

Overseas Subsidiaries and the Productivity of Two-way Trading Manufacturers in Global Value Chains*

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Abstract

Purpose – This research examines the effect of a foreign subsidiary on the productivity growth of a Two-way trading manufacturing firm in Korea. We explore firms engaged in both trade and FDI simultaneously to verify whether participation in GVC as a broad concept is an efficient internationalization strategy to increase the productivity of a Korean manufacturing firm.

Design/methodology – Based on the firm-level data by utilizing the Survey of Business Activities from Statistics Korea, we examine the impact of vertically integrated foreign subsidiaries on the productivity of a manufacturing firm that exports and imports simultaneously.

Findings – The results show that if a Two-way trading firm establishes one or more overseas subsidiaries, the total factor productivity growth increases. Moreover, the FDI effect is statistically significant when the destination country has an economically close relationship with Korea. However, these effects are disparate depending on the industrial competitiveness or market situation where the subsidiary is located. Nonetheless, the synergy effect resulting from industrial combination is represented in China and the USA only.

Originality/value – As the importance of GVC has become more emphasized around the world. In spite of the scarcity of related domestic studies, we explored the effect of multinational manufacturing firms participating in GVC using firm-level data.

Keywords: Export, Foreign Direct Investment, Global Value Chain, Productivity, Vertical Integration

JEL Classifications: F14, F60, O14

1. Introduction

Over the last three decades, there have been many changes in the manufacturing sectors worldwide. Owing to advances in logistic technologies in the marine and aviation industries, firms save not only international transaction costs but also time. Also, the advancement of information communication technology (ICT) has been proceeding rapidly after the 1980s. The recent digital shifts are transforming economies and societies. Following these trends, many scholars have been interested in intermediate goods and service trade or extra value-added gains from specialized tasks. As global production networks expand and fragmentation of tasks become more common, production systems also changes and spread across borders, enlarging global value chains (GVCs). A GVC is defined as a series of linked activities in which stages of the production process are located in different countries. It is a form of integration in which value-added gains are accumulated through a series of production

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processes, as well as a process of separation during which production tasks move across national boundaries.

This research applies the notion of GVC to Korean manufacturing firms' globalization strategy and measures how much GVC impacts their efficiency to increase productivity. Korea is a representative country aggressively participating in globalization. In this study, globalization activity is divided into trading and FDI. On the one hand, most Korean firms engage in importing, exporting, or both activities. Since major manufacturing firms have grown through trade, they advocate those experiences as fundamental to development. Supporting policies of the Korean government were focused on exporting firms until the 2000s, resulting in a strong dependence on exports (Je Hyun-Jung, Hong Ji-Sang and Kim Yeo-Jin, 2010). To calculate the GVC participation ratio at the firm level, it is necessary to distinguish final goods from intermediate goods in the total exports (or total import) by each individual firm. However, it is impossible to clearly measure the real effect due to data limitations. Therefore, it takes an alternative approach by adopting some unique features of Korean trade¹. Because more than 80% of Korea's total trade consists of intermediate goods and raw materials, it can be assumed that it is more likely to participate in GVC as companies export and import simultaneously. Accordingly, a GVC firm in this paper is defined as a firm that exists in the manufacturing industry and trades Two-ways, importing and exporting synchronously. Each firm that is involved in the manufacturing industry imports intermediate goods to make its products and exports processed goods to acquire more value-added gains; this differentiates a pure intermediary trading firm from a GVC firm.

On the other hand, many domestic and foreign manufacturing firms shift production networks to other regions where the cost of inputs, including labor, capital, and intermediate goods, is lower. The competition between existing domestic suppliers and new foreign suppliers decreases the cost of inputs and increases their quality. As a result, firm productivity rises when it can use inputs from the international supply chain that are of better quality and of more varied types than before. By using ICT, firms can control production processes that are dispersed overseas, analyze global market surveys without delay, and manage logistics efficiently. Korea has become a country with net capital outflows, increasingly investing abroad since 2006. Except for 2008 when the global financial crisis occurred, Korea's FDI has increased more than three times, with an annual average increase of 7.0 percent, from 2005 to 2014. Many firms can avail cheaper labor as they move parts of the production lines that are labor-intensive, such as component procurement or product assembly, to locations where labor is cheaper. Korean firms in particular participate in GVC by trading with subsidiaries located in China or other East-Asian countries. In light of this, we test the effect of GVC participation on firm's productivity.

As the importance of GVC has become more emphasized around the world, related studies about GVC in Korea are also increasing. For example, Lee Joon-Ho, Choi Jeong-Il and Lee Ok-Dong (2014) explained the concept of GVC and referred to practical cases to support policy for small-medium sized firms. Lee Joon-Koo, Kim Jong-Cheol and Lim Jin-Ho (2016) and Choi Soo-Ho and Choi Jeong-Il (2016a/2016b) studied GVC cases in a particular industry or a few companies. Chung Sung-Hoon (2016) measured the extent to which Korea has participated in GVC and evaluates effects in the domestic manufacturing industry. Kim Seog-Min (2019) investigated the change trends in global value chains and examined the trade

¹ According to the OECD, Korea's FDI has risen about 12 times in the 2000s, from \$971.8 million in 2000 to \$11,037 million in 2012. According to UN Comtrade, Korea's exports have increased about 3.3 times from US \$159,874 million in 2002 to US \$543,627 million in 2012, while imports in the same period more than doubled from US \$151,692 million in 2002 to US \$387,552 million in 2012. Exports and imports are calculated as the sum of raw materials, intermediate goods, and capital goods excluding consumer goods.

structure, GVCs participation, and competitiveness of the Korean manufacturing industry by sector. However, most research converges on the industrial level, and it is still hard to find literature dealing with GVC effects using micro-level data in Korea. Accurate measurement and controlling complex data to carry out empirical research on GVCs at the firm-level data is demanded (Amador and Cabral, 2014). That is the difference between previous studies and ours. To gain more profits or grow, every single firm should decide whether to expand its global activities. Each firm wants to know what strategy can lead to a better status. Therefore, this study aims to answer three questions concerning GVC at the firm-level as follows. If a Two-way trading firm establishes one or more subsidiaries abroad, will its total factor productivity growth increase? Which country or region will have a greater FDI effect? Which type of FDI (for manufacturing subsidiaries or service subsidiaries) is more effective at improving the productivity of the domestic (manufacturing) parent companies?

The remainder of this paper is organized as follows. Section 2 summarizes related literature and discusses the three hypotheses proposed in this study. Section 3 provides the data and summary statistics. Section 4 presents empirical models and explains our results. Section 5 discusses the conclusions.

2. Literature Reviews and Hypotheses Development

In this section, related literature is categorized into three branches, namely international strategy of the firm, national economic relationship, and industrial linkage effect. The first branch concerns the effect of the level of internationalization on productivity at the firm level. This article examines the effect of outward FDI on domestic manufacturing firm productivity, and that is the difference from previous research that reveals the hierarchy of productivity according to the internationalization level (Arnold and Hussinger, 2010; Engel and Procher, 2012; Girma, Greenaway and Kneller, 2004; Girma, Kneller and Pisu, 2005; Helpman, Melitz and Yeaple, 2004; Tomiura, 2007; Wagner, 2006). That is, we test if productivity is higher when a Two-way trading manufacturing firm separates tasks by setting up subsidiaries abroad compared with firms that do not have any foreign subsidiaries. Early studies focused on the cases of developed countries (Castellan, Mariotti and Piscitello, 2008; Hijzen, Jean and Mayer, 2011; Kimura Fukunari and Kiyota Kozo, 2006; Kleinert and Toubal, 2007; Navaretti, Castellani and Disdier, 2009). Lately, similar studies have been released from developing countries such as Slovenia and China using firm-level data (Cozza, Rabellotti and Sanfilippo, 2015; Damijan and Decramer, 2014; Li et al., 2017). However, the effect of FDI on productivity growth is controversial since existing results are inconsistent. As shown in Li et al. (2017), who adopted resource-based views and the institutional theory, FDI boosts the productivity of multinational enterprises in emerging economies with a significant positive result. Our result agrees with this finding and set the hypothesis as follows.

H1: The productivity of a firm that has one or more subsidiaries abroad is higher than that of a firm that has none, even though they both practice Two-way trading.

The second branch of literature is related to the target regions of FDI and firm productivity. FDI is a structure that consists of a source country and a target country. There are theories about the decision regarding investment target location; for instance, the OLI paradigm by Dunning (1988/2001) and the LLL model by Mathews (2006/2017). Si Yuefang, Liefner Ingo and Wang Tao (2013), who investigated China's FDI, noted that the OLI paradigm fits and explains FDI from China to other developing countries, and the LLL model demonstrates FDI toward developed countries. In Korea's case, firms invest aggressively toward not only developed but also developing countries. Therefore, it is difficult to understand Korean FDI by adopting only one theory. Instead, this study assumes that the FDI toward a certain

country that has a strong economic connection with the source country affects the productivity growth of the domestic parent firm. Our dataset distinguishes whether the foreign subsidiary and the domestic parent firm are vertically integrated. Furthermore, it also set the economically connected regions based on the ratio of trade volume. When a complementary relationship between the share of trade and FDI is established, this assumption is valid. According to Helpman (1984), intra-firm trade increases when overseas production links to vertical integration with domestic production. Carr, Markusen and Maskus (2001), Helpman, Melitz and Yeaple (2004) and Markusen and Maskus (2001) are representative theoretical studies explaining complementary and alternative relationships between FDI and trade. From the view of GVC, the imports and exports of intermediate goods and FDI are complementary, as the proportion of intermediary goods among the total trade volume between countries increases due to the international diversification of tasks in production. According to OECD-WTO (2015) and reports from the import-export bank of Korea, China and the USA are the largest and the second-largest partners of Korea in terms of intermediate goods trade and FDI from 2004 to the present. Summing up these characteristics, the second hypothesis is as follows.

H2: Two-way trading manufacturing firms that have overseas subsidiaries in regions with high economic relevance to Korea are more likely to increase productivity than firms that set up subsidiaries in other regions.

The last branch of literature concerns the connection between manufacturing and service on firm productivity. Many prior studies have analyzed the effect of offshoring or outsourcing on FDI in manufacturing subsidiaries. From the perspective of GVC, the combination of manufacturing and service industries has a positive impact on value-added growth. According to Baldwin, Ito and Sato (2014), the trend of service input as a production factor is increasing due to the global expansion of GVCs. Several studies have examined the effect of service liberalization or investment on manufacturing firms' productivity (Arnold, Javorcik and Matto, 2011; Arnold et al., 2015; Bas, 2014; Duggan, Rahardja and Varela, 2013; Francois and Woerz, 2008; Shepotylo and Vakhitov, 2015). Overall results of the related studies show that the productivity of the manufacturing process corresponding to the downstream of the production process increases when the service proportion as an input factor increases. In this study, the industry type of FDI is divided into either manufacturing or service subsidiaries. This way we can check which type of FDI has a bigger effect from vertical integration with the domestic parent firm in the manufacturing sector. Additionally, this research examines what conditions results in higher productivity growth between single-type and mixed-type subsidiaries. To do this, the third hypothesis set as follows.

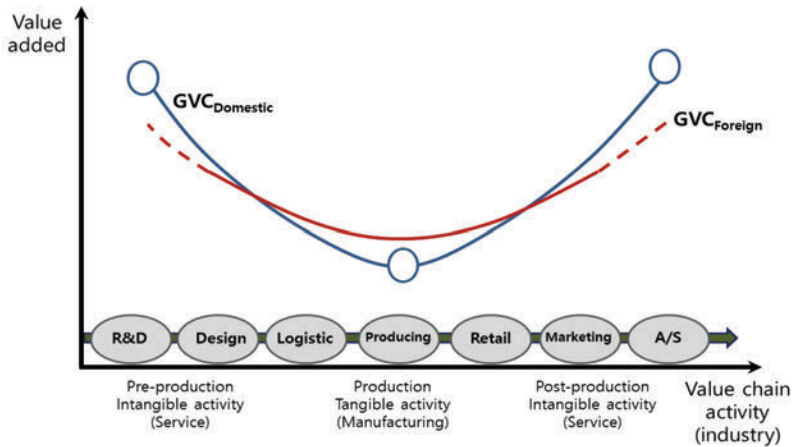
H3: Two-way trading manufacturing firms that have combined manufacturing and service subsidiaries increase productivity more than firms that have only one kind of subsidiary.

Fig. 1 shows the third hypothesis as represented in a smile curve. Baldwin, Ito and Sato (2014) showed that the shape or length of a value chain is different depending on eras. That is, GVC of the 2000s represented a steeper form between top and bottom points than GVC of the 1970s. This means that the value-added gains generated from pre-production or post-production levels (e.g., research and development (R&D) or marketing) are higher than those from the tangible production level (e.g., intermediates assembly line). This result can be interpreted as a change of value-chains from not only different periods in one country but also from the same period in different countries. Applying this idea, we set two types of GVC combinations. First, this research considers that a developed country has rich R&D technology and marketing knowledge such that it has a relative advantage in planning and

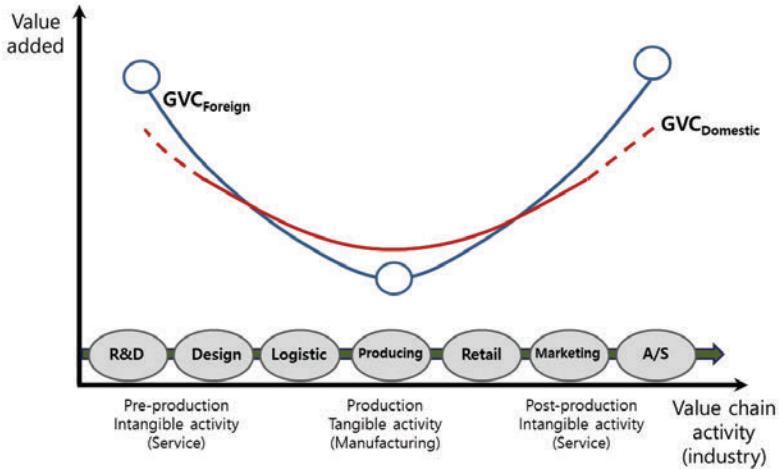
design as well as sales (rather than manufacturing) among all production processes. Second, it also considers the developing country that has abundant workers, so that it has a relative advantage in manufacturing tasks (rather than research or marketing activities). Since the fragmentation of tasks across borders is becoming more common, many firms relocate or establish subsidiaries abroad or in a region where they can generate more value-added gains. In our analysis, at the upper panel A, there is an assumption that the domestic is the developed country, and foreign is the developing country. Thus, the slope of the foreign country's value chain is gentle and the slope of the home country's value chain is steep.

Fig. 1. Two Types of Crossing Smile Curves: Firm-Level Conceptualization

Panel A. Country type: Domestic – Developed and Foreign – Developing



Panel B. Country type: Domestic – Developing and Foreign– Developed



Moreover, the steep line is longer than the gentle line because most developing countries do not have production lines to generate higher added value. The dotted line at both edges of the foreign curve expresses this latent situation. Practically speaking, developing countries do not have enough resources for R&D or supporting services after sales. The domestic parent

firm can handle all these tasks. However, a firm can generate more value-added gains if it establishes a subsidiary for manufacturing tasks in the developing country rather than performing these tasks in the home country. At the lower panel B, the assumption is that the domestic firm's country is the developing country and the foreign subsidiary's country is the developed country. In this case, the slopes of the two curves are switched. The parent firm concentrates on manufacturing tasks. Subsidiaries located in the foreign country perform the R&D, sales, or other service tasks by absorbing valuable information that it could not obtain domestically from the local market. No matter what the domestic situation is, either developed or developing, more value-added gains are generated along the surface of the crossed lines on condition that the linkage is effective.

3. Data and Summary Statistics

3.1. Data

Our primary data source is the Survey of Business Activities (SBA) from Statistics Korea. This dataset covers all firms with more than 50 full-time employees and at least 300 million Korean won of equity capital in all industries. For enterprises classified under "wholesale and retail trade" service industries, and other service industries, those with capital stock of 1 billion won or more were included in the target population even though they have 49 full-time employees or less. The research range is restricted to the manufacturing sector since the goal of this paper is to find out which conditions result in higher productivity for globalized firms.

The key variables include the characteristics of each foreign affiliate such as industry, country location, and share of equity capital. This study analyzes international vertical integration effects under the conditions encountered by subsidiaries located abroad. The database does not report the domestic firms' transaction values with subsidiaries, but it is assumed that domestic firms establish subsidiaries abroad to save costs or for purposes of globalization. Therefore, it can be assumed that if a firm exports to a country where its subsidiary is located, then it is willing to transfer its goods to the next stage of the production process or sell in the local market through its subsidiaries, not to other partners or competitors. Each subsidiary classified by type of industry and regional sector, and 14 dummy variables were set for each respective category, so they cannot coexist. Industrial sectors were divided into two types, manufacturing and service sectors. Regional sectors were classified into seven parts: foreign, Asia, China, other Asia, non-Asia, the USA, and the rest of the world (ROW). Definition of the firm's vertical integration and its subsidiaries is as follows. First, the database furnishes different variables, such as affiliate and subsidiary, depending on the share of the equity capital. The parent firm means a firm owning at least 50 percent of the equity capital of its affiliates in this study. Second, to define the vertical relationship between the parent firm and its foreign subsidiary, this research considered a supplier industry as one that supplies intermediate inputs of the producer industry based on an input-output table (I-O table) by the bank of Korea². From the perspective of GVC, vertical integration can be defined

² We classified the manufacturing industry in the input-output table into 79 sub-categories (3 digits), and the service industry into the producer service and retail service. Producer service refers to the supporting service needed by other firms' production activity: for instance, finance and insurance activities (K); real estate activities and renting and leasing (L); professional, scientific and technical activities (M); business facilities management and business support services (N). The retail service refers to moving goods, knowledge, or human resources to the establishment and support-related service: for example, wholesale and retail trade (G), transportation (H), information and communications (J).

as a case in which some of the production processes are linked to the front and rear industries. The downstream industry is defined as the industry that purchases more than 5 percent of the total production inputs from a specific supplier industry and the upstream industry as that supplier industry. If manufacturing firm A (in the front industry) has manufacturing subsidiary B (in the rear industry), then A and B are vertically integrated. In the case of the service industry, if manufacturing firm A in the front industry has subsidiary C in the producer service or retail service industry, then A and C are also in a vertical integration relation. Our research aims to determine which supply chain is effective, the manufacturing side or the service side.

In this section, we check the distribution of subsamples as classified by the subsidiaries' information and confirm summary statistics of key variables used in the main regression before explaining the empirical models as follows.

Table 1 shows the distribution of GVC participating firms as classified by the regional and industrial information of the vertically integrated subsidiary for the period from 2009 to 2013. A firm may simultaneously have more than one subsidiary and those could be in the same or different industries. From the result, 1,062 firms had at least an average of one subsidiary. Eight hundred and twenty firms (77 percent) had foreign subsidiaries, and the number of firms that established subsidiaries in Asia was more than double the number of firms that set up subsidiaries in non-Asian countries. The number of firms with a foreign subsidiary decreased by about 180 in the period from 2009 to 2010, but this decrease recovered. The number of firms that established manufacturing subsidiaries abroad was around double the number of firms that set up service subsidiaries abroad. Most of the foreign manufacturing subsidiaries were located in Asia, with 75 percent in China. In the service sector, firms established subsidiaries in Asian or non-Asian countries at a similar volume. However, at the country level, the number of subsidiaries in the USA was more than those in China. The results in Table 1 cannot fully explain why the industrial and regional distributions of foreign subsidiaries differed. However, by using the smile curve referred to above, the difference in the relative technical level or production cost serves as the motivation for FDI.

Table 1. Distribution of GVC Participating Firms Classified by Region and Industry of Vertically Integrated Subsidiary (period: 2009~2013)

Numbers of Firms Having One or More Subsidiaries		2009	2010	2011	2012	2013	Average
Total		1219	1003	972	1031	1085	1062.0
Foreign		955	777	759	787	824	820.4
Asia	Sub total	841	684	686	687	719	723.4
	China	646	509	516	516	538	545.0
Non-Asia	Sub total	377	330	319	356	362	348.8
	the USA	276	240	237	266	275	258.8
Numbers of Firms Having One or More Manufacturing Subsidiaries		2009	2010	2011	2012	2013	Average
Total		955	763	758	785	817	815.6
Foreign		764	614	606	612	630	645.2
Asia	Sub total	704	569	565	559	578	595.0
	China	576	452	449	447	457	476.2
Non Asia	Sub total	186	166	170	183	187	178.4
	the USA	102	87	98	108	112	101.4

Table 1. (Continued)

Numbers of Firm Having One or More Service Subsidiaries		2009	2010	2011	2012	2013	Average
Total		560	496	469	505	532	512.4
Foreign		344	300	285	301	321	310.2
Asia	Sub total	234	220	207	204	218	212.6
	China	113	96	105	106	115	107.0
Non Asia	Sub total	221	199	180	205	211	203.2
	the USA	180	163	149	166	169	165.4

Source: The Survey of Business Activities (SBA) from Statistics Korea from 2009 to 2013.

- Notes:**
1. Each number is the number of domestic GVC-participating firms with one or more vertically integrated subsidiaries.
 2. Foreign (among region standards where a subsidiary is located) means the rest of the world, except Korea.
 3. Service (among industry standards in which a subsidiary is included) means producer service or retail service.

Driffield and Love (2007) classified the motivations for FDI into four types based on two standards, the technical gap measured by R&D intensity and the input price gap measured by unit labor cost. According to their theory, the FDI motivation from the source country (e.g., Korea) to the host country (the USA) is the sourcing of technology, in which case Korean firms invest to utilize the highly intense R&D in the region even though the unit labor cost is high. Meanwhile, the FDI motivation from the source country (e.g., Korea) to the host country (China) is the ownership advantage or the search for efficiency. The investing firms can exploit technology because of the ownership advantage. Also, there exists definite motivation to achieve production efficiency from cheap unit labor costs (Dunning, 1988).

Fig. 2. Taxonomy of Motivations for FDI

		Unit Labor Costs(ULC)	
		ULChost<ULCsource	ULChost>ULCsource
R&D Intensity (RDI)	RDIhost>RDIsource	<Cell 1> Technology sourcing / Location advantage	<Cell 2> Technology sourcing
	RDIhost<RDIsource	<Cell 4> Ownership advantage / Efficiency seeking	<Cell 3> Ownership advantage

Source: Driffield and Love (2007).

3.2. Summary Statistics

The database provides basic information such as the number of employees, capital, age, and others. It contains various financial data including export, and import values, and R&D expenditures. Furthermore, to analyze independent decisions about trade and FDI at the individual firm level, firms owned by another parent firm are excluded from our sample.

Table 2 presents the summary statistics on the foreign subsidiary information and the parent firm characteristics. The total number of Korean parent firms that had vertically

integrated subsidiaries in 2009 is 1,043. In our model, dependent variables were calculated based on the differences between log-translated productivity levels in 2013 and 2009.

Table 2. Summary Statistics

Variable	Definition	Mean	Std.dev.	Min	Max
TFP growth	$\text{TFP growth} = \ln(\text{TFP})_{i,13} - \ln(\text{TFP})_{i,09}$	0.00	0.10	-1.04	1.33
LP growth	$\text{LP growth} = \ln(\text{LP})_{i,13} - \ln(\text{LP})_{i,09}$	0.02	0.66	-5.07	5.33
F_Sub _{i,09}	1 if the firm i has 1 or more subsidiary abroad, 0 otherwise.	0.46	0.50	0	1
A_Sub _{i,09}	1 if the firm i has 1 or more subsidiary in Asia, 0 otherwise.	0.40	0.49	0	1
C_Sub _{i,09}	1 if the firm i has 1 or more subsidiary in China, 0 otherwise.	0.30	0.46	0	1
OA_Sub _{i,09}	1 if the firm i has 1 or more subsidiary in other Asia except China, 0 otherwise.	0.23	0.42	0	1
NA_Sub _{i,09}	1 if the firm i has 1 or more subsidiary in Non-Asia, 0 otherwise.	0.22	0.41	0	1
F_MNF _{i,09}	1 if the firm i has 1 or more manufacturing subsidiary abroad, 0 otherwise.	0.35	0.48	0	1
A_MNF _{i,09}	1 if the firm i has 1 or more manufacturing subsidiary in Asia, 0 otherwise.	0.32	0.47	0	1
C_MNF _{i,09}	1 if the firm i has 1 or more manufacturing subsidiary in China, 0 otherwise.	0.25	0.44	0	1
OA_MNF _{i,09}	1 if the firm i has 1 or more manufacturing subsidiary in other Asia except China, 0 otherwise.	0.16	0.37	0	1
NA_MNF _{i,09}	1 if the firm i has 1 or more manufacturing subsidiary in Non-Asia, 0 otherwise.	0.10	0.31	0	1
U_MNF _{i,09}	1 if the firm i has 1 or more manufacturing subsidiary in the United States of America, 0 otherwise.	0.06	0.23	0	1
R_MNF _{i,09}	1 if the firm i has 1 or more manufacturing subsidiary in others ³ , 0 otherwise.	0.07	0.25	0	1
F_SVC _{i,09}	1 if the firm i has 1 or more service subsidiary abroad, 0 otherwise.	0.20	0.40	0	1
A_SVC _{i,09}	1 if the firm i has 1 or more service subsidiary in Asia, 0 otherwise.	0.14	0.34	0	1
C_SVC _{i,09}	1 if the firm i has 1 or more service subsidiary in China, 0 otherwise.	0.07	0.25	0	1

³ Other is the rest of the world except Asian countries and the USA.

Table 2. (Continued)

Variable	Definition	Mean	Std.dev.	Min	Max
OA_SVC _{i,09}	1 if the firm <i>i</i> has 1 or more service subsidiary in other Asia except China, 0 otherwise.	0.10	0.30	0	1
NA_SVC _{i,09}	1 if the firm <i>i</i> has 1 or more service subsidiary in Non-Asia, 0 otherwise.	0.14	0.34	0	1
U_SVC _{i,09}	1 if the firm <i>i</i> has 1 or more service subsidiary in the United States of America, 0 otherwise.	0.11	0.31	0	1
R_SVC _{i,09}	1 if the firm <i>i</i> has 1 or more service subsidiary in others, 0 otherwise.	0.07	0.25	0	1
ln(L) _{i,09}	The natural logarithm of the number of employee	5.27	1.06	3.91	11.35
ln(K/L) _{i,09}	The natural logarithm of the capital intensity	4.61	0.99	-0.83	7.59
ln(R&D) _{i,09}	The natural logarithm of the R&D cost	5.57	3.78	-4.61	15.80
ln(Age) _{i,09}	The natural logarithm of the age	3.14	0.62	0.00	4.53

Source: The Survey of Business Activities (SBA) from Statistics Korea from 2009 to 2013

Notes: 1. TFP is calculated following Levinsohn and Petrin (2003) method and LP is the labor productivity.

2. Each independent variable is the value measured in 2009.

The variable can be interpreted as the productivity growth of an individual firm for four years since we chose firms that survived in 2009 and 2013 as a Two-way trader. Two types of productivity were measured. One is total factor productivity (TFP) following Levinsohn and Petrin (2003); the other is labor productivity (LP), computed as the value-added divided by the number of employees. All explanatory variables are 2009 values to solve endogeneity problems caused by a reverse causality issue. Out of the 1,043 firms, 479 (46 percent) had foreign subsidiaries, 417 (40 percent) of which established subsidiaries in Asia, while 229 (22 percent) had non-Asian subsidiaries. Firms in the manufacturing industry focused on investing in Asia due to its proximity. This basic result illustrates the “Factory Asia” phenomenon explained by Ramondo (2016).

This paper also found that the foreign-investment decisions of firms varied depending on to what industry the subsidiary belonged. First, manufacturing subsidiaries are classified based on their location. There were 365 firms (35 percent) that established manufacturing subsidiaries abroad. Three hundreds and thirty-three firms (32 percent) set up subsidiaries in Asia, one-quarter of the firms had manufacturing subsidiaries in China and 166 firms (16 percent) set up their manufacturing subsidiaries in Asian countries other than China. Only 104 firms (10 percent) had subsidiaries in non-Asian countries. To summarize, manufacturing subsidiaries of Korean manufacturing firms were mostly in Asia, especially in China. Next, service subsidiaries are separated by their location; 208 firms (20 percent) had service subsidiaries in other countries, with 146 firms (14 percent) in Asia and in non-Asian countries. In contrast with the manufacturing sector, more firms established service subsidiaries in the USA (11 percent) than in China (7 percent). Thus, service subsidiaries of Korean manufacturing firms preferred to set up in the USA before other regions. Last, there are some independent variables to control firm-specific characteristics; for example, the number of employees, capital intensity, the cost for R&D and firm age. On average, a firm had 194 employees aged 23 years, and spent around 262 million won on R&D. All these variables in Table 2 take the natural logarithm.

4. Empirical Model and Results

Our goal is to examine whether the existence of vertically integrated subsidiaries affects the productivity growth of domestic manufacturing trading firms for a sample of Korean firms that survived for 4 years from 2009. As mentioned above, the two types of dependent variable are productivity growth for these 4 years, and the independent variables are the firms' characteristics in our model. Regional and industrial information of subsidiaries are represented as dummy variables among explanatory variables. All regressions include three-digit industry dummies, and they estimate OLS regressions with conditional subsamples.

Our study distinguishes subsamples in three steps, as follows. First, it studies the effect of subsidiaries established abroad on the productivity growth of a domestic parent firm. For this case, the firm is a multinational enterprise (MNE). As the counterpart, non-MNE refers to a firm that has no subsidiary, or has subsidiaries in Korea only. This way, it is possible to compare the effects depending on the existence of foreign subsidiaries and test Hypothesis 1. Next, to test Hypothesis 2, foreign subsidiaries are divided into two categories: Asia and non-Asia, additionally breaking down Asia into China and other Asian countries excluding China. Prior to separating the whole sample, we examined the effect of a foreign subsidiary's existence on the parent firm's productivity growth without reference to the industrial aspect of its subsidiary. The productivity growth is estimated as follows:

$$\text{Productivity growth}_{i,13-09} = \alpha + \beta \text{Sub}_{i,09} + \gamma X_{i,09} + \delta_j + \varepsilon_{i,13} \quad (1)$$

The dependent variable refers to the productivity growth of firm i measured by TFP and labor productivity differences. The coefficient β is interpreted as the effect of the existence of a vertically integrated subsidiary in 2009 on productivity growth. The variable X includes individual characteristics of firm i in 2009: for instance, the number of employees, capital intensity, age, R&D cost, and TFP or labor productivity level. The coefficient δ is a three-digit industry dummy that controls the impact of each industry.

The first situation is represented as columns (1) and (4) in Table 3. If a Two-way trading manufacturing firm had one or more subsidiaries abroad, then the firm's TFP growth is 1.8 percent larger compared with other firms that did not have any foreign subsidiary. However, there is no significant difference in labor productivity growth between the two groups. This means that Hypothesis 1 is accepted for TFP only. As the next step, foreign subsidiaries are separated into two categories: Asia and non-Asia. Columns (2) and (5) display the results. The result shows that a firm with one or more vertically integrated subsidiaries in non-Asian countries increased its TFP by 2.3 percent and its labor productivity by 16 percent more than those that had one or more vertically integrated subsidiaries in Asia. It appears that Hypothesis 2 is rejected. However, the result changed after excluding China from the total Asian sample as shown in columns (3) and (6). This indicates that a firm with one or more vertically integrated subsidiaries in China increased its TFP by 1.4 percent and its labor productivity by 8.2 percent. Moreover, a firm with one or more vertically integrated subsidiaries in non-Asian countries increased its TFP by 2.1 percent and its labor productivity by 15.3 percent. Meanwhile, the labor productivity of a firm with subsidiaries in Asia outside of China decreased instead. This finding indicates that Hypothesis 2 is acceptable because the FDI effect toward China, which has a relatively strong economic relationship with Korea, is statistically significant and positive as compared with other Asian countries. Results from other independent variables are consistent. If the size of the firm or capital intensity is bigger, then the productivity growth is positive. Younger firms grow faster than older firms, but R&D per sales is insignificant in increasing productivity growth.

Table 3. Effects of Having a Foreign Subsidiary on the Productivity Growth of a Two-way Trading Manufacturing Firm

Dependent Variables	TFP Growth			LP Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
F_Sub _{i,09}	0.018*** (0.006)			0.070 (0.047)		
A_Sub _{i,09}		0.000 (0.006)			-0.070 (0.046)	
C_Sub _{i,09}			0.014** (0.005)			0.082** (0.041)
OA_Sub _{i,09}			-0.007 (0.006)			-0.093** (0.045)
NA_Sub _{i,09}		0.023*** (0.006)	0.021*** (0.006)		0.166*** (0.048)	0.153*** (0.050)
ln(L) _{i,09}	0.007*** (0.002)	0.004* (0.002)	0.005* (0.002)	0.059*** (0.017)	0.046*** (0.018)	0.049*** (0.018)
ln(K/L) _{i,09}	0.016*** (0.003)	0.017*** (0.003)	0.017*** (0.003)	0.234*** (0.028)	0.231*** (0.028)	0.239*** (0.028)
ln(Age) _{i,09}	-0.013*** (0.003)	-0.012*** (0.003)	-0.012*** (0.003)	-0.082*** (0.025)	-0.074*** (0.025)	-0.078*** (0.025)
ln(R&D) _{i,09}	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.011 (0.009)	0.011 (0.009)	0.011 (0.009)
ln(TFP) _{i,09}	-0.641*** (0.036)	-0.632*** (0.037)	-0.645*** (0.037)			
ln(LP) _{i,09}				-0.546*** (0.038)	-0.537*** (0.038)	-0.550*** (0.038)
Constant	1.140*** (0.071)	1.131*** (0.072)	1.157*** (0.072)	3.278*** (0.291)	3.294*** (0.291)	3.333*** (0.291)
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observation	1,043	1,043	1,043	1,043	1,043	1,043
R ²	0.502	0.505	0.508	0.512	0.516	0.519

Notes: 1. Dependent variable is calculated on the differences from log-translated productivity (i.e. TFP or LP) in 2013 and log-translated productivity in 2009. All explanatory variables are values in 2009. Every regression includes 3-digit industry dummy.

2. Standard errors are presented in parentheses. *p<0.1, **p<0.05, ***p<0.01.

Next, several dummy variables based on the industry sector of the subsidiaries are added to investigate whether industrial combination between manufacturing and service is effective in increasing the productivity growth of the parent firm. This new equation for the productivity growth is estimated as follows:

$$Productivity\ growth_{i,13-09} = \alpha + \beta_1 MNF_{i,09} + \beta_2 SVC_{i,09} + \beta_3 (MNF_{i,09} \times SVC_{i,09}) + \gamma X_{i,09} + \delta_j + \varepsilon_{i,13} \quad (2)$$

Equation 2 was derived from equation 1 with subdivided industrial dummies. It helps to calculate the single effect by sector and synergy effects of combining two sectors. If a firm had manufacturing subsidiaries abroad that work well enough to increase the productivity growth of its parent firm in Korea, then β_1 will be positive and statistically significant. Following the same logic, if a firm had service subsidiaries abroad that are effective in boosting the productivity growth of its parent firm in Korea, then β_2 will be positive and significant as well.

Last, a crossed term is inserted, $MNF_{i,09}$ times $SVC_{i,09}$, to examine the additional effect that exists if the firm had both types of subsidiaries in 2009. If there is a synergy effect between a manufacturing subsidiary and a service subsidiary, then β_3 will also be positive and statistically significant.

Table 4. Robustness Checks

Dependent Variables	TFP Growth			LP Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
F_MNF _{i,09}	0.023 *** (0.007)			0.134 ** (0.055)		
F_SVC _{i,09}	-0.003 (0.007)			-0.130 ** (0.053)		
F_MNF _{i,09} × F_SVC _{i,09}	0.014 (0.009)			0.191 *** (0.066)		
A_MNF _{i,09}		0.022 *** (0.007)			0.125 ** (0.051)	
A_SVC _{i,09}		-0.039 *** (0.008)			-0.430 *** (0.056)	
A_MNF _{i,09} × A_SVC _{i,09}		0.004 (0.010)			0.125 * (0.074)	
NA_MNF _{i,09}		0.027 *** (0.008)			0.209 *** (0.062)	
NA_SVC _{i,09}		0.031 *** (0.007)			0.241 *** (0.050)	
NA_MNF _{i,09} × NA_SVC _{i,09}		-0.005 (0.010)			-0.036 (0.077)	
C_MNF _{i,09}			-0.006 (0.006)			-0.068 (0.047)
C_SVC _{i,09}			-0.028 *** (0.009)			-0.274 *** (0.068)
C_MNF _{i,09} × C_SVC _{i,09}			0.049 *** (0.011)			0.421 *** (0.083)
OA_MNF _{i,09}			0.016 ** (0.007)			0.096 * (0.049)
OA_SVC _{i,09}			-0.046 *** (0.007)			-0.429 *** (0.056)
OA_MNF _{i,09} × OA_SVC _{i,09}			0.013 (0.011)			0.197 ** (0.083)
U_MNF _{i,09}			0.006 (0.010)			0.054 (0.071)
U_SVC _{i,09}			0.043 *** (0.007)			0.312 *** (0.050)
U_MNF _{i,09} × U_SVC _{i,09}			0.070 *** (0.013)			0.574 *** (0.098)
R_MNF _{i,09}			0.054 *** (0.009)			0.396 *** (0.066)
R_SVC _{i,09}			-0.012 * (0.007)			-0.090 (0.055)
R_MNF _{i,09} × R_SVC _{i,09}			-0.075 *** (0.011)			-0.581 *** (0.079)

Table 4. (Continued)

Dependent Variables	TFP Growth			LP Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(L)_{i,09}$	0.003 (0.002)	0.004 (0.002)	0.009 *** (0.002)	0.032 * (0.017)	0.043 ** (0.018)	0.077 *** (0.018)
$\ln(K/L)_{i,09}$	0.016 *** (0.003)	0.015 *** (0.003)	0.012 *** (0.003)	0.253 *** (0.027)	0.223 *** (0.027)	0.236 *** (0.025)
$\ln(\text{Age})_{i,09}$	-0.011 *** (0.003)	-0.008 ** (0.003)	-0.007 ** (0.003)	-0.064 *** (0.024)	-0.042 * (0.024)	-0.031 (0.023)
$\ln(\text{R\&D})_{i,09}$	0.002 (0.001)	0.001 (0.001)	0.002 * (0.001)	0.014 (0.009)	0.005 (0.009)	0.016 ** (0.008)
$\ln(\text{TFP})_{i,09}$	-0.679 *** (0.036)	-0.652 *** (0.036)	-0.732 *** (0.035)			
$\ln(\text{LP})_{i,09}$				-0.596 *** (0.037)	-0.565 *** (0.037)	-0.654 *** (0.036)
Constant	1.226 *** (0.070)	1.183 *** (0.072)	1.311 *** (0.070)	3.709 *** (0.286)	3.562 *** (0.295)	3.925 *** (0.291)
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes
observation	1,043	1,043	1,043	1,043	1,043	1,043
R ²	0.529	0.555	0.619	0.547	0.584	0.648

Notes: 1. The dependent variable is calculated on the differences from log-translated productivity (i.e. TFP or LP) in 2013 and log-translated productivity in 2009. All explanatory variables are values in 2009. Every regression includes 3-digits industry dummy.

2. Standard errors are presented in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Columns (1) and (3) in Table 4 present our baseline estimation result by using two types of subsidiaries abroad. A firm that had one or more vertically integrated manufacturing subsidiaries abroad increased its TFP by 2.3 percent and its labor productivity by 13.4 percent compared with those that did not have such subsidiaries. On the contrary, a firm that had one or more vertically integrated service subsidiaries in other countries decreased its labor productivity by 13.0 percent compared to those that did not have such subsidiaries. The results of the crossed term indicate that a Two-way trading firm with both types of foreign subsidiaries derives positive effects in labor productivity. From these findings, Hypothesis 3 is partially acceptable. Columns (2) and (4) report the results when foreign regions are separated into Asian and non-Asian regions. The result shows that a firm that had one or more vertically integrated manufacturing subsidiaries in Asia increased its TFP by 2.2 percent and its labor productivity by 12.5 percent compared with those that did not have subsidiaries in the same regions. However, a firm that had one or more vertically integrated service subsidiaries in Asia decreased its TFP by 3.9 percent and its labor productivity by 43 percent compared with those that did not set up subsidiaries for service tasks in Asia. On the contrary, a firm that had one or more vertically integrated manufacturing subsidiaries in non-Asian countries increased its TFP by 2.7 percent and its labor productivity by 20.9 percent compared with those that did not set up subsidiaries in the same regions. Furthermore, a firm that had one or more vertically integrated service subsidiaries in non-Asian countries increased its TFP by 3.1 percent and its labor productivity by 24.1 percent compared to those that did not have subsidiaries for service tasks in non-Asian countries. Finally, the crossed effect is not statistically significant to the location. In summary, a firm that had manufacturing subsidiaries in China had higher productivity growth. Hence, Hypothesis 1 is supported, but Hypothesis 3 is rejected. Columns (3) and (6) show the results of robustness checks that apply

diversified locations. We split Asia into China and other Asian countries, and non-Asian countries into the USA and the ROW. As previously mentioned, the research goal is not simply to examine the foreign subsidiary's effect at the bilateral country level. Instead, our study aims to determine how economically close those countries are with Korea and test Hypothesis 2.

In the case of Asian countries, if a firm established manufacturing subsidiaries in Asian regions other than China, then two types of productivity growth increase and show statistically significant results. However, results are opposite when a firm established service subsidiaries in other Asian regions. Foreign subsidiaries that combined two sectors are ideal to increase the productivity growth of parent firms. These results are observed only in China, not in other Asian regions. This is probably because China is where many Korean firms have invested in manufacturing and service subsidiaries encompassing larger portions of the production process as compared with other Asian countries; likely, combining the two sectors encourages productivity growth. Also, this implies that Hypotheses 2 and 3 hold true. Among non-Asia cases, if a firm set up manufacturing subsidiaries only in the USA, then it does not help to increase the productivity of the domestic parent firm. By contrast, if a firm had service subsidiaries in the USA, then this resulted in increased productivity. The results are the opposite in the Asian cases. However, similar to China, if a firm established a manufacturing subsidiary and an additional service subsidiary, then the domestic parent firm in the manufacturing sector experiences productivity growth. Moreover, comparing the size of the interaction term, the productivity growth due to the establishment of crossed industrial subsidiaries in the USA is larger than the increase in productivity by establishing two types of subsidiaries in China. Since Korean companies have been exporting to and directly investing in the USA for a longer period compared with China, the productivity of firms that have established subsidiaries in the United States have increased.

Finally, this paper examined the effect in the ROW. If a firm had a manufacturing subsidiary in a non-Asian region outside of the USA, then the TFP and labor productivity of the firm increase. However, if a firm had a service subsidiary in the same regions, then there is a slight decrease in TFP growth. One thing not expected in this study is that TFP and labor productivity decreased when a manufacturing subsidiary and a service subsidiary were held simultaneously. Although our model cannot explain the exact cause, Hypothesis 2 is rejected because the region includes Europe, Middle and South America, Oceania and Africa, which are relatively less economically relevant than Asia or the USA. Furthermore, if manufacturing subsidiaries and service subsidiaries are cross-established in this region, the economic loss is greater than the gain due to FDI, which means that Hypothesis 3 is rejected. If a Two-way trading firm establishes subsidiaries in some of the countries in the ROW, then TFP growth (that is able to confirm whether the learning effect from the advanced technology exists) decreases by 7.5 percent. This implies that there is no technology spillover from that region. Additionally, if a Two-way trading firm establishes subsidiaries in the ROW, labor productivity growth (which can represent whether the value-added effect per worker occurs) decreases by 58 percent. Considering that the number of employees in Two-way trading firms had been rising overall between 2009 and 2013, if a firm establishes subsidiaries in the ROW, then the decline in the value-added is bigger than the loss of hiring. The results indicate that having both manufacturing and service subsidiaries simultaneously anywhere, except China or the USA, is not effective in boosting the productivity of a Two-way trading manufacturing firm.

5. Conclusion

This research examines the effect of a foreign subsidiary on the productivity growth of a Two-way trading manufacturing firm in Korea by utilizing the Survey of Business Activities

from Statistics Korea. We explore firms engaged in both trade and FDI simultaneously to verify whether participation in GVC as a broad concept is an efficient internationalization strategy to increase the productivity of a Korean manufacturing firm. Vertical integration is defined by adopting the I-O structure of domestic parent firms' and foreign subsidiaries' information to reflect industrial proximity. Also, subsample regressions consider regional features. In the distribution of subsidiaries, Korean firms directly invest mainly in Asia, with most subsidiaries established in China as manufacturing subsidiaries in 2009. Meanwhile, service offshoring, which is just as crucial as manufacturing offshoring in GVC, spread more to non-Asian regions, especially the USA, than to Asian regions.

To summarize the results based on our hypotheses, we arrived at three conclusions related to the performance of Korean firms participating in GVCs. First, the productivity growth of a firm that has one or more subsidiaries abroad is higher than firms that do not have any foreign subsidiaries. Second, the FDI effect from a parent firm toward subsidiaries in a foreign country is statistically significant when the two countries have an economically close relationship, even if they are geographically apart. Third, the effect of having foreign subsidiaries on the productivity of Two-way trading firms is dissimilar depending on industrial competitiveness or the market situation because the overseas expansion target is different by sector. Nonetheless, there are two obvious points. The FDI of a domestic manufacturing firm is effective when its subsidiaries operate in a non-Asian service sector, and the synergy effect coming from industrial combination is displayed exceptionally in China and the USA.

Policy implications of this paper are as follows. It is related to the need to be cautious in selecting and concentrating when the firms decide on FDI. There is a comparative advantage that exists between countries and industries, as we already know. For example, we can expect that if the firm set a subsidiary to strengthen service in Asia, then there will be a negative effect. Similarly, government assistance to offer foreign investment information may affect a firm's GVC participation and future plans. Thus, it helps to suggest proper directions for policymakers and strategists of firms.

There is abundant literature analyzing the effects of trade or FDI from Korea, but only a few have studied globalization activities from the perspective of GVCs. In spite of the scarcity of related domestic studies, we explored the effect of multinational manufacturing firms participating in GVC using firm-level data. The limitations of this study are as follows. In the survey, we did not find accurate questions about the existence of added production processes in Korea or answers about the exact amount of investment from a domestic firm to overseas subsidiaries. Thus, it was unable to work with sufficient information and some parts of the results were left ambiguous. Due to the absence of such data, it is hard to fix the problem instantly. This affects the result of the short-term effects of FDI made by Two-way trading manufacturing firms when applying productivity growth for four years from 2009 to 2013. Some parts of the results are statistically insignificant for this reason, such as, the investment effect toward other Asian countries. In future research, the periods covered to examine the long-term effect of GVC participation on productivity growth will be expanded.

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