RIETI Discussion Paper Series 17-E-073

Do Overseas Subsidiaries Benefit from Parent Firms' Intangibles?

HOSONO Kaoru
RIETI

MIYAKAWA Daisuke
Hitotsubashi University

TAKIZAWA Miho
Toyo University

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 17-E-073

May 2017

Do Overseas Subsidiaries Benefit from Parent Firms' Intangibles?*

HOSONO Kaoru
Gakushuin University and RIETI
MIYAKAWA Daisuke
Hitotsubashi University
TAKIZAWA Miho
Toyo University

Abstract

Using data for 3,800 Japanese firms and their 20,000 overseas subsidiaries over the period 2000-2013, we estimate the subsidiary-level production function to check whether or not intangible assets accumulated by parent firms contribute to the subsidiary production. We find that, first, the intangibles (i.e., software, advertisement, and research & development capital) owned by parent firms positively contribute to subsidiary production. Second, the contribution is stronger in the case of smaller subsidiaries. Third, such positive contribution from parent firms' intangible to subsidiaries' production is confirmed for most of the subsidiary locations. These results jointly suggest that intangibles contribute to firm activities even if they are in geographically remote locations.

Keywords: Foreign direct investment, Intangibles, Production function
JEL classification: F23; F21; L21

*This research was conducted as a part of the Research Institute of Economy, Trade and Industry (RIETI) research project (Microeconometric Analysis of Firm Growth). We thank Kozo Kiyota, Naomi Kodama, Atushi Oyama, Makoto Yano, Kyoji Fukao, Masayuki Morikawa and the seminar participants at RIETI for helpful suggestions. We also thank RIETI for providing us the data converter connecting multiple datasets used in this paper. The authors gratefully acknowledge the financial support received from the Grant-in-Aid for Scientific Research (B) No. 17H02526, JSPS.

I. Introduction

Given that firms' overseas activities through foreign direct investments (FDI) have been expanding over the last several decades (Urata and Kawai 2000), numerous extant studies have examined the economic implication of FDI such as what the determinants of FDI are (Head and Ries 2003; Kimura and Kiyota 2006; Todo 2011), what kind of economic gain parent firms obtain from FDI (Federico and Minerva. 2008; Todo and Shimizutani 2008; Yamashita and Fukao 2010; Hijzen, Jean, and Mayer 2011), and what kind of economic gain firms located in host countries obtain (Todo 2006).

Apart from these economic implications of FDI, economists have also been interested in the determinants of successful investments in terms of foreign subsidiary performance. This reflects the obvious needs for practitioners and policy makers to understand what governs the success of foreign subsidiaries in host countries. Despite this strong motivation, however, mainly due to the lack of data availability, the understanding on the background mechanism leading to better performance of foreign subsidiaries is far less than comprehensive.

We should recall that a few extant studies specifically examining the profitability and productivity of foreign subsidiaries (e.g., Belderbos, Ito, and Wakasugi 2008; Sakakibara and Yamawaki 2008; Ito and Fukao 2010) have reported that various attributes associated with foreign subsidiaries such as size, age, and the degree of local procurement matter for the profitability of local subsidiaries. On the one hand, these studies have certainly clarified how the attributes of foreign subsidiaries and the economic conditions associated with host countries lead to better performance of subsidiaries. On the other hand, we should note that extant studies have not succeeded on providing an extensive analysis on the contribution of resources provided by parent firms to the business activities of their subsidiaries. Notably, Sakakibara and Yamawaki (2008) and Belderbos, Ito, and Wakasugi (2008) have pointed out that under some specific conditions, parent firms' R&D activities contribute to their

foreign subsidiary profit. However, such R&D activities done by parent firms might be only a part of resources transferred from parent firms. To illustrate, suppose a Japanese manufacturing enterprise opens up a foreign plant. While the plant could be largely managed by the local staffs, it is natural to assume that its parent firms located in Japan contributes to its operations in various dimensions including not only research and development (R&D) but also administrative works, advertisement, and employee training. In other words, it would be highly possible that not only the local resources and parent firms' R&D activities but also various resources accumulated domestically in their parent firms could contribute to the operation of foreign subsidiaries as important inputs. To the best of our knowledge, it is still an open question as to how such resources provided by parent firms could contribute to subsidiary activities and performance.[1]

Against these backgrounds, the goal of this study is to empirically examine the abovementioned conjecture and expand the discussion on the determinants of foreign subsidiary activities and performance. Toward this end, we employ a large size of linked subsidiary-parent data for the period 2000–2013 accounting for 3,800 Japanese parent firms and their 20,000 overseas subsidiaries to estimate the subsidiary-level production function. Note that, rather than employing the profit (e.g., Sakakibara and Yamawaki 2008; Ito and Fukao 2010) or productivity (e.g., Belderbos, Ito, and Wakasugi 2008) of subsidiaries as the outcome variable as observed in the extant studies, we examine the production function so that we can explicitly identify the contribution of various inputs to subsidiary production and operations. Our data includes information on physical inputs (i.e., capital and labor) of subsidiaries and parent firms, as

[1] From a slightly different viewpoint, Urata, Matsuura, and Wei (2007) document under what conditions "management technology" is transferred from Japanese parent firms to their overseas subsidiaries. In their analysis, the degree for the management technology to be transferred is measured by the responses to survey question asking whether local staff or Japanese staff was responsible for various jobs at overseas subsidiaries. While they found that some conditions including the lengths of subsidiary operation matter for the transfer of the management technology, it is not explicitly analyzed to what extent such a transfer contribute to local business activities, which is the central theme of this paper.

well as other information required for calculating subsidiary-level value-added as output and measuring intangibles held by parent firms. All these information help us to precisely measure the inputs both in subsidiary- and parent firm-level and the subsidiary output, which is one distinguished feature of the present study.

Note that the point raised in this study is closely related to the classical debate on why foreign-owned firms perform well compared to domestically-owned counter-parts. While the literature has pointed out that the inherent large size of foreign-owned firms (Lipsey and Sjoholm 2004) and obvious selection effect (Andrews et al. 2009) can partly explain their better performance, another group of studies has suggested that potential omitted variables associated with the resources provided by parent firms might cause upward bias in the estimates of FDI return. For example, Bridgman (2014) claims that omitting the inputs from the side of parent firms and estimating the return of FDI by using only subsidiary-level information leads to substantial upward bias to the return.[2] Although we do not intend to explicitly compare foreign-owned with domestically-owned firms but make a comparison among foreign (i.e., Japanese in our case)-owned firms holding access to various resources of Japanese parent firms, the analysis in the present study could help us quantify the impact of omitting important inputs in the production function estimation.

We should also note that resource provision and spillover from related parties such as nearby firms (Koenig, Mayneris, and Poncet 2010) and transaction partners (Inui, Ito, and Miyakawa 2015) have been one important research topic in the international trade literature. Thus, we aim at contributing to this ongoing discussion on the scope of firms' operations by explicitly taking into account parent firms.

The results obtained in the present study are summarized as follows. First, we find a positive contribution from parent firms' intangibles accumulated

[2] Based on the same idea, Lipsey (2010) discusses that it is necessary for the government to identify actual firms' production location for taxation, by precisely taking into account all the resources used for the production of firms' overseas subsidiaries.

domestically to their foreign subsidiary production. This result is obtained from the estimation properly controlling for subsidiary-level fixed effect. Thus, we are confident that the time-series variation of value-added within each subsidiary has a strong relationship with the dynamics of parent firms' intangibles. Furthermore, the result is confirmed even after controlling for the number of overseas subsidiaries held by parent firms as one additional explanatory variable. This implies that even under the environment where a parent firm holds a large number of overseas subsidiaries, the intangibles accumulated in the parent firm still contribute to subsidiary production on average. Second, we also found that the contribution is stronger in the case of smaller subsidiaries. These results imply that while the contribution from parent intangible is significant even after controlling for various factors as mentioned above, there are some cases enhancing the contribution. Third, such a positive contribution from parent firms' intangible to subsidiaries' production is confirmed for most of the subsidiary location including U.S., China. And EU countries. Furthermore, among those areas, the strongest contribution from parent intangibles is found for China. These results imply again that there are several specific environments subsidiaries can largely benefit from the transfer of resources from parent firms.

The rest of the paper proceeds as follows. Section 2 briefly reviews the related extant literature and discusses the contribution of this study. Section 3 overviews the data we used in the present study and construct variables. Section 4 explains the empirical methodology and presents the results. Section 5 concludes and discuss potential directions for future studies.

II. Related Literature

As mentioned in the previous section, most of the extant studies examining the activities of overseas subsidiaries have employed subsidiary characteristics as the explanatory variables for the performance of those subsidiaries. One

exception is Sakakibara and Yamawaki (2008), which point out a positive relationship between the R&D investment conducted by Japanese parent firms and the profitability of their US subsidiaries. They use the Japanese governmental survey data accounting for the activities of foreign subsidiaries owned by Japanese firms over 1990 to 1996 and regress the subsidiary-level profit on various covariates including subsidiary-level attributes and parent firms' R&D intensity. They claim that exclusively in the case of US subsidiaries held by Japan, parent firms' R&D intensity is positively correlated with subsidiary profit. In a similar vein, Belderbos, Ito, and Wakasugi (2008) use subsidiary-level information over 1996 to 1997 and 1999 to 2000, and examine the determinants of the labor productivity of foreign subsidiaries held by Japanese firms. They pointed out that the technology transfer from parent firms to their foreign subsidiaries, which is proxied for by the ratio of (i) the royalty payment from subsidiary to parent firms to (ii) subsidiary value-added, lead to the improvement in the subsidiary productivity.

While both of these studies shed some light on one potential resource provision by parent firms to their overseas subsidiaries, thus sharing the same motivation as ours, the present study is distinct at least in the following three dimensions. First, we measure not only the R&D-related attributes associated with parent firms but also much broader sets of intangible assets accumulated and owned by the parent firms. As briefly mentioned above, it is natural to assume that parent firms contributes to subsidiary operations in various dimensions consisting of not only R&D but also administrative works and employee training. The present study intends to expand the list of resources provided by parent firms by taking into account these items. Second, we include the tangible assets and labor inputs employed by parent firms in addition to the intangibles. While the direct contribution of these physical inputs located in remoted areas (i.e., Japan) to subsidiaries is difficult to perceive, it is still possible for relatively small subsidiaries to rely on those physical inputs by parent firms. As one of the motivation of this study is to avoid omitted variable

bias to subsidiary-level production function estimation as much as possible, we believe that it is highly necessary to incorporate these items to our analysis. Third, instead of solely relying on subsidiary-level data as in Belderbos, Ito, and Wakasugi (2008), we construct comprehensive linked subsidiary-parent firms level data over long horizon (2000–2013) to measure the parent-level attributes more precisely than these extant studies.

III. Data and Variables

A. Data Overview

We use two datasets for this study. The first data source is the *Basic Survey on Overseas Business Activities* (BSOBA) published by the METI (Ministry of Economy, Trade and Industry). The purpose of the survey is to understand the overseas activities of Japanese firms and its impact on host countries as well as on Japanese economy. To this end, the survey covers the universe of enterprises in Japan holding overseas subsidiaries. In this survey, the overseas subsidiaries are defined as the foreign enterprises for which Japanese firms hold more than 10 percent share.[3] We exclude the case that parent firms belong to financial and real estate industries.

The second data source is the *Basic Survey of Japanese Business Structure and Activities* (BSJBSA) published by the METI. The main purpose of this annual survey is to gauge quantitatively the activities of Japanese enterprises, including capital investment, exports, FDI, and investment in R&D. To this end, the survey covers the universe of enterprises in Japan with more than 50 employees and with paid-up capital of over 30 million yen. Annual data covering around 30,000 firm observations in each year were included.

[3] It is also recorded as Japanese firms' overseas subsidiaries that the firms (i) for which more than 50 percent share is held by the foreign firms and (ii) Japanese firms hold more than 10 percent share for such foreign firms. We exclude this type of overseas subsidiaries from our analysis as it is not straightforward to construct linked subsidiary-parent firm data in this case.

B. Variable Construction for value-added, tangibles, and labor

In this section, we explain how to construct the variables we use in our estimation of subsidiary-level production function. First, as the dependent variables in our subsidiary production function estimation, we define the real value-added VA_{spt} of subsidiary s belonging to parent firm p over the period t. We use each subsidiary's total sales as the nominal gross output while the nominal intermediate input is defined as the sum of the cost of sales and selling, and the general and administrative expenses less wages and depreciation. Then, the nominal value added is defined as the difference between the nominal gross output and nominal intermediate input. This nominal value-added is deflated by the output deflator taken from the World Development Indicator for U.S., Canada, and Australia, that from EU KLEMS for EU countries, and that from APO productivity database 2016 for Asian countries. We convert the nominal value-added into the values in constant prices (i.e., real gross output) based on the year 2000.

Second, as the subsidiary-level independent variables, we define each subsidiary's labor input L_{st} and real tangible assets Tan_{st}. The former item is measured by each parent firm's total number of workers. The latter item is computed as follows: First, we calculate the initial (real) level of Tan_{st} for each subsidiary by using the nominal capital investment in the initial data point for each subsidiary in BSOBA, country-level depreciation rate and capital growth rate obtained from the World KLEMS for U.S., Canada, and Australia, that from EU KLEMS for EU countries, and that from APO productivity database 2016 for Asian countries as well as country-level capital goods deflator obtained from the World Development Indicator for U.S., Canada, and Australia, that from EU KLEMS for EU countries, and that from APO productivity database 2016 for Asian countries. Second, we compute the series of real tangible investment for each subsidiary by using the series of nominal capital investment in each year

for each subsidiary as well as the abovementioned country-level capital goods deflator. Finally, we apply the PI method to these data and compute the series of real tangible assets Tan_{st} for each subsidiary. We should note that BSOBA does not provide the stock of tangible assets used by each subsidiary in each year. This is the reason that we compute the series of real tangible inputs (i.e., stock) by using the abovementioned items.

Third, regarding parent firm-level independent variables, we use each parent firm's total number of workers multiplied by the sectoral working hours from the Japan Industrial Productivity (JIP) database L_{pt}. Also, the data of the tangible capital stock held by parent firm p, which belongs to industry IND, is constructed as follows. First, we define the real capital input $Tan_{p,t}$ as the nominal book value of tangible fixed assets held by the parent firm p at period t from the BSJBSA multiplied by the conversion ratio for each industry $\alpha_{IND,t}$ at each data point. We calculate this conversion ratio for each industry $\alpha_{IND,t}$ by using the data of real capital stock ($RealK_{IND,t}^{JIP}$) and real value added ($RealY_{IND,t}^{JIP}$) at each data point taken from the JIP database as follows:

$$\frac{RealY_{IND,t}^{JIP}}{RealK_{IND,t}^{JIP}} = \frac{\sum_{p \in IND} Y_{p,t}^{BSJBSA}}{\sum_{p \in IND} BVK_{p,t}^{BSJBSA} * \alpha_{IND,t}}$$

In this expression, $\sum_{p \in IND} Y_{p,t}^{BSJBSA}$ denotes the sum of the real value added of parent firm p belonging to the industry IND. In order to compute this number, we use each parent firm p's total sales as the nominal gross output. As for wholesale and retail industries, the nominal gross output is measured as each subsidiary's total sales minus total purchases of goods. Then, this nominal gross output is deflated by the output deflator taken from the JIP database of 2015 to convert it into values in constant prices (i.e., real gross output) based on the year 2000. The nominal intermediate input is defined as the sum of the cost of sales and selling, and the general and administrative expenses less wages and

depreciation. Using the intermediate deflator in the JIP database, this nominal intermediate input is converted into values in constant prices (i.e., real intermediate input) for the year 2000. The real value added is defined as the difference between the real gross output and the real intermediate input. In the above expression, $\sum_{P\in IND} BVK_{p,t}^{BSJBSA}$ is the sum of the nominal book value of tangible fixed assets of industry *IND* in BSJBSA. We should note that among the four items in the expression above ($RealY_{IND,t}^{JIP}$, $RealK_{IND,t}^{JIP}$, $\sum_{p\in IND} Y_{p,t}^{BSJBSA}$, and $\sum_{p\in IND} BVK_{p,t}^{BSJBSA}$), only the last item is measured as a nominal term. Thus, using all the information, we can back up the conversion ratio $\alpha_{IND,t}$ from the above equation.

For the subsample analyses that we implement in the later section, we also use the ratio of subsidiary sales to the sales of parent firm at period t ($Subsidiary\ relative\ sales_{s,t}$). For an additional analysis, we also employ the variables accounting for the number of parent firms' employees working in headquarter (L_HQ_{pt}) and that in non-head quarter divisions (L_nonHQ_{pt}). Table 1 shows the summary statistics for these variables.

Using these two datasets for 2000-2013, we estimate foreign subsidiary-level Cobb-Douglas production function augmented by parent firm-level information consisting of real tangible capital, labor, and intangibles, the last of which we detail in the next section.

C. Measuring Intangibles

In order to construct the variables that account for parent firms' intangible capital stock ($Intan_{p,t}$), we follow the method used in Corrado, Hulten, and Sichel (2009) and measure the investment and stock of three types of intangibles: Software ($Soft_{p,t}$), advertisement ($Adv_{p,t}$), and R&D ($RD_{p,t}$). Note that Corrado, Hulten, and Sichel (2009) classify intangible assets into the following three categories: computerized information, innovative property, and

economic competencies. According to them, software investment, which comprises of custom software, packaged software, and own account software, is recognized as a major part of the investment in computerized information; R&D accounts for a large part of the innovative property, while advertisement represents a part of the investment in economic competencies, which comprises brand equity, firm-specific human capital, and organizational change. In this sense, the three items we measure for the present study account for the three categories of intangibles considered in Corrado et al. (2009).

To measure the abovementioned three items (i.e., software, R&D, and advertisement) for each firm, we follow Miyagawa, Takizawa, and Edamura (2013). For software, first, the ratio of workers engaged in information processing to the total number of employees is multiplied by the total cash earnings in order to measure the value of software investment. Then, we add the cost of information processing to this number to compute the total software investment. Finally, we deflate the nominal software investment by the deflator for software investment obtained from the JIP database to obtain the real software investment. For R&D, we subtract the cost of acquiring fixed assets for research from the cost of R&D (i.e., in-house R&D and contract R&D) to compute the value of the investment in R&D. We use the output deflator for (private) research in the JIP database to deflate the nominal R&D investment. Finally, for advertisement, we obtain the data for advertising expenses from the BSJBSA. We use the output deflator for advertising in the JIP database as the deflator for advertising investments. Note that all of the information is obtained from the BSJBSA.

For all of the data in the three intangible investment categories, we use the PI method where we use FY1994 as the base year to construct a data series of intangible assets from FY2000. All of the depreciation rates used for this computation follow those of Corrado et al. (2012). The depreciation rates for software, R&D, and advertising are 31.5 percent, 15 percent, and 55 percent, respectively. We define the total intangible assets as the sum of software stocks,

R&D stocks, and advertisement stocks. According to the JIP database, software, science and engineering R&D, and brand equity account for about 70 percent of the total intangible assets in Japan. Table 1 shows the summary statistics for these variables.

IV. Empirical Analysis

A. Specification

For estimating the subsidiary-level production function, we begin with the following standard Cobb-Douglas production function consisting only of tangibles and labor held by subsidiary as well as the subsidiary-level fixed-effect η_s and the year-level fixed-effect $Year_t$:

$$(1) \qquad log(VA_{spt}) = \alpha + \beta_1 log(L_{st}) + \beta_2 log(Tan_{st}) + \eta_s + Year_t + \varepsilon_t$$

Second, in order to take into account the possibility that the parent-level intangibles contribute to the production, we augment the equation (1) with the additional independent variable $Intan_{pt}$:

$$(2) \qquad log\left(VA_{spt}\right) = \alpha + \gamma_1 log(L_{st}) + \gamma_2 log(Tan_{st}) + \gamma_3 log\left(Intan_{pt}\right) + \eta_s + Year_t + \varepsilon_t$$

Furthermore, taking into account the possibility that the tangibles and labor used by parent firms also contribute to subsidiary production, we incorporate L_{pt} and Tan_{pt}:

$$(3) \quad log(VA_{spt}) = \alpha + \delta_1 log(L_{st}) + \delta_2 log(Tan_{st}) + \delta_3 log(Intan_{pt})$$

$$+\delta_4 log(L_{pt}) + \delta_5 log(Tan_{pt}) + \eta_s + Year_t + \varepsilon_t$$

Note that in all the specifications introduced above, we control for the subsidiary-level fixed-effect, which subsumes all the unobservable time-invariant effects associated with each subsidiary. In this sense, the coefficients associated with parent firms' intangibles (i.e., γ_3 and δ_3) represent the within-subsidiary estimates of the impact of $Intan_{pt}$ on VA_{spt}[4].

B. Baseline Results

In this section, we present the estimation results based on the equation (1) to (3). Table 2 summarizes the estimated coefficients based on the full sample estimation. First, we can see that the subsidiary-level tangible and labor contribute to subsidiary production and the estimated coefficients are fairly same over the three specifications. This gives a confident that additional explanatory variables (e.g., $Intan_{pt}$) are not largely overlapped with these subsidiary-level tangible and labor. It should also be noted that from the result in column (1), we can see that the production function is estimated as exhibiting decreasing returns to scale (i.e., 0.514+0.085<1). This could be due to measurement errors in our data construction. Second, as the most important result, from columns (2) and (3), we can confirm that the parent firms' intangibles contribute to subsidiary production. Given the coefficients

[4] As discussed in the recent productivity analysis literature, we need to take into account the endogeneity issue that a productivity shock simultaneously hits the value-added and the inputs employed in production process. It is one remedy for this issue to employ GMM estimation taking care of the endogeneity issue. We leave this to our future research topic.

associated with tangibles and labor held by subsidiary are almost same over the three columns, we can infer that the parent firms' intangibles work as an independent factor of subsidiary's production from tangibles and labor held by subsidiary. The size of the coefficients associated with $log(Intan_{pt})$ is comparable with that of $log(Tan_{st})$. Given the standard deviations of $log(Intan_{pt})$ and $log(Tan_{st})$ (2.22 and 2.52 in Table 1), the economic impact associated with the change in $Intan_{pt}$ by one standard deviation (2.22*0.093=0.21) is evidently larger than that of Tan_{st} (2.52*0.073=0.18). From column (3), we can also see that while the contribution of L_{pt} and Tan_{pt} are relatively small, there is statistically significant association between subsidiary output and parent firms' tangible assets and labor input.[5]

In order to examine the time-series property of the contribution of parent firms' intangibles, we implement the four-year window rolling estimation based on equation (3) and extract five series of the estimates (i.e., δ_1 to δ_5). Figure 1 depicts the coefficient associated with parent firms' intangibles (i.e., δ_5). Interestingly, the impact declined over the period including the great financial crisis, although the coefficients are statistically significant and positive for all the periods.

We also run the year-by-year cross-section estimation for equation (3) without the subsidiary fixed-effect (η_s) and year effect. Figure 2 depicts the estimated δ_5 with the 95% confidence band. First, we can see that the obtained estimates show the comparative magnitude in the estimated δ_5 with that in Table 2 and Figure 1, which implies that not only the within-subsidiary variation but also the cross-sectional variation in the value-added and parent-level intangibles generate $\delta_5 > 0$. Second, nonetheless, comparing the dynamic pattern of the coefficient in Figure 2 over the periods including the financial crisis with that

[5] Given some firms exhibit relatively large number for intangibles, we re-estimate the model by using the data excluding the outliers. We drop 1% observation each in both the bottom and top tails of all the variables and confirm that the results are almost identical to that in the baseline estimation.

in Figure 1 over the same periods, we can see that omitting subsidiary-level fixed effect and year-effect results in a substantial positive bias to the estimates.

Further to see which type of parent intangibles contributes to subsidiary production most, we repeat the estimation of the equation (3) by replacing $log(Intan_{pt})$ with the three intangibles, i.e., $log(Soft_{p,t})$, $log(Adv_{p,t})$, and $log(RD_{p,t})$. The second and the fourth columns in Table 3 show that while the software and advertisement show the positive coefficients statistically away from zero, the coefficient associated with R&D asset is not significantly away from zero in model (3). Recall that the motivation of the present study is to examine the contribution of broader sets of resources transferred from parent firms to subsidiaries than examined in the extant studies (i.e., R&D). These results confirm the necessity to take into account various intangibles for characterizing subsidiary production function.

How can we evaluate the economic impact associated with parent firms' intangibles? For the purpose of evaluating the obtained empirical results, there are two possible directions. First, applying the procedure of growth accounting, we can quantify, on average, to what extent the growth in parent firms' intangibles explain their subsidiary production. By comparing the contribution with other inputs (i.e., subsidiaries' labor and tangible assets as well as parent firms' labor and tangible assets), we can explicitly evaluate the economic impact associated with parent firms' intangibles. Second, if parent firms' intangibles contribute to subsidiary production, such an additional gain should be taken into account for measuring, for example, the return of parent firms' intangible investment. As far as the accumulation of parent firms' intangibles generate such a positive "byproduct" in their subsidiary production, omitting such output inevitably results in underestimating the effect on parent firms' intangible investment. Note that this discussion is highly appropriate given the recent discussion on the low level of intangible investment in Japanese firms. Correctly measuring overall economic impact associated with intangible

investment is necessary for motivating Japanese firms to implement appropriate amounts of intangible investments.

Regarding the first viewpoint, we measure the share of the growth in subsidiary value-added originating from the growth in parent firms' intangibles out of the overall growth in subsidiary value-added. To be more precise, we measure the average growth rates of L_{st}, Tan_{st}, $Intan_{pt}$, L_{pt}, and Tan_{pt} over all the subsidiary-year observations. Then, given the estimated coefficients associated with these variables (Table 2 Column (3)), we compute how much part of the growth in subsidiary value-added VA_{spt} (i.e., $\Delta VA_{spt}/VA_{spt}$) is explained by $\delta_3(\Delta Intan_{pt}/Intan_{pt})$. The contribution turns out to be around 9.58%, which is comparable level with the share associated with subsidiary labor (i.e., $\delta_1(\Delta L_{st}/L_{st})$ out of $\Delta VA_{spt}/VA_{spt}$, 8.80%) and much larger than that of subsidiary tangible assets (i.e., $\delta_2(\Delta Tan_{st}/Tan_{st})$ out of $\Delta VA_{spt}/VA_{spt}$, 2.61%). This exercise implies that we could overestimate subsidiary's performance (e.g., TFP) if we omit parent firms' intangibles from the list of inputs.

Regarding the second viewpoint, we compute the contribution to subsidiary value-added driven by the increase in parent firms' intangibles. As one exercise, given the coefficient associated with the log of parent firms' intangibles is 0.093 as shown in Column (3) of Table 2, the increase in parent firms' intangible by one standard deviation (2.22 in log-scale) leads to 0.206 (log-scale) increase in the subsidiary value-added in log-scale. As the standard deviation of parent firms' value-added is 1.53 in log-scale (not reported in Table 1), such a change in subsidiary value-added accounts for around 27% of the standard deviation of parent firms' value-added (i.e., exp(0.206-1.53)=0.266), which is apparently not negligible. In other words, the abovementioned back-of-the-envelope calculation shows that a substantial part of parent firms' expenditure for intangible investment is recovered through the increase in subsidiaries' value-added. As we pointed out above, omitting such an additional gain in subsidiary value-added results in underestimating the return on parent firms' intangible

investment. Although it is beyond the scope of the present study to examine how parent firms evaluate the return of their intangible investments and implement their intangible investments, it is useful to understand the overall contribution associated with parent firms' intangible investments.

C. When the Contribution Becomes Larger?

It is important to analyze under what environment such a contribution associated with parent firms' intangibles to subsidiary production takes place since it helps us to understand the background mechanism. For this purpose, we implement one subsample analysis based on the relative sales size of a subsidiary to parent firm.

Table 4 summarizes the estimation results based on equation (1)–(3) and using the subsample of subsidiaries reporting relatively smaller sales compared to parent firms. First, we can see that the coefficient associated with $log(Intan_{pt})$ in the case of smaller subsidiaries is much larger than the baseline case in Table 2. This implies the positive contribution of parent firms' intangibles to subsidiary operations more for subsidiary operation in the case that such subsidiaries are small and not accumulated own resources. Second, consistent with this finding, the contribution of labor and tangibles held by subsidiary are bit lower than that in the baseline estimation. Third, as we discuss more explicitly in the next section, the contribution of parent firms' labor turns out to be larger in the production of small subsidiaries than in the baseline case (Table 2). This implies that in the case of small subsidiaries, the labor input in parent firms is used as an important input for subsidiaries (e.g., administrative functions in headquarter).

D. Additional Analyses

Parent firms' labor input in headquarter: In the abovementioned results, we fairly confirm that parent firms' intangibles positively contribute to subsidiary production. But, is there any other type of intangibles we need to take into account? Apart from the three intangibles we employ, the result in Table 4 suggests that the administrative ability provided by parent firms could be another resource possibly transferred to subsidiaries. As it is difficult to precisely measure the work of such an administrative function from data, we proxy for it by the number of workers in parent firms' head quarter. Assuming a large part of the workers at parent firms' headquarter effectively engage in administrative work, we hypothesize that the number of workers in headquarter (L_HQ_{pt}) has a positive association with overseas subsidiary production while the number of workers in non-headquarter divisions (L_nonHQ_{pt}, e.g., plants, domestic sales representatives, etc.) does not have a direct impact on subsidiary production. Table 5 shows the estimation of the equation (3) by replacing $log(L_{pt})$ with $log(L\_HQ_{pt})$ and $log(L\_nonHQ_{pt})$. The result confirms our conjecture and implies that the administrative function provided by parent firms' headquarter positively contribute to subsidiary production.

Number of subsidiaries held by parent firm: In the baseline estimation, we examined the contribution of parent firms' intangibles unconditional on the number of subsidiaries held by parent firms. While the impact of such number could be subsumed by the subsidiary-level fixed-effect as far as such a number is stable within each parent firm over the sample periods, it is still possible to have bias to the estimated coefficient associated with $log(Intan_{pt})$ when the number of subsidiaries held by parent firms ($\#Subsidiary_{pt}$) is an important confounder omitted from the estimation. To illustrate, suppose that parent firms increase its intangible investment as the number of overseas subsidiaries increase given such intangibles have spillover effect to the subsidiaries. Thus,

there is a positive correlation between parent firms' intangibles and the number of subsidiaries. If, in addition, the output of each subsidiary tends to be smaller when the number of subsidiaries becomes larger, we have downward bias to the estimated coefficient associated with $log(Intan_{pt})$ by omitting the number of subsidiaries from our estimation. Taking into account this concern, we estimate the equation (3) with an additional variable $log(\#Subsidiary_{pt})$.[6] Table 6 summarizes the results. First, we confirm the positive contribution of $log(Intan_{pt})$ on subsidiary production as in the baseline estimation even after controlling for $log(\#Subsidiary_{pt})$. Second, somewhat surprisingly, the marginal impact associated with parent firms' intangibles becomes smaller by incorporate $log(\#Subsidiary_{pt})$ to our estimation. Given the coefficient associated with the number of subsidiaries show negative sign, this result implies that there is a negative association between the number of subsidiaries and parent firms' intangible. We leave the further analysis on the mechanism governing parent firms intangible investment and the number of subsidiaries (i.e., extensive margin of FDI) to our future research.

Area subsamples: As discussed in Sakakibara and Yamawaki (2008), for example, the impact associated with the resource transferred from parent firms could depend on the area in which subsidiaries locate. Taking advantage of our comprehensive dataset covering the subsidiaries locating in U.S., China, EU countries, and other Asian countries, we estimate the equation (3) for each area subsamples. Table 7 summarizes the results and shows that in all the areas except for Asian countries excluding China, we can confirm the positive contribution of parent firms' intangibles on subsidiary production. As the same exercise in Figure 2, we also run the year-by-year cross-sectional estimation for each area subsample. The four panels in Figure 3 depict the estimated δ_5 with

[6] Note that it is more desirable to introduce the interaction term between the parent firms' intangibles and the number of subsidiaries held by the parent firms so that we can explicitly examine the conditional impact. We leave this to our future study.

the 95% confidence band. The fact that the size of coefficients in Figure 3 are not necessarily same as in that in Table 7 suggests again that omitting firm-level fixed effect and year-effect results in substantial bias to the estimates. Note the fact that the coefficient associated with parent intangibles in the case of US subsidiaries is consistent with finding in Sakakibara and Yamawaki (2008) reporting a positive relationship between the R&D investment conducted by Japanese parent firms and the profitability of their US subsidiaries. Nonetheless, the present study reports that the coefficients associated with parent intangibles in China and EU countries are also positive and statistically away from zero. This is contrasting with the results reported in Sakakibara and Yamawaki (2008) that there are not significant relationships between the R&D investment conducted by Japanese parent firms and the profitability of their subsidiaries located in those areas. In addition to the difference in the sample periods considered in the present study (2000–2013) and that in Sakakibara and Yamawaki (2008) (i.e., 1990–1996), the wider coverage of the resources (i.e., parent firms' intangibles) in the present study might lead to such differences. This comparison again suggests the importance to include wide range of resources held by parent firms to examine their subsidiary activities.

V. Conclusion

In this study, using comprehensive data accounting for Japanese firms and their overseas subsidiaries, we estimated the subsidiary-level production function and tested whether or not intangible assets accumulated by the parent firms contribute to the subsidiary production. We found that first, the intangibles owned by parent firms positively contribute to subsidiary production. Second, the contribution is stronger in the case of smaller subsidiaries. Third, such a positive contribution from parent firms' intangible to subsidiaries' production is confirmed for most of the subsidiary locations. These results jointly suggest

that intangibles contribute to firm activities even when those are geographically remoted.

The analysis in the present study could be expanded toward various directions. First, we can expand the analysis to further incorporate the intangibles held by subsidiaries. Second, more careful production function estimation would be required. Third, it would be promising direction to employ more flexible (e.g., Translog) functional form to check the complementarity and substitutability among various inputs. Fourth, further subsample analyses based on parent firms' share holdings, labor transfer inside firms, and industry would be helpful to make the implication of the empirical results more transparent. In the future, we intend to extend this research by considering the above-mentioned points.

REFERENCES

Andrews, M., L. Bellmann, T. Schank, and R. Upward. 2009. "The Takeover and Selection Effects of Foreign-Owned Establishments: And Analysis using Linked Employer-Employee Data," *Review of World Economics* 145: 293-317.

Belderbos, R., B. Ito, and R. Wakasugi. 2008. "Intra-Firm Technology Transfer and R&D in Foreign Affiliates: Substitutes or Complements? Evidence from Japanese Multinational Firms," Journal of the Japanese and International Economies 22: 310-319.

Corrado, C., C. Hulten, and D. Sichel. 2009. "Intangible Capital and U.S. Economic Growth," *Review of Income and Wealth* 55: 661-685.

Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio, and Massimiliano Iommi. 2012. "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results," IZA Discussion Paper Series, no. 6733, Institute for the Study of Labor (IZA), Germany.

Federico, S and G. A. Minerva. 2008. "Outward FDI and Local Employment Growth," Review of World Economics 144: 295-324.

Head, K. and J. Ries. 2003. "Heterogeneity and the FDI versus Export Decision of Japanese Manufacturers," *Journal of the Japanese and International Economies* 17: 448-467.

Hijzen, A., S. Jean., and T. Mayer. 2011. "The Effects at Home of Initiating Production Abroad: Evidence from Matched French Firms," Review of World Economics 147: 457-483.

Inui,T., Ito, K., and D. Miyakawa. 2015. "Overseas Market Information and Firms' Export Decisions," *Economic Inquiry* 53: 1671-1688.

Ito, K. and K. Fukao. 2010. "Determinants of the Profitability of Japanese Manufacturing Affiliates in China and other Regions: Does Localization of Procurement, Sales and Management Matter?" *The World Economy* 33: 1639-1671.

Kimura, F. and K. Kiyota. 2006. “Exports, FDI, and Productivity: Dynamic Evidence from Japanese Firms,” *Review of World Economics* 142: 695-719.

Kimura, Y. and T. A. Pugel. 1995. “Keiretsu and Japanese Direct Investment in US manufacturing,” Japan and the World Economy 7: 481-503.

Koenig, P., F. Mayneris, and S. Poncet. 2010. “Local Export Spillovers in France,” *European Economic Review* 54: 622-641.

Lipsey, R. E. 2010. “Measuring the Location of Production in a World of Intangible Productive Assets, FDI, and Intrafirm Trade,” Review of Income and Wealth 56: S99-S110.

Miyagawa, T., M. Takizawa, and K. Edamura. 2013 “Does the Stock Market Evaluate Intangible Assets? An Empirical Analysis using Data of Listed Firms in Japan,” *RIETI Discussion Paper*, 13-E-052.

Sakakibara, M. and H. Yamawaki. 2008. “What Determines the Profitability of Foreign Direct Investment? A Subsidiary-Level Analysis of Japanese Multinationals,” *Managerial and Decision Economics* 29: 277-292.

Todo, Y. 2006. “Knowledge Spillover from Foreign Direct Investment in R&D: Evidence from Japanese Firm-Level Data,” *Journal of Asian Economics* 17: 996-1013.

Todo, Y. 2011. “Quantitative Evaluation of the Determinants of Exports and FDI: Firm-Level Evidence from Japan,” *The World Economy* 34: 355-381.

Todo, Y. and S. Shimizutani. 2008. “Overseas R&D Activities and Home Productivity Growth: Evidence from Japanese Firm-Level Data,” *Journal of Industrial Economics* 56: 752-777.

Urata, S. and H. Kawai. 2000. “Intrafirm Technology Transfer by Japanese Manufacturing Firms in Asia,” in *The Role of Foreign Direct Investment in East Asian Economic Development*, NBER-EASE Volume 9, 2000: 49-77.

Urata, S., T. Matsuura, and Y. Wei. 2007. “International Intrafirm Transfer of Management Technology by Japanese Multinational Corporations,” in Almas Heshmeti ed, *Commercialization and Transfer of Technology: Major Country Case Studies*.

Yamashita, N. and K. Fukao. 2010. “Expansion Abroad and Jobs at Home: Evidence from Japanese Multinational Enterprises,” *Japan and the World Economy* 22: 88-97.

Lipsey, R. E. and F. Sjoholm. 2004 “Foreign Direct Investment, Education and Wages in Indonesian Manufacturing,” *Journal of Development Economics* 73: 415-422.

FIGURE AND TABLES

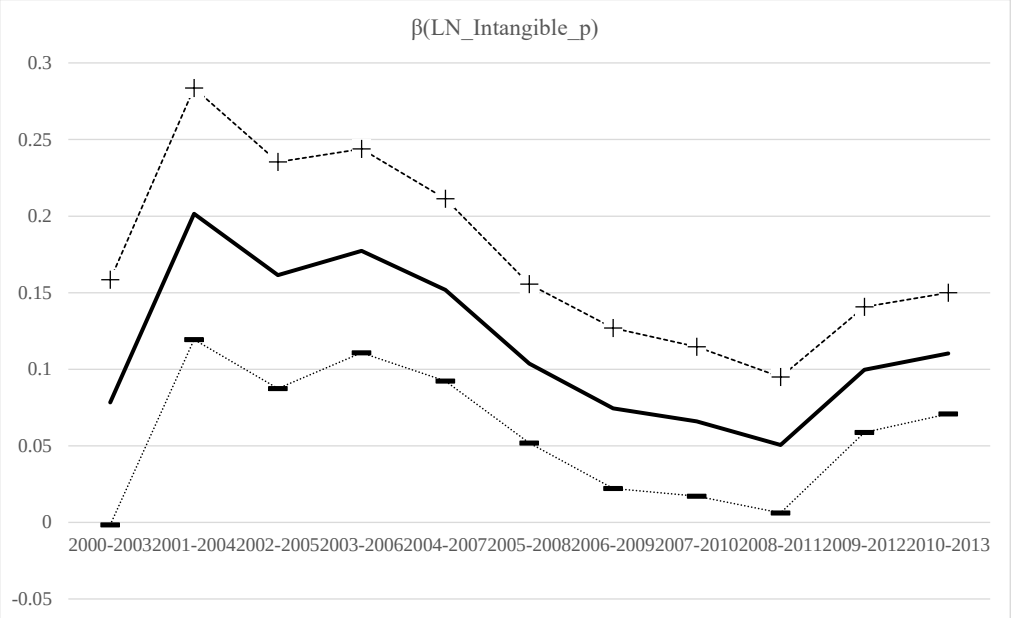

FIGURE 1. COEFFICIENTS OF PARENT FIRM'S INTANGIBLES

Notes: This figure plots the point estimates of the coefficient associated with parent firms' intangibles in the four-year moving window estimation as well as the 95% confidence band. For each estimation, we employ the equation (3) with subsidiary-level fixed effect and year-level fixed-effect.

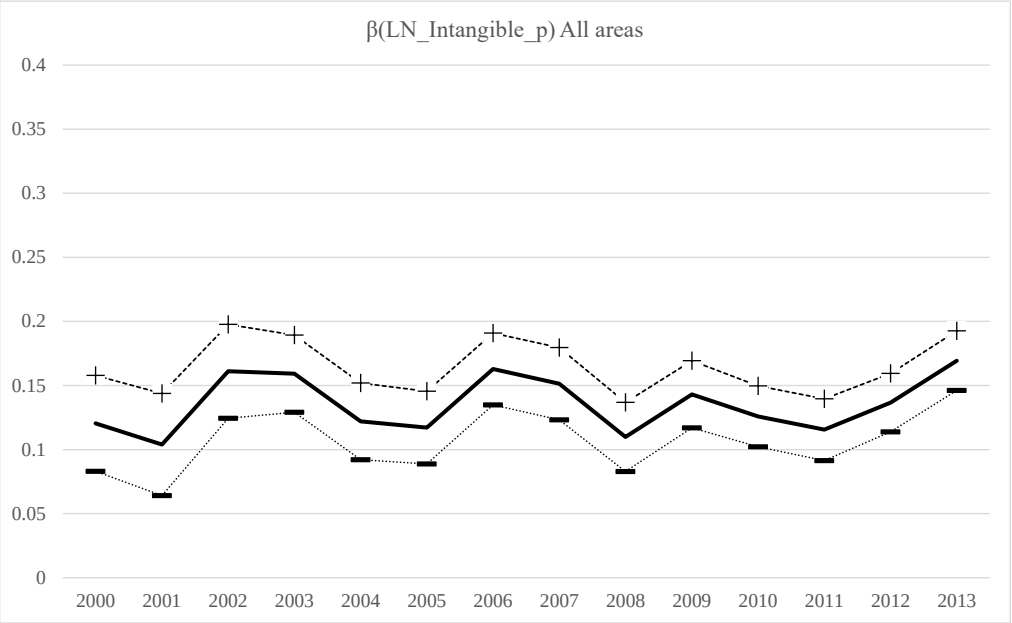

FIGURE 2. COEFFICIENTS OF PARENT FIRM'S INTANGIBLES

Notes: This figure plots the point estimates of the coefficient associated with parent firms' intangibles in the cross-section estimation as well as the 95% confidence band. For each estimation, we employ the equation (3) without subsidiary-level fixed effect or year-level fixed-effect.

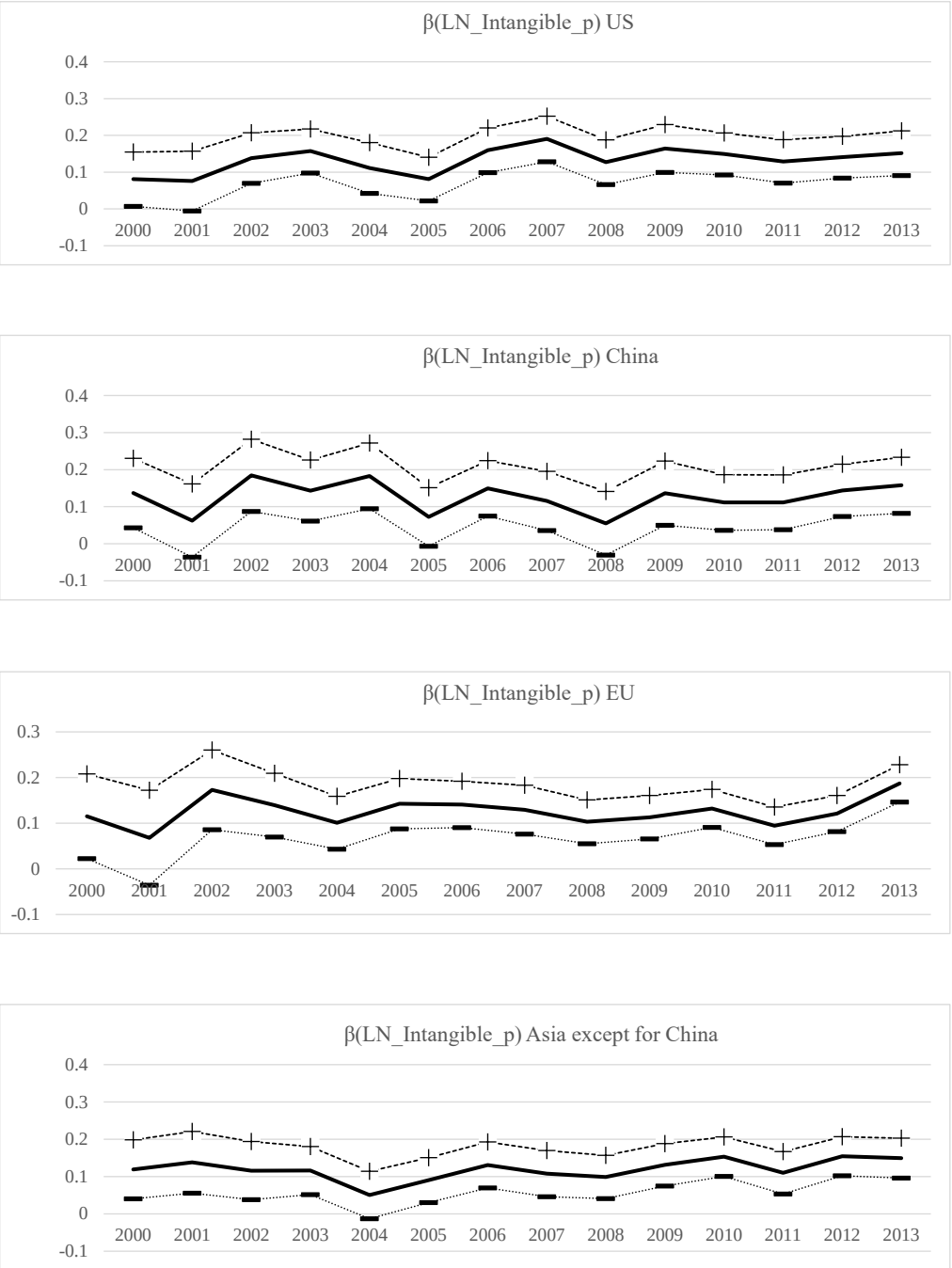

FIGURE 3. COEFFICIENTS OF PARENT FIRM'S INTANGIBLES FOR EACH AREA

Notes: This figure plots the point estimates of the coefficient associated with parent firms' intangibles in the year-by-year cross-section estimation as well as the 95% confidence band for each area – U.S., China, EU countries, and Asian countries excluding China. For each estimation, we employ the equation (3) without subsidiary-level fixed effect and year-level fixed-effect.

TABLE 1. SUMMARY STATISTICS

Variable	Definition of variables	Obs	Mean	Std. Dev.	Min	Max
LN_V	Log of subsidiary's value-added	85462	5.67	1.69	-0.08	14.88
LN_L_sub	Log of subsidiary's employee number	85462	4.46	1.71	0.00	10.74
LN_Tangible_sub	Log of subsidiary's tangible assets	85462	6.09	2.52	-4.05	15.21
LN_Intangible_p	Log of parent firm's intangibles	17979	7.31	2.22	-2.49	14.86
LN_L_p	Log of parent firm's employee number	17979	6.24	1.24	3.91	11.72
LN_Tangible_p	Log of parent firm's tangible assets	17979	7.63	1.77	-0.85	14.56
Subsidiary relative sales	The ratio of sunsidiary's sales to parent firm's sales	85462	0.10	0.38	0.00	30.89
#(Subsidiary)	The number of subsidiaries held by parent firm	17979	5.48	11.73	1.00	419.00

Notes: The table shows the summary statistics of the variables we use in the estimation. All the numbers except for the three variables accounting for parent firm attributes (i.e., parent firms' intangibles, labor, and tangible assets) and the number of subsidiaries, which is measured over parent firms-year, all the variables are measured over subsidiaries-year.

TABLE 2. BASELINE ESTIMATION RESULTS

Dependent var = LN_V	Full sample (1)		Full sample (2)		Full sample (3)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
<Subsidiary-level variables>						
LN_L_sub	0.514	0.005 ***	0.506	0.006 ***	0.505	0.006 ***
LN_Tangible_sub	0.085	0.004 ***	0.074	0.005 ***	0.073	0.005 ***
<Parent firm-level variables>						
LN_Intangible_p			0.117	0.009 ***	0.093	0.009 ***
LN_L_p					0.055	0.015 ***
LN_Tangible_p					0.038	0.007 ***
<Fixed-effect>						
Foreign subsidiary	yes		yes		yes	
Year	yes		yes		yes	
Constant term	yes		yes		yes	
No. Obs.	102,388		85,490		85,462	
No. Group	20,237		17,422		17,414	
Obs per group						
min	1		1		1	
avg	5.1		4.9		4.9	
max	14		14		14	
R-squared						
within	0.1523		0.1476		0.1482	
between	0.4277		0.4974		0.5051	
overall	0.4236		0.4855		0.4929	
F	983.62		736.31		657.74	
Prob>F	0.0000		0.0000		0.0000	

Notes: The table summarizes the estimation results based on the equation (1), (2), and (3). *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE 3. THREE INTANGIBLES

Dependent var = LN_V	Full sample (2) from Table 2		Full sample (2)		Full sample (3) from Table 2		Full sample (3)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
<Subsidiary-level variables>								
LN_L_sub	0.506	0.006 ***	0.505	0.006 ***	0.505	0.006 ***	0.507	0.006 ***
LN_Tangible_sub	0.074	0.005 ***	0.080	0.005 ***	0.073	0.005 ***	0.075	0.005 ***
<Parent firm-level variables>								
LN_Intangible_p	0.117	0.009 ***			0.093	0.009 ***		
LN_Soft_p			0.038	0.010 ***			0.029	0.010 ***
LN_Adv_p			0.021	0.006 ***			0.012	0.006 **
LN_RD_p			0.015	0.009 *			0.007	0.009
LN_L_p					0.055	0.015 ***	0.078	0.016 ***
LN_Tangible_p					0.038	0.007 ***	0.053	0.008 ***
<Fixed-effect>								
Foreign subsidiary	yes		yes		yes		yes	
Year	yes		yes		yes		yes	
Constant term	yes		yes		yes		yes	
No. Obs.	85,490		75,452		85,462		74,496	
No. Group	17,422		14,856		17,414		14,573	
Obs per group								
min	1		1		1		1	
avg	4.9		5.1		4.9		5.1	
max	14		14		14		14	
R-squared								
within	0.1476		0.1449		0.1482		0.1450	
between	0.4974		0.4820		0.5051		0.5070	
overall	0.4855		0.4674		0.4929		0.4887	
F	736.31		570.43		657.74		508.07	
Prob>F	0.0000		0.0000		0.0000		0.0000	

Notes: The table summarizes the estimation results based on the equation (1), (2), and (3) with the following separately measured three intangibles: Software (LN_Soft_p), advertisement (LN_Adv_p), and R&D (LN_RD_p). *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE 4. SUBSIDIARY'S RELATIVE SIZE

Dependent var = LN_V	Full sample From Table 2		Subsidiary relative sales<Median		Full sample From Table 2		Subsidiary relative sales<Median		Full sample From Table 2		Subsidiary relative sales<Median	
	(1)		(1)		(2)		(2)		(3)		(3)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
<Subsidiary-level variables>												
LN_L_sub	0.514	0.005 ***	0.483	0.012 ***	0.506	0.006 ***	0.477	0.012 ***	0.505	0.006 ***	0.475	0.012 ***
LN_Tangible_sub	0.085	0.004 ***	0.073	0.010 ***	0.074	0.005 ***	0.069	0.010 ***	0.073	0.005 ***	0.068	0.010 ***
<Parent firm-level variables>												
LN_Intangible_p					0.117	0.009 ***	0.171	0.022 ***	0.093	0.009 ***	0.154	0.023 ***
LN_L_p									0.055	0.015 ***	0.114	0.033 ***
LN_Tangible_p									0.038	0.007 ***	0.019	0.014
<Fixed-effect>												
Foreign subsidiary	yes		yes		yes		yes		yes		yes	
Year	yes		yes		yes		yes		yes		yes	
Constant term	yes		yes		yes		yes		yes		yes	
No. Obs.	102,388		30,034		85,490		29,538		85,462		29,536	
No. Group	20,237		7,709		17,422		7,634		17,414		7,634	
Obs per group												
min	1		1		1		1		1		1	
avg	5.1		3.9		4.9		3.9		4.9		3.9	
max	14		14		14		14		14		14	
R-squared												
within	0.1523		0.1047		0.1476		0.1054		0.1482		0.1060	
between	0.4277		0.3465		0.4974		0.4517		0.5051		0.4742	
overall	0.4236		0.3690		0.4855		0.4426		0.4929		0.4587	
F	983.62		173.96		736.31		161.15		657.74		144.20	
Prob>F	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	

Notes: The table summarizes the estimation results based on the equation (1), (2), and (3). We show the results from the full sample and the observations with smaller size, which is measured by ratio of subsidiary's sales to parent firm's sales, than the median level. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE 5. CONTRIBUTION OF PARENT FIRMS' LABOR INPUT

Dependent var = LN_V	Full sample (3) from Table 2		Full sample (3)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
<Subsidiary-level variables>				
LN_L_sub	0.505	0.006 ***	0.506	0.006 ***
LN_Tangible_sub	0.073	0.005 ***	0.075	0.005 ***
<Parent firm-level variables>				
LN_Intangible_p	0.093	0.009 ***	0.101	0.010 ***
LN_L_p	0.055	0.015 ***		
LN_L_HQ_p			0.033	0.008 ***
LN_L_nonHQ_p			0.007	0.009
LN_Tangible_p	0.038	0.007 ***	0.045	0.007 ***
<Fixed-effect>				
Foreign subsidiary	yes		yes	
Year	yes		yes	
Constant term	yes		yes	
No. Obs.	85,462		82,122	
No. Group	17,414		16,543	
Obs per group				
min	1		1	
avg	4.9		5.0	
max	14		14	
R-squared				
within	0.1482		0.1466	
between	0.5051		0.5079	
overall	0.4929		0.4953	
F	657.74		592.94	
Prob>F	0.0000		0.0000	

Notes: The table summarizes the estimation results based on the equation (3). The first column is the result presented in Table 2 while the second column summarizes the results based on the model using the following two types of labors used in parent firms: Log of the number of workers in parent firms' headquarter and that in non-headquarter divisions. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE 6. ROBUSTNESS CHECK: NUMBER OF FOREIGN SUBSIDIARIES

Dependent var = LN_V	Full sample (3) from Table 2		Full sample (3)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
<Subsidiary-level variables>				
LN_L_sub	0.505	0.006 ***	0.507	0.006 ***
LN_Tangible_sub	0.073	0.005 ***	0.075	0.005 ***
<Parent firm-level variables>				
LN_Intangible_p	0.093	0.009 ***	0.084	0.010 ***
LN_#Subsidiary			-0.039	0.015 **
LN_L_p	0.055	0.015 ***	0.064	0.016 ***
LN_Tangible_p	0.038	0.007 ***	0.036	0.007 ***
<Fixed-effect>				
Foreign subsidiary	yes		yes	
Year	yes		yes	
Constant term	yes		yes	
No. Obs.	85,462		83,125	
No. Group	17,414		16,730	
Obs per group				
min	1		1	
avg	4.9		5.0	
max	14		14	
R-squared				
within	0.1482		0.1473	
between	0.5051		0.4991	
overall	0.4929		0.4873	
F	657.74		603.29	
Prob>F	0.0000		0.0000	

Notes: The table summarizes the estimation results based on the equation (3) augmented with the number of overseas subsidiaries measured for each parent firm. The first column is the result presented in Table 2 while the second column summarizes the results based on such an augmented model. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE 7. ESTIMATION RESULTS FOR DIFFERENT AREAS

Dependent var = LN_V	Full sample		USA		China		Europe		Non-China Asia	
	(3) from Table 2		(3)		(3)		(3)		(3)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
<Subsidiary-level variables>										
LN_L_sub	0.505	0.006 ***	0.478	0.015 ***	0.558	0.013 ***	0.553	0.020 ***	0.392	0.012 ***
LN_Tangible_sub	0.073	0.005 ***	0.083	0.011 ***	0.074	0.010 ***	0.005	0.013	0.091	0.010 ***
<Parent firm-level variables>										
LN_Intangible_p	0.093	0.009 ***	0.084	0.024 ***	0.144	0.019 ***	0.150	0.030 ***	0.027	0.021
LN_L_p	0.055	0.015 ***	0.068	0.035 *	0.057	0.035	-0.021	0.042	0.128	0.035 ***
LN_Tangible_p	0.038	0.007 ***	0.054	0.017 ***	0.011	0.016	0.050	0.021 **	0.021	0.016
<Fixed-effect>										
Foreign subsidiary	yes		yes		yes		yes		yes	
Year	yes		yes		yes		yes		yes	
Constant term	yes		yes		yes		yes		yes	
No. Obs.	85,462		14,117		20,677		9,542		16,449	
No. Group	17,414		2,731		4,886		1,751		3,263	
Obs per group										
min	1		1		1		1		1	
avg	4.9		5.2		4.2		5.4		5.0	
max	14		14		14		14		14	
R-squared										
within	0.1482		0.1392		0.1800		0.1719		0.1306	
between	0.5051		0.6498		0.4850		0.6187		0.4689	
overall	0.4929		0.6400		0.4851		0.6081		0.4726	
F	657.74		102.09		192.33		89.63		109.91	
Prob>F	0.0000		0.0000		0.0000		0.0000		0.0000	

Notes: The table summarizes the estimation results based on the equation (3). The first column is the result presented in Table 2 while the second, third, fours, and fifth columns summarize the results based on the observations for U.S., China., EU countries, and Asian countries excluding China. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.