g	π_{SH}
H	S	f	π_{HS}
S	S	g+f	π_{SS}

The first row depicts a strategy of complete home production. With this strategy, the firm serves the foreign markets in S with exports of final product from Home. As is clear, this non-off-shoring minimizes the fixed cost, but bears a relatively high wage and loses the opportunity of utilizing productivity overseas. The following two rows depict partial globalization strategies; either intermediates are produced in South and assembled at home(2nd row), or vice versa(3rd row). The third row is dominated by the second row strategy as we assume $f > g$. With the second row strategy, intra-firm trade on intermediate from S to H occurs. This case theoretically implies that all of the affiliate's sales should be the exports back to the parent. The bottom row strategy describes complete globalization, whereby all production activities are performed in the low-wage S. Here, fixed cost is highest, but variable cost is lowest and the productivity of the foreign affiliate is fully utilized. In this case, part of final products made in the affiliate will be exported to Home and the remainder will be sold in South.

Now we describe profit functions of the above 3 strategies as follows:

$$\pi_{HH} = D\left(\frac{1}{\rho_H}\right)^{1-\sigma} \tag{5}$$

$$\pi_{SH} = D\left((\frac{1}{\rho_S})^{1-\beta}(\frac{w}{\rho_H})^{\beta}\right)^{1-\sigma} - g \tag{6}$$

$$\pi_{SS} = D(\frac{w}{\rho_S})^{1-\sigma} - f - g \tag{7}$$

In what follows, we ask how a foreign affiliate's productivity level affects a multinational firm's off-shoring choice. To do so, we compare the above 3 profit function pairwisely. Given the values of w, ρ_H, σ, D, f, g, and β at1/2, firstly, we investigate a case where partial off-shoring is preferred to non-off-shoring such that$\pi_{SH} \geq \pi_{HH}$. That is,

$$\rho_S^* \geq w\frac{1}{\rho_H}\left((\rho_H)^{\sigma-1}+\frac{g}{D}\right)^{\frac{2}{\sigma-1}} \Longleftrightarrow \left(\frac{\rho_S^*}{w}\right)^{\frac{\sigma-1}{2}} \geq \rho_H^{\frac{\sigma-1}{2}} + \frac{g}{D\rho_H^{\frac{\sigma-1}{2}}} \tag{8}$$

Secondly, now we investigate another case where complete off-shoring is preferred to the above partial one. We can calculate the range of ρ_S^{**} when $\pi_{SS} \geq \pi_{SH}$[10] :

$$\rho_S^{**} \geq w\rho_H \left(\frac{1+\sqrt{1+4\frac{f}{D}\left(\frac{1}{\rho_H}\right)^{\sigma-1}}}{2}\right)^{\frac{2}{\sigma-1}} \tag{9}$$

, where $\sigma > 1$. A critical value ρ_S^{**} is a minimal productivity level of a foreign affiliate where the multinational decides to off-shore both activities. We can easily see that ρ_S^{**} in Equation (9) is increasing in ρ_H, f and w, but decreasing in D. This implies that when the productivity of the parent, the fixed cost of assembly, or South wage increases, the productivity of South is required to be higher enough for the complete off-shore decision. On the other hand, when any one of the previous three values(ρ_H, f or w) becomes lower or the value of D increases, the complete off-shoring decision easily occurs even at the lower level of the affiliate's productivity.

Now we can describe a complete order of $\pi_{SS} \geq \pi_{SH} \geq \pi_{HH}$ in Figure 3. Figure 3 shows the profits function of three integration strategies. The horizontal axis captures a foreign affiliate's productivity level as $\left(\frac{\rho_S}{w}\right)^{\frac{\sigma-1}{2}}$, instead of the bare productivity level ρ_S, which is for simplifying comparison among the profit function, and the vertical axis represents profit level.

Firstly, we can see that $\pi_{H,H}$ is flat line along X axis. Secondly, $\pi_{S,H}$ is drawn as a liner line with a positive slope with an intercept at $-g$. Now we can see that $\pi_{H,H} = \pi_{S,H}$ at the first cut-off, which is found in equation (8). Lastly, $\pi_{S,S}$ is drawn as a second polynomial curve with an intercept of $-(g+f)$ on the vertical axis. As long as the profit $\pi_{S,S}$ evaluated at the cut-off between (H,H) and (S,H) is less than $\pi_{H,H}$, a pattern of $HH \to SH \to SS$ will hold. Algebraically, if $D\left[\rho_H^{\frac{\sigma-1}{2}} + \frac{g}{D\rho_H^{\frac{\sigma-1}{2}}}\right]^2 - g - f < D\rho_H^{\sigma-1}$, which is simplified as $g(1+\frac{g}{D}\rho_H^{\sigma-1}) < f$, then the profit pattern of $HH \to SH \to SS$ will be preserved. This

[10] Another inequality case of $\rho_S \leq w\rho_H \left(\frac{1-\sqrt{1+4\frac{f}{D}\left(\frac{1}{\rho_H}\right)^{\sigma-1}}}{2}\right)^{\frac{2}{\sigma-1}}$ is ignored because ρ_S should be positive.

inequality is also consistent with our initial assumption of $g < f$.[11]

The implication of above condition is that when either total market demand is large enough or the productivity of headquarter is not too low, the optimal offshoring strategy shows a pattern of $HH \rightarrow SH \rightarrow SS$.[12] On the contrary, if both total market demand is small and the productivity of headquarter is too low, then SH never be upheld as a equilibrium. It mean SH is always dominated by either HH or SS. For this case, the necessity of transferring two activities into South at the same time arises more strongly at a lower productivity level of the affiliate. This interpretation is supported by rapidly increasing profit function of π_S as shown in Figure 3.

In sum, the more productive foreign affiliate takes the form of (S,S), which has the empirical implications of the small fraction of exports back to the parent. On the other hand, the less productive foreign affiliate tends to be in the form of (S,H), which implies the large fraction of exports back to the parent.

3 Data

There are not many firm-level datasets available that allow one to directly link intra-firm imports and exports at the firm level. This is most likely due to limitations on the access to the data. For this paper, we draw on unpublished data from the South Korean Export Import Bank. Since 1999 the Export Import Bank has been pursuing a benchmark survey of South Korean multinational affiliates abroad. The Export Import Bank has included increasingly more firms in the survey, starting with about 100 parents and their foreign affiliates of 250 in 1999, and adding more firms and foreign affiliates in subsequent years. In 2006, in particular, the bank has extensively increased the coverage of the survey and the total number of parents becomes about 1000 parents with 2000 affiliates from about 500 parents with 1000 affiliates in 2005. Taken together between 1999 and 2006 a total of about 1200 firms across services and manufacturing have been surveyed. Together these parents have about 2400 affiliates.[13] The firm-level data has many missing data, however,

[11]The cut-off between $\pi_{S,S}$ and $\pi_{H,H}$ could be located below $\rho_H^{\frac{\sigma-1}{2}} + \frac{g}{D\rho_H^{\frac{\sigma-1}{2}}}$, which is a cut-off point between $\pi_{H,H}$ and $\pi_{S,H}$. In this case, (S,H) will never be the equilibrium. We ignore this case because our data suggests the existence of (S,H).

[12]We can rationally assume the significant market size of Korea and the partner country such as China or the high headquarter productivity of the Korean multinationals.

[13]The survey does not necessarily have all foreign affiliates data belonging to a parent firm. For example, even if a parent firm has 10 foreign affiliates, the survey does not have all 10 affiliates data. Rather, the

especially in the beginning of the survey. It is therefore not possible to build a panel for all the years involved.[14] We take 2006, the last year of the survey, for the cross-sectional comparison and restrict ourselves to manufacturing, which has the more complete data.[15] We additionally had to drop some data because some affiliates do not report their sales variables. We end up with 565 parents and 955 foreign affiliates.

The dataset provides the general information of foreign affiliates such as location, industry, sales, and employment. Critical to our empirical analysis, the dataset also includes quite detailed information of the intra-firm trade values. In particular, the affiliate reports its total sales, composed of six items, exports back to the parent, exports back to Korea other than the parent, sales to other affiliates sharing the same parent in the host country, sales to others in the host country, exports to other affiliates sharing the same parent abroad, and exports to others aborad.[16] For our analysis, we construct two variables, the share of the exports back to the parent out of total sales and the share of sales to other unaffiliated firms out of total sales. The high exports value to the parent relative to the total sales captures the partial globalization. On the other hand, the high sales value to other unaffiliated firms relative to the total sales implies the complete globalization.

This assumption is critical for our empirical analysis. At the same time, it brings a concern. One can rightly argue that our constructed variables does not necessarily represent the complete globalization. That is, (H,S) has the same empirical implications as (S,S) in terms of sales and our model does not make explicit predictions regarding the productivity order between (S,H) and (H,S). Instead, we assume (S,H) dominates the other by assuming $f > g$. Note that (H,S) implies that the affiliate finalizes the product using components received from the parent. What matters in the empirical analysis, however, is that the sales to other unaffiliated entities does include the (S,S) case. This means the affiliate with higher ratio of selling to other unaffiliated entities is more likely to represent the complete globalization than that with lower ratio. Moreover, the imports from the parent relative to the total purchase is positively correlated with the exports back to the parent

survey reports some representative affiliates data. For this reason, aggregating up according to the same parent firm might have sample issues.

[14] In fact, the panel setting is not required because our study is the productivity comparison across firms.

[15] About 65% of data are manufacturing. The data include 18 sub-manufacturing sectors. Another reason why we restrict ourselves to manufacturing is that we can more easily identify the parents for manufacturing and thus link the affiliate data with the parent data in the KIS dataset.

[16] The dataset also reports the total purchase composed of similar six items. The purchase data is less complete, however. Additional 15% do not report the purchase data.

while negatively correlated with the sales to other unaffiliated entities. The correlations are 0.1909 and -0.1370, respectively. Therefore, the high value of selling to other unaffiliated entities or the low value of the exports back to the parent is unlikely to represent (H,S).

EXIM survey dataset does not provide the parent firm's information. It only gives the parent firm ID. Subsequently, we link the data from the Export Import Bank with the Korean Information System (KIS) database of Korea Investors Services Co., Ltd. This extensive dataset contains the balance sheets and the profits and loss statements of most South Korean firms that are registered as corporations in South Korea let alone all firms listed on the Korea Stock Exchange. After merging both KIS and EXIM, we draw on the KIS data for information on the parents' sales and employment. For our empirical analysis, we use the total sales of the affiliate as well as its employment for the labor productivity.[17] The benchmark data set from the Export Import Bank provides information on the activities of the affiliates and also specifies the country in which the affiliate is located. Obviously, the multinationals of our benchmark survey are a sample of the overall population of South Korean multinationals. These firms account for about 50 percent of South Korean total outward FDI as of 2006.

Table 1 provides key characteristics of the intra-firm data that are of primary importance for our analysis. The table breaks the data down according to the regions and sectors in which the affiliates are active. It also provides the number of affiliates. As one can see, a majority of the affiliates is located in Asia and particularly in China. Indeed in recent years, there has been a surge of South Korean multinational activity in China. The North America (mainly the US) and Europe also account for a significant fraction of the affiliate locations. In general, the share of the exports back to the parent is relatively higher for affiliates located in Asia than those in North America or Europe. As for the sectors in which the affiliates are active, these are clearly dominated by electronics and vehicles. Note that the affiliates and parents are classified by the two-digit Korean Standard Industrial Classification that is closely related to the Standard Industrial Classification (SIC) or the North America Industry Classification System (NAICS). The share is quite stable except for apparel and other vehicle industry. These sectors send large share of sales to the parent.

[17] Total factor productivity(TFP) will be a better measure. The use of cross-section data, however, makes it practically impossible to estimate the true TFP for each firm. As an alternative, this paper also uses an approximate TFP following Tomiura (2007). Formally, $ATFP = ln\frac{Y}{L} - \frac{1}{3}ln\frac{K}{L}$. The costs of this productivity measure is less observations because some affiliates do not report the capital stock.

In sum, as one can see, there is a bit of variation in the ratios across industries and regions. For this reason, we add industry and region or country fixed effects in our empirical analysis. We also include some control variables such as per capita GDP, distance from Korea, and tariff rate Korean government impose toward the host country. These variables are from the World bank.

4 Empirical Implementation and Results

In this section, we attempt to analyze the facts found in Figure 1-3 using econometric tools. We expect that the firm with more productive affiliate forms a complete globalization while the firm with less productive affiliate is partially globalized.[18] To test the above prediction, ideally, we need information how a product is produced and how much value is added in the affiliate and/or the parent. In reality, however, we do not have that detailed data. In fact, we are not aware of any dataset in the world having that detailed information.

As indicated, however, we can draw the empirical implications from the sales data. We will investigate the share of the affiliate's exports back to the parent relative to its total sales and its relationship with the affiliate's productivity. According to the model, the most productive affiliate will send less to the parent and sell more to other unaffiliated entities. On the other hand, the less productive affiliate will send more to the parent.

Table 2 roughly shows this relationship. The second column compares the productivity of the affiliate whose share of the exports back to the parent is one or less than one. If the share is one, it conceptually represents the partial globalization. As the table shows, the affiliate productivity is much lower for the affiliate whose share is one. The third column shows the comparison of the parent's productivity. The difference is less clear. The second row group changes the perspective. If the affiliate sells all products to other unaffiliated entities, they conceptually represent the complete globalization. As one can see, the affiliate productivity is consistent with our prediction. Again, the parent's productivity is less clear.

Next, we will estimate the following equation:

[18]The least productive firm will remain at home as a domestic firm. Our data have the already established multinationals only so that we would not consider the domestic firms. The existing literature have established the stylized facts such as multinationals are more productive than domestic firms. Korean firms are also shown to have similar patterns in Debaere, Lee and Lee (2010).

$$\frac{S_ip}{S_i} = \beta_1 \ln(S_i/L_i) + \beta_2 \ln(S_p/L_p) + X's + D_{ind} + D_{region} + \epsilon_i \tag{10}$$

where i represents the affiliate and p the parent. S_ip implies the affiliate i's exports to the parent, S_i the i's total sales, L_i the i's total employment, S_p the p's total sales, and L_p the p's total employment. Hence, our productivity measure is labor productivity. We will also use approximate productivity defined in footnote 18. Because the dependent variable is the share bounded by 0 and 1 and, thus, the usual OLS can produce the predicted variables outside the bound, we use pooled Bernoulli quasi-MLE following the suggestion by Papke and Wooldridge (2008).[19] $X's$ are other control variables such as the tariff rate the Korean government impose, the distance to the host country, and the per capita GDP of the host country. D_{ind} and D_{region} are the dummy variables for industry and region, respectively. In particular, the regions are the continents or the host countries depending on the estimation specifications.[20]

The variable of interest is β_1. β_1 should be negative according to our model, implying that as the productivity of the affiliate is higher, the complete globalization is more likely so that the share of exports back to the parent will be lower. This baseline regression results are reported in Table 3. The first column shows the relationship between productivity and the exports share while controlling per capita GDP of the host country, transportation costs, and regional and industry effects. Thus, β's pick up the effect of the productivity rather than variations across regions or industries found in Table 1. The standard errors in the parenthesis are clustered by the same parent firm. It shows the affiliate productivity is negatively correlated with the share of the exports back to the parent as expected. The parent productivity is positively related with the share unlike the predictions of previous works. The control variables are mostly insignificant. Per capita GDP of the host country is negative reflecting Table 1. The Korean affiliates located in North America or Europe (rich countries) tend to export less back to the parent. The transportation costs do not seem to matter for intra-firm trade. As for the number of observation, about 50 out of 955 affiliates do not report the level of employment. Also, we don't have Korean tariff data to certain countries. The second column controls the host country effects rather than regional and

[19] In Stata, *glm* commend with the option of Bernoulli distribution and profit function produces the scaled coefficient bounded by 0 and 1.

[20] When including continents instead of the countries, we additionally control China since the mass of Korean affiliates are located in China. See the table 1.

China effects. In this specification, we had to remove host country specific variables. Again, the affiliate productivity is negatively correlated with the exports share. Third and fourth columns limit the sample into the affiliates located in less developed countries(LDCs) as South in the model represents the country with the cheap labor costs.[21] At the same time, as Table 1 suggests, LDCs are the more appropriate setting in that foreign affiliates located in LDCs sell significant portion of products both in the host country and to the parent. The coefficient becomes higher as expected. The next four columns use approximate TFP instead of labor productivity. The results are similar. Per capita GDP of the host country becomes significant. The Korea affiliates located in the rich country tend to export less to the parent.

The Table 4 changes the perspective of the sales. Here, the share of the sales to other unaffiliated entities out of total sales is measured. Once we change the perspective, the affiliate productivity becomes positive though it is insignificant in the case of approximate TFP measure. It implies that as the productivity of the affiliate higher, the complete globalization is more likely with the implications of more sales to other unaffiliated entities. As for the controls, the tariff rate becomes significant. It implies that the ratio of the foreign affiliates' direct selling to other unaffiliated entities is higher as the Korean tariff rate is higher. This makes sense because a multinational firm directly sells goods in the host country rather than slicing up the value chain between home and foreign countries as the tariff rate in home is high.

So far we have focused on correlations. One may rightly be concerned about the endogeneity problem, however, because the affiliate productivity and sales activity might be simultaneously determined. We will use the average productivity of other Korean affiliates located in the same host country as an instrument variable. The idea is that the average productivity captures the hardship of investment environment of the host country, which is strongly correlated with the affiliate's productivity located in that host country, but not much with its sales activity. For instance, Chen and Moore (2010) found that the average productivity of the investors were higher when investors invested in difficult countries where not many multinationals have invested. On the other hand, there is no productivity premium for the investors investing in easy countries where many multinationals have already

[21] South in the model has labor cost advantages. Conceptually, however, it does not have to be located in LDCs. DCs could provide the cheap production costs because the better suited high skilled workers in DCs can provide the better quality than high skilled workers in the Home country.

invested. The condition to implement this method is that we need to have at least two affiliates located in the same host country. Also, we can't have host specific effects in this case. The estimation results are reported in Table 5. The estimates corroborate our findings. Affiliate labor productivity is significantly positive and the magnitude of coefficients are larger.

5 Conclusion

This paper challenges the view that the intangible asset such as productivity can be fully shared inside the firm. Our data show that the productivity is different across foreign affiliates of the same parent firm. Having this in mind, we particularly relates foreign affiliate productivity with the multinational's integration strategy. We present the theoretical model and draw empirical implications. Our Korean multinational data confirms the implications. Indeed, the multinational has the foreign affiliate carry out both intermediate and assembly activities or either one depending on the affiliate's productivity. In particular, we show that the most productive affiliate exports less(more) to the parent(to others) and that the less productive one send more(less) to the parent(to others).

This paper can be extended into the dynamic version. Anecdotal evidence suggests that the older affiliate becomes more productive as it gets familiar with the host country. This means that a multinational may start the overseas activities with the partial globalization and extend its operations and have less intra-firm trade as the affiliate gets familiar with the host country.

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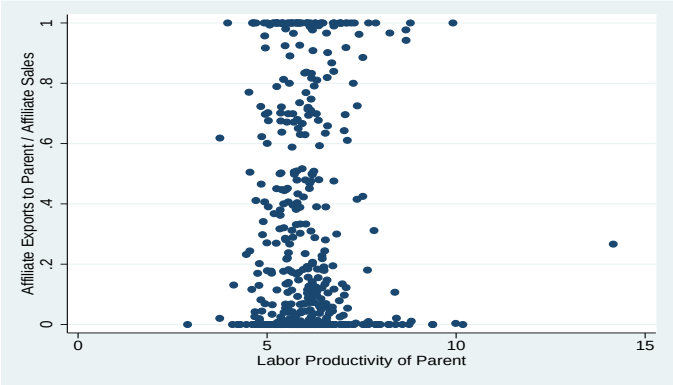
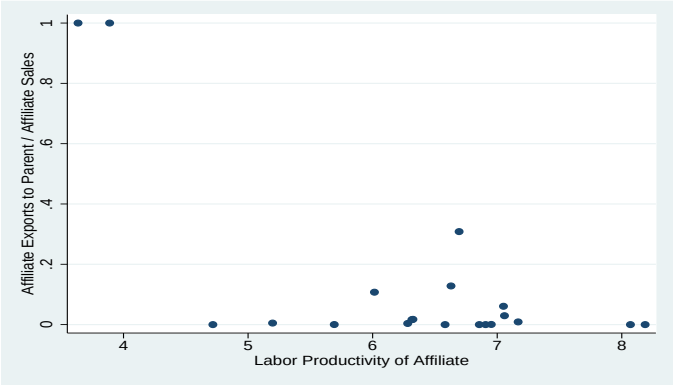
Figure 1: Share of Exports to Parent vs. Productivity of Parent



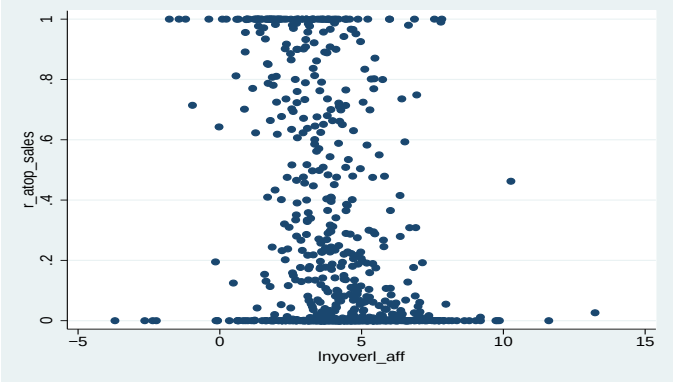
Source: Export-Import Bank of Korea.

Figure 2: Share of Exports to Parent vs. Productivity of Affiliate - a specific MNC



Source: Export-Import Bank of Korea.

Figure 3: Share of Exports to Parent vs. Productivity of Affiliate



Source: Export-Import Bank of Korea.

Figure 4: The trade-off between fixed costs and production efficiency among three strategies

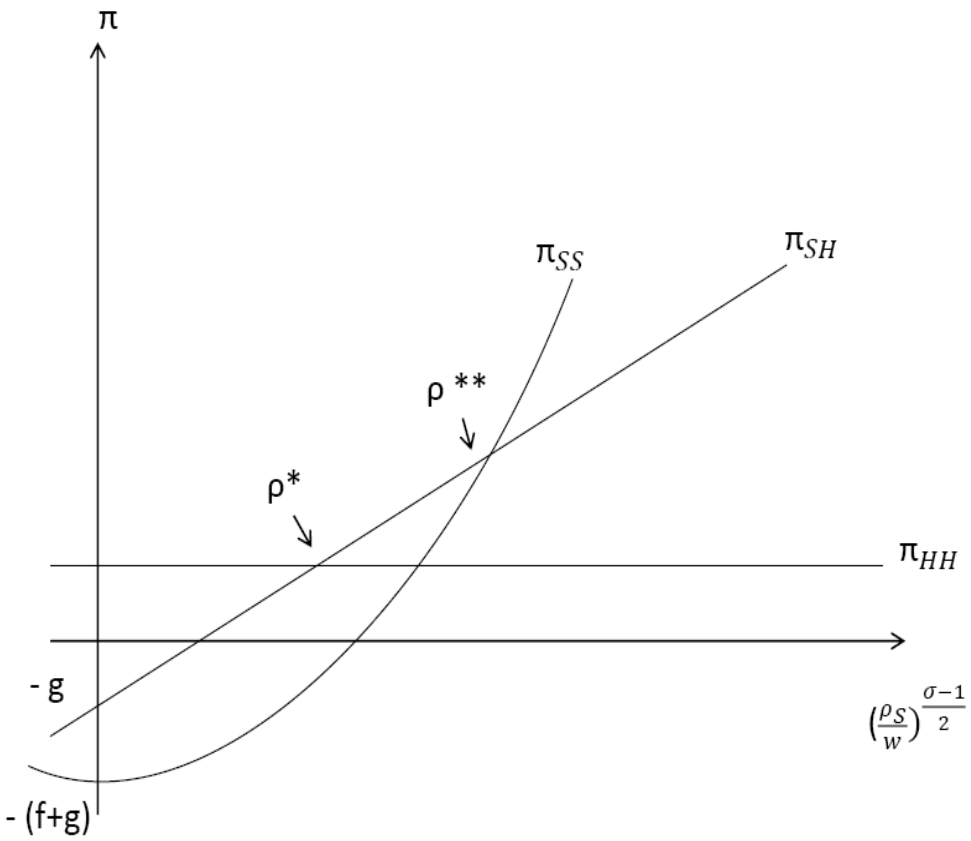


Table 1: Sales Activity by Regions and Sectors

	Exports to Parent / Total Sales	Sales to Others / Total Sales	Obs
1. Average	0.258	0.557	955
2. By regions			
China	0.3	0.53	593
Asia excl. China	0.248	0.578	203
N. America	0.073	0.716	67
Europe	0.036	0.606	56
S.America	0.253	0.551	22
ROW	0.409	0.449	14
3. By sectors			
food products	0.12	0.683	34
textile	0.288	0.544	57
apparel	0.612	0.271	91
leather, bags, footware	0.317	0.599	12
wood products	0.167	0.768	12
chemical	0.123	0.755	73
rubber and plastic	0.24	0.591	17
nonmetallic mineral	0.065	0.527	21
primary metal	0.136	0.678	45
fabricated metal	0.178	0.557	88
machinery	0.237	0.592	55
computer, office products	0.273	0.494	15
electrical machinery	0.31	0.488	25
electronics	0.296	0.514	186
medical, scientific	0.335	0.558	27
vehicle	0.136	0.651	130
other vehicle	0.772	0.227	8
other manufacturing	0.257	0.537	59

Data is from Export-Import Bank of Korea and KIS.

Table 2: Productivity vs. Affiliate sales

	Affiliate productivity	Parent productivity	Obs
1. Sales to Parent			
Sales to Parent<1	4.2	6.221	842
Sales to Parent=1	2.424	6.375	94
2. Sales to Others			
Sales to Others<1	3.916	6.259	665
Sales to Others=1	4.281	6.18	271

Data is from Export-Import Bank of Korea and KIS.

Table 3: Results on Productivity vs. Affiliate sales to Parent

	Labor Productivity				Approximate TFP			
	Whole Sample	Whole Sample	LDCs	LDCs	Whole Sample	Whole Sample	LDCs	LDCs
Affiliate Productivity	-0.192***	-0.203***	-0.226***	-0.238***	-0.185***	-0.202***	-0.222***	-0.242***
	(0.0296)	(0.0340)	(0.0326)	(0.0368)	(0.0315)	(0.0365)	(0.0340)	(0.0397)
Parent Productivity	0.0747**	0.0893**	0.105**	0.122***	0.0855***	0.104***	0.125***	0.143***
	(0.0355)	(0.0395)	(0.0431)	(0.0449)	(0.0298)	(0.0347)	(0.0367)	(0.0403)
ln(per cap GDP of Host)	-0.0266		-0.297*		-0.0580		-0.362**	
	(0.0775)		(0.158)		(0.0777)		(0.161)	
ln(Distance)	0.278		0.377		0.268		0.440	
	(0.286)		(0.403)		(0.286)		(0.405)	
Tariff Rate	1.414		1.302		1.703		1.468	
	(2.713)		(2.937)		(2.652)		(2.839)	
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region & China	Yes	No	Yes	No	Yes	No	Yes	No
Country	No	Yes	No	Yes	No	Yes	No	Yes
Observations	893	904	782	782	883	894	775	775

Data is from Export-Import Bank of Korea and KIS. Robust standard errors clustered by the same parent firm in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Results on Productivity vs. Affiliate sales to Others

	Labor Productivity		Approximate TFP	
Affiliate Productivity	0.0644**	0.0637*	0.0525	0.0574
	(0.0325)	(0.0378)	(0.0352)	(0.0422)
Parent Productivity	-0.0996***	-0.0994***	-0.0844***	-0.0881***
	(0.0313)	(0.0345)	(0.0261)	(0.0301)
ln(per cap GDP of Host)	0.0470		0.0582	
	(0.0694)		(0.0693)	
ln(Distance)	-0.325		-0.327	
	(0.251)		(0.248)	
Tariff Rate	4.643*		4.546*	
	(2.404)		(2.380)	
Industry	Yes	Yes	Yes	Yes
Region & China	Yes	No	Yes	No
Country	No	Yes	No	Yes
Observations	893	904	883	894

Data is from Export-Import Bank of Korea and KIS. Robust standard errors clustered by the same parent firm in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: IV regression Results

	Labor Productivity		Approximate TFP	
	Exports to Parent	Sales to Others	Exports to Parent	Sales to Others
Affiliate Productivity	-0.763*	0.462*	-0.593	0.327
	(0.414)	(0.276)	(0.424)	(0.296)
Parent Productivity	0.199**	-0.181***	0.131**	-0.109***
	(0.0930)	(0.0664)	(0.0538)	(0.0405)
ln(per cap GDP of Host)	0.280	-0.177	0.0947	-0.0532
	(0.261)	(0.178)	(0.212)	(0.157)
ln(Distance)	0.340	-0.465*	0.264	-0.404
	(0.324)	(0.262)	(0.312)	(0.254)
Tariff Rate	1.308	4.769**	1.909	4.408*
	(2.804)	(2.389)	(2.973)	(2.534)
Industry	Yes	Yes	Yes	Yes
Region & China	Yes	Yes	Yes	Yes
Observations	877	877	868	868

Data is from Export-Import Bank of Korea and KIS. Robust standard errors clustered by the same parent firm in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The IV is the host country's TFP.