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Sustaining Innovation through Joining Global Supply Chain Networks: The Case of Manufacturing Firms in Thailand

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Abstract: Joining global supply chain networks helps firms to enhance innovation performance as firms need to satisfy various standard requirements from overseas customers. From the global value chain theory, there is no evidence on what types of supply chain ownership structures help firms to achieve more innovation. This deficiency led us to investigate types of supply chain ownership structures, i.e., Pure Domestic Chain, Pure Joint Venture (JV) Chain, Pure Multinational Corporation (MNC) Chain, Export Chain, and Import Chain, that can help firms to achieve more innovation. One-way ANOVA is used to analyze 856 responses collected from the Thai manufacturing industry during 2012–2017. The results indicate that firms in the Pure MNC Chain have the highest levels of product and process innovation. There is less innovation for the Pure JV Chain, Export Chain, Import Chain, and Pure Domestic Chain, in decreasing order. This means that firms in global supply chain networks tend to have better innovation performance than firms in local supply chain networks. The innovation capabilities of local firms can be enhanced through knowledge transfer and knowledge co-creation by joining global supply chain networks.

Keywords: process innovation; product innovation; supply chain ownership structures; pure domestic chain; pure joint venture chain; pure multinational corporation chain; export chain; import chain

1. Introduction

Innovation is the key driver for the survival and growth of firms in emerging and developed countries [1], where sources of knowledge for innovation development can be acquired through internal interaction within a firm and external collaboration with supply chain partners [2]. The former refers to internal efforts in which firms utilize existing resources for innovation development. However, ignoring external exploration of outside knowledge may cause firms to fall behind their competitors because knowledge also resides outside the organization, and firms can access pools of knowledge when they collaborate with partners in the supply chain networks—cooperation and collaboration of a firm with suppliers and customers across extensive enterprises [3]. Thus, firms can achieve and create new knowledge for innovation development if they actively collaborate with partners in the supply chain networks [3,4].

From the global value chain perspective, knowledge is transferred back and forth among partners in the supply chain networks, where expatriates are agents of knowledge transfer from the headquarters to overseas affiliates, and they are also the agents of learning to enhance knowledge of the headquarters [5]. Similarly, alliances between Multinational Corporation (MNC) firms and

domestic firms lead to new knowledge creation, where domestic firms actively contribute through learning, coordinating, and utilizing the knowledge of MNC firms, and these activities support the MNC firms in new knowledge creation, knowledge integration, and knowledge dissemination [6].

Even though there is extensive study on the significance of technology and knowledge transfer from MNC firms to improve local firms' capabilities, there is a lack of evidence to define types of supply chain ownership structures that help firms to achieve more innovation. This deficiency allowed us to investigate the types of supply chain ownership structures, i.e., Pure Domestic Chain, Pure Joint Venture (JV) Chain, Pure Multinational Corporation (MNC) Chain, Export Chain, and Import Chain, that can help firms to achieve more product and process innovation. This paper contributes to the global value chain theory by identifying the types of supply chain ownership structures that can help firms to achieve more product and process innovation. The remainder of this research paper is organized as follows. Section 2 briefly summarizes the literature review. The research methodology is described in Section 3. Section 4 presents the results and discussions. Then, the conclusions and further studies are discussed in Section 5.

2. Literature Review

Sources of knowledge for innovation development can be acquired through internal efforts within the firms, e.g., cross-functional teams, quality control circles, in-house training, R&D personnel development, and external efforts by collaborating with external partners, e.g., customers, suppliers, research centers, government agencies, and universities [2]. Firms can achieve a higher level of innovation when they adopt both simultaneously because knowledge is not only created inside the firms through internal efforts but through knowledge transferred from and knowledge co-creation with partners in the supply chain networks [7]. The absorptive capacity of the local firms is the main moderator for knowledge transfer from and knowledge co-creation with foreign firms [8]. Being poor in absorptive capacity may cause firms to be unsuccessful in transferring and co-creating new knowledge [9]. Thus, knowledge resides among partners in the supply chain networks, but which networks of supply chains bring firms more product and process innovation?

2.1. Firm Innovation

Innovation has been extensively studied, where it consists of product, process, marketing, and organizational innovation [10–12]. Innovation is defined as changes in the products and/or services of a firm [1]. The Organization for Economic Co-operation and Development [10] redefined innovation as creating new or significantly improving products, processes, marketing, or organizational methods in business practices. Thus, innovation is a continuous process of exploring new ideas from existing or new knowledge so that these new ideas can improve the firms' proficiency. Mangematin and Mandran [13] and Yunus [4] classified innovation as incremental and radical innovation. The former is the process of improving products and/or processes, including innovation in packaging, whereas the latter is the achievement of technological breakthroughs in products and/or processes [13].

Product innovation and process innovation are the main focuses of this study because these two types of innovation are adopted by firms mainly at the early stages of their business operations [14]. Product innovation is defined as a process of improving the quality of existing products and/or creating new products, whereas process innovation is defined as cost reduction in producing existing products and/or new products [15,16]. Firms that adopt product innovation tend to adopt process innovation, and vice versa [10]. Even Petsas and Giannikos [17] stated that firms generally try to adopt product innovation first, before switching to process innovation; these two types of innovation tend to complement one another. Firms can earn more profits and have better performance when they simultaneously adopt the product and process innovations [16,18,19].

Product and process innovations can be achieved not only through internal efforts but also through external collaboration with supply chain partners. Among external partners, customers and suppliers are considered as the downstream and upstream partners, where most firms collaborate to upgrade

their innovation capabilities. Firms mostly need to work with customers because they need to satisfy various standard requirements, e.g., quality controls, lean manufacturing, product design, international standards, and good manufacturing practices. To fulfill customer requirements, firms need to closely work with suppliers so that they can acquire knowledge and skills in machine operation, process design, and plant operation.

The benefits of joining supply chain networks can be found in the case of Toyota, where this company established a Toyota network to allow its suppliers to extend their dynamic learning capability beyond the firms' boundaries [20]. After operating this network, Toyota found that its suppliers, including local firms, could learn faster and achieve more innovation. Thus, Toyota's network created space for knowledge sharing among suppliers and helped them to improve innovation performance [21]. The greater the diversity of cooperation networks, the higher the benefits of innovation development [22]. In other words, global supply chain integration helps firms to acquire new knowledge for innovation in their products and processes [23].

2.2. Global Value Chain and Innovation Development

During the age of globalization, firms need to understand the global value chain (GVC)—a phenomenon in which firm production is expanded globally through outsourcing and offshoring to other countries—because it provides firms with various benefits, e.g., allows firms to access global markets, allows firms to access low labor costs during business operation, enables firms to free up their internal resources to focus on business core values, and enables firms to access knowledge and resources from supply chain partners. In addition, joining the GVC also pushes firms to have diverse thinking on interactivity, partnerships, business operation, and governance, which are likely to upgrade or downgrade the growth of a firm [24,25]. Thus, the GVC helps in knowledge transfer from and knowledge co-creation with partners in the supply chain networks [7]. With the active support of leading firms (customers), the local firms (suppliers) tend to upgrade their governance and innovation capability [26].

There are two main holistic approaches in the GVC, i.e., the governance approach and the upgrading approach [27]. The governance approach is defined as the top-down process by which leading firms integrate economic activities geographically and organizationally. The governance approach also refers to the process by which particular players in the chain exert control over other participants and to how these leading firms (chain drivers) distribute knowledge and values to local firms [28]. However, an upgrading approach is defined as the bottom-up process that is adopted by local firms to improve their business positions in the global economy [25]. The upgrading approach also refers to knowledge dynamics, which is transferred from leading firms to upgrade the local firms' innovation capabilities [29]. Hence, the governance and upgrading approaches of GVC identify how knowledge flows for innovation development among partners in the supply chain networks [30].

2.3. Cluster Theory and Innovation Development

The external sources of knowledge are also found in the clustering theory, where an industrial cluster is defined by Porter [31] as "a geographically proximate group of firms and associated institutions in related industries, linked by economic and social interdependencies." The industry cluster linkages provide firms with opportunities to access external sources of knowledge to improve their innovation capabilities, e.g., producing value-added products and improving production processes [32]. Cluster linkage, governmental regulations, and high commitment from the top executive can also help firms to achieve green manufacturing [33]. The higher the absorptive capacity of a firm, the stronger and denser will be the cluster linkages, and this leads to the possibility of innovation development [34]. Local firms, especially small and medium-sized enterprise (SMEs), have limited financial resources, low technological capabilities, insufficient infrastructure, and a low level of managerial skills [35]. To handle these obstacles, firms need to join linkages with other supply chain partners, e.g., other firms,

customers, and suppliers in the cluster, because cluster linkages help firms to achieve, align, and mobilize resources effectively and efficiently for innovation development [36].

2.4. Supply Chain Ownership Structures and Innovation Development

Supply chain ownership structures are ownership structures in whole supply chain networks. The ownership structure is defined as the distribution of equity concerning votes and capital [37]. Bragoli, Cortelezzi, and Marseguerra [38] and Boeing, Mueller, and Sandner [39] defined two groups of ownership structures: Privately Owned Enterprises (POEs) and State-Owned Enterprises (SOEs). In this paper, only the ownership structures in the POE group are considered, and they consist of 100% locally owned (Domestic), Joint Venture (JV), and 100% foreign-owned (MNC). Meanwhile, the supply chain network is defined as a collaboration of firms with upstream (suppliers) and downstream (customers) partners across extensive enterprises [3]. Thus, the firm's main customer, the firm itself, and the firm's main supplier are regarded as the three partners in the supply chain network, where each partner in the supply chain network possesses only one type of ownership structure.

Across ownership structures and supply chain networks, five types of supply chain ownership structures are defined, i.e., Pure Domestic Chain (Domestic, Domestic, Domestic), Pure JV Chain (JV, JV, JV), Pure MNC Chain (MNC, MNC, MNC), Export Chain (Domestic/JV/MNC, Domestic/JV/MNC, JV/MNC), and Import Chain (Domestic/JV/MNC, Domestic/JV/MNC, Domestic). The Pure Domestic Chain means that the ownership structures of the supply chain partners, i.e., customer, firm, and supplier, are all Domestic firms. This is the same for the case of the Pure JV Chain and Pure MNC Chain, where the customer, firm, and supplier of these two chains are JV and MNC, respectively. The Export Chain refers to one type of supply chain ownership structure where the ownership structure of the customer is either a JV firm or an MNC firm, and ownership of firm and supplier can be any type. Two cases need to be excluded from the Export Chain because the Export Chain (JV, JV, JV) and Export Chain (MNC, MNC, MNC) are already categorized as the Pure JV Chain (JV, JV, JV) and Pure MNC Chain (MNC, MNC, MNC), respectively. The Import Chain, similarly, refers to one type of supply chain ownership structure, where the ownership structure of the customer is a domestic firm, and the ownership structures of the firm and supplier can be any type. There is one case that needs to be excluded from the Import Chain because the Import Chain (Domestic, Domestic, Domestic) is already categorized as the Pure Domestic Chain (Domestic, Domestic, Domestic).

From our interview, domestic firms generally do not have policies or plans to expand their production outside the country, so they generally have no plan to join the global supply chain for innovation development. Their innovation mostly occurs through internationalization and technology education from customers and suppliers [40]. If the local firms have international suppliers, they tend to send their engineers to learn how to operate and maintain machines, and if the local firms have international customers, the country of destination requires the local firms to adopt higher standards. Hence, internationalization helps the local firms in the supply chain networks to enhance innovation performance [41], where internationalization relies highly on firms' internal capabilities [42] and the types of their ownership structures [43]. Firms that are 100% foreign-owned (MNC firms) tend to have higher internationalized capabilities, compared with 100% locally owned firms (Domestic firms) [44]. Thus, internationalization helps in knowledge creation and knowledge transfer among partners in the supply chain networks.

To benefit from internationalization, firms need to improve their absorptive capacity and build trust with partners in the supply chain networks [45]. The greater the absorptive capacity, the higher the knowledge transfer among partners in the supply chain networks [46]. The knowledge transfer from foreign firms does not equally spill over into local firms [47]. Firms may not achieve adequate benefits if their internationalization with supply chain partners is below a threshold level [41]. Customers are likely to be important for knowledge transfer in product innovation, whereas suppliers are likely to be important for knowledge transfer in process innovation [48]. From the literature review, researchers have mainly studied knowledge transfer and knowledge spillover among partners in the supply

chain networks for innovation development, e.g., from leading firms to local firms [8,49,50]. However, there is no precise empirical evidence to show types of supply chain ownership structures that bring firms more innovation. Thus, this study investigates innovation development among different types of supply chain ownership structures.

H1: *There is a significant difference in product innovation among firms with different supply chain ownership structures.*

H2: *There is a significant difference in process innovation among firms with different supply chain ownership structures.*

3. Methodology

3.1. Sample and Data Collection

This research was conducted based on our data, which was collected annually during 2012–2017. For each year, we took both a qualitative and a quantitative approach [51]. First, we did an extensive literature review on the topic. Then an outline for a questionnaire was designed for an in-depth interview with experts in the field, such as top management or staff who had enough knowledge of their firms [52]. After getting concepts from case studies, we designed a questionnaire for data collection. This designed questionnaire was commented on and evaluated by three academic professors. These processes helped us to design a reliable and validated questionnaire before data collection [53].

The designed questionnaires consisted of Part 1: a profile of the establishment and its supply chain networks, and Part 2: its achievement in upgrading product and process innovation. The designed questionnaires were distributed (in the Thai manufacturing industry) to managers, CEOs, directors, senior managers, or line group managers. Each respondent might have had different groups of suppliers and customers, but the designed questionnaire asked them to highlight only the ownership structures of the main customer and the main supplier, which were assumed to have a major influence on the focal firm.

We targeted the innovation development in the manufacturing firms in Thailand because the Thai government has reallocated human and capital resources from agriculture to the manufacturing and service industries. Also, the agricultural and service industries' share of the total Gross Domestic Product (GDP) has declined, while the manufacturing industry share has increased [54]. Thus, understanding the best practices for innovation development in the manufacturing industry is critical for Thai economic development.

A list of manufacturing firms was selected from the Department of Industrial Works database, Ministry of Industry, Thailand. Then we collected data from these firms through email, post office, and walk-in interviews. The total return rate was 1308 responses. These data were used for our empirical analysis, to investigate innovation within different supply chain ownership structures.

3.2. Data Cleaning

There were three steps for data cleaning [55]. First, we defined the types of supply chain ownership structures by investigating the ownership structures of a supplier, firm, and customer. If a respondent did not answer the questions about the ownership structures of his/her supplier, customer, or firm, this respondent was excluded from our analysis. This exclusion occurred because we could not classify which types of supply chain ownership structures that the firm possessed. Of 1308 questionnaires, there were 158 invalid questionnaires. Second, we calculated the standard deviations of product innovation and process innovation separately. If the standard deviations of the product and process innovations were both zero, the respondent was also excluded from our analysis. These respondents did not pay enough attention to answer our questionnaires. They merely selected the same number in response to each question. From this step, there were 94 invalid questionnaires. Third, we excluded

200 invalid respondents who had missing values for more than 20% of the total responses. From these three steps, 856 questionnaires were included in our empirical analysis.

3.3. Measurement Scale

The ownership structure (Domestic, JV, or MNC) of each partner in the supply chain network (supplier, firm, and customer) was extracted from Part 1: Profile of the establishment and its supply chain networks. Each partner in the supply chain network could possess only one type of ownership structure among the three types. For example, if a firm was Domestic, the firm could not be a JV or an MNC. This also applied to the ownership structures of the main supplier and the main customer of the firm.

The supply chain ownership structure was an independent variable in this study. From the ownership structures of each partner in the supply chain network, there were five types of supply chain ownership structures (Supplier, Firm, Customer) that were classified in this research. They were the Pure Domestic Chain (Domestic, Domestic, Domestic), Pure JV Chain (JV, JV, JV), Pure MNC Chain (MNC, MNC, MNC), Export Chain (Domestic/JV/MNC, Domestic/JV/MNC, JV/MNC), and Import Chain (Domestic/JV/MNC, Domestic/JV/MNC, Domestic). The Pure Domestic Chain meant that the customer, firm, and supplier were all Domestic. For the Export Chain where the customer was JV or MNC, the firm could be Domestic, JV, or MNC, and the supplier could be Domestic, JV, or MNC.

Two cases were excluded from the Export Chain because the Export Chain (JV, JV, JV) and Export Chain (MNC, MNC, MNC) were already categorized as the Pure JV Chain (JV, JV, JV) and Pure MNC Chain (MNC, MNC, MNC), respectively. There was also one case that needed to be excluded from the Import Chain because the Import Chain (Domestic, Domestic, Domestic) was already categorized as the Pure Domestic Chain (Domestic, Domestic, Domestic). The details of the supply chain ownership structures are illustrated in Table 1.

Table 1. The five types of supply chain ownership structures.

The Ownership Structure of Each Supply Chain Partner			Five Types of Supply Chain Ownership Structure
Supplier [c]	**Firm[c] (Respondent)**	**Customer [c]**	
Domestic	Domestic	Domestic	Pure Domestic Chain
JV	JV	JV	Pure JV Chain
MNC	MNC	MNC	Pure MNC Chain
Domestic/JV/MNC [d]	Domestic/JV/MNC [d]	JV/MNC [d]	Export Chain [a]
Domestic/JV/MNC [d]	Domestic/JV/MNC [d]	Domestic	Import Chain [b]

[a] Pure MNC Chain and Pure JV Chain were excluded from the Export Chain. [b] Pure Domestic Chain was excluded from the Import Chain. [c] Each supply chain partner possessed one type of ownership structure (Domestic, JV, or MNC). [d] Domestic/JV/MNC meant that the firm could be Domestic, JV, or MNC.

The dependent variables consisted of product and process innovation. Tsuji et al. [56], Tsuji, Minetaki, and Akematsu [57], Ogawa et al. [58], Tsuji et al. [59], and Ueki and Tsuji [60] categorized product innovation as (1) redesigning packaging or significantly changing the appearance design, (2) significantly improving current products, (3) creating a new product based on existing technologies, and (4) creating a new product based on new technologies. Similarly, this study defined product innovation as (1) introducing a new product by redesigning the packaging of an existing product; (2) introducing a new product by significantly improving an existing product; (3) developing a new product based on the existing technologies; and (4) developing a new product based on new technologies. These four types of product innovation were considered because they ranged in order based on their complexity. A 3-point Likert scale was used to measure each type of product innovation, where 0 = Not tried yet, 1 = Tried, 2 = Achieved.

Unlike with product innovation, firms generally adopt an incremental process innovation. Firms mainly improve process innovation by saving costs, reducing labor input, upgrading product quality, upgrading from subcontracting to own manufacturing, reducing defective products, reducing delivery delays, and reducing variation in product quality [61]. In this study, process innovation

was categorized as (1) reducing defects during a manufacturing process, (2) reducing labor input (person-hours), (3) reducing unscheduled line stops, (4) reducing workers' injuries, (5) reducing plant accidents, (6) reducing delivery delays, (7) reducing dispersion in product quality, and (8) reducing time for a changeover of a production line. A 4-point Likert scale was used to measure each type of process innovation, where 0 = No, 1 = Little, 2 = Somewhat, 3 = Much.

The significance level in this empirical analysis was denoted by the number of asterisks (*), where (*), (**), and (***) stand for a 95%, 99%, and 99.9% Confidence Interval (CI), respectively. The supply chain ownership structure was used as an independent variable in this study.

4. Results and Discussions

4.1. Data Description

The descriptive statistics of the respondents are presented as follows. First, we saw that 81.4% of the respondents were Domestic firms. The JV firms and MNC firms accounted for 10.5% and 8.1%, respectively. Most firms produced their products to be sold to Domestic customers, 75.4%. The firms sold only 12.9% to MNC customers and 11.8% to JV customers. In terms of a firm's suppliers, 71.5% of the respondents had Domestic suppliers, 16.2% of the respondents had JV suppliers, and 12.3% of the respondents had MNC suppliers. The details of the ownership structures of respondent firms, customers, and suppliers are shown in Table 2.

Table 2. Ownership structures of respondent firms, customers, and suppliers.

Sections	Description of Each Section	Freq.	Percent
The ownership structure of Respondent Firms	100% locally owned (Domestic)	697	81.4%
	100% foreign-owned (MNC)	69	8.1%
	Joint Venture (JV)	90	10.5%
	Total	856	100.0%
The ownership structure of Customers	100% locally owned (Domestic)	645	75.4%
	100% foreign-owned (MNC)	110	12.9%
	Joint Venture (JV)	101	11.8%
	Total	856	100.0%
The ownership structure of Suppliers	100% locally owned (Domestic)	612	71.5%
	100% foreign-owned (MNC)	105	12.3%
	Joint Venture (JV)	139	16.2%
	Total	856	100.0%

Second, we categorized firms in accordance with their sizes and supply chain ownership structures, as shown in Table 3. From this table, there were 43.9% small firms included in our study. The medium and large firms accounted for 24.5% and 31.5%, respectively. The Pure Domestic Chain accounted for 59.6%. This percentage was followed by the Export Chain (18.8%), Import Chain (15.8%), Pure JV Chain (3.2%), and Pure MNC Chain (2.7%). The percentage of respondents in each chain was different, but this portion represented the population of manufacturing firms in Thailand. These respondents were adequate for one-way ANOVA analysis because the data had a normal distribution [62]. Mcarthur [63] mentioned that "inequality of sample sizes in one-way ANOVA is not an issue. If data is normally distributed and each group is independent, one-way ANOVA analysis would be entirely suitable." From the ANOVA analysis, we also conducted post hoc analysis using Fisher's Least Significant Difference (LSD). This is the default method of the SPSS, and it was used to compare the mean for each group of supply chain ownership structures. There was a small percentage of Pure JV Chain and Pure MNC Chain in this study, and they were mostly large firms, which accounted for 88.9% and 78.3%, respectively. In contrast, for the Pure Domestic Chain, the large firms accounted for 18.2%. This means that the larger the firm, the higher the possibility of joining a global supply chain network.

Third, the frequency, mean, and standard deviation of each type of product and process innovation are presented in Table 4. For product innovation, the mean of developing a new product based on new technologies (0.662) was lower than the other three types of product innovation. This showed that the respondents mainly adopted the first three types of product innovation because these were less complicated in that they did not need complex levels of technology usage. According to respondents, firms mainly focused on reducing workers' injuries (1.680), reducing plant accidents (1.697), and reducing delivery delays (1.771) for process innovation.

Table 3. Size of respondent firms in each supply chain ownership structure.

Five Types of Supply Chain Ownership Structures	Sizes of Respondent Firms (Number of Employees)						Each Type of Chain	
	Small (01–49)		Medium (50–199)		Large (200-Up)			
	Freq	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Pure Domestic Chain	274	53.7%	143	28.0%	93	18.2%	510	59.6%
Pure JV Chain	1	3.7%	2	7.4%	24	88.9%	27	3.2%
Pure MNC Chain	3	13.0%	2	8.7%	18	78.3%	23	2.7%
Export Chain	44	27.3%	42	26.1%	75	46.6%	161	18.8%
Import Chain	54	40.0%	21	15.6%	60	44.4%	135	15.8%
Total	376	43.9%	210	24.5%	270	31.5%	856	100.0%

Table 4. Types of product and process innovation (DV).

Types of Product and Process Innovation		Freq.	Mean	Std. Dev.
Product Innovation	Introducing a new product by redesigning packaging of an existing product	753	0.888	0.859
	Introducing a new product by significantly improving an existing product	747	0.858	0.844
	Developing a new product based on the existing technologies	750	0.851	0.826
	Developing a new product based on new technologies	749	0.662	0.794
Process Innovation	Reducing defects during a manufacturing process	853	1.543	0.931
	Reducing labor input (person-hours)	855	1.193	0.981
	Reducing unscheduled line stops	854	1.308	0.965
	Reducing workers' injuries	855	1.680	1.045
	Reducing plant accidents	855	1.697	1.063
	Reducing delivery delays	855	1.771	0.983
	Reducing dispersion in product quality	854	1.527	0.994
	Reducing time for a changeover of a production line	794	1.374	1.008

4.2. Product Innovation (H1)

The product innovation consisted of four types: (1) introducing a new product by redesigning the packaging of an existing product; (2) introducing a new product by significantly improving an existing product; (3) developing a new product based on the existing technologies; and (4) developing a new product based on new technologies. Our empirical results provided substantial evidence that there was a significant difference in product innovation among the supply chain ownership structures, as illustrated in Table 5.

From post hoc, as shown in Table 6, the Pure Domestic Chain had the lowest level of product innovation in (1) introducing a new product by redesigning the packaging of an existing product; and (2) introducing a new product by significantly improving an existing product. In contrast, firms in the Pure MNC Chain, Pure JV Chain, and Export Chain showed a higher level of product innovation in (3) developing a new product based on the existing technologies, and (4) developing a new product based on new technologies.

The results showed that firms that joined global supply chain networks (Pure JV Chain, Pure MNC Chain, Export Chain, and Import Chain) had higher levels of product innovation than firms in the completely local supply chain network (Pure Domestic Chain). This may be due to the firms in the local supply chain networks being mostly small firms, as presented in Table 3. They were usually family businesses with a limited commercial focus, limited human and capital resources, low absorptive capacity, and a less systematic management structure for knowledge creation [35,64]. They mainly utilized only existing local knowledge. Most knowledge might have been inherited from a parent company. Local firms can improve their product innovation by extending their networks from local to global supply chain networks. This means that knowledge can be transferred from foreign customers and/or foreign suppliers to improve local firms' capabilities [46]. This finding was also consistent with Giuliani, Pietrobelli, and Rabellotti [65], where learning and interacting with leading firms helped to stimulate and upgrade firm innovation, which was better than interaction with firms in the same functional position (horizontal cluster), the same framework of business system, or the same national systems. This is because knowledge for product innovation is co-created between a local firm and its partners in the global supply chain networks [9,66]. The global supply chain networks help firms to achieve, align, and mobilize resources effectively and efficiently for innovation development [36]. Firms with diverse supply chain cooperation, especially small firms, benefit more in product innovation [22].

The ability to innovate regarding a new product based on existing/new technology is acquired through knowledge transfer by joining global supply chain networks or collaborating with foreign customers (Pure JV Chain, Pure MNC Chain, and Export Chain) because these two types of product innovation require firms to have higher capabilities. Firms that have foreign customers perform better than firms that have only domestic customers (Pure Domestic Chain and Import Chain). This is because foreign customers have various standard requirements. To match these requirements, firms might need to collaborate and work closely on knowledge acquisition, knowledge transfer, and knowledge creation. From our direct interviews with the local Thai manufacturing firms, we found that local firms depended highly on knowledge from their foreign customers for product quality and standard improvements. Because of differences in standards between foreign customers and local firms, collaboration among supply chain partners was necessary. As a result, new knowledge was transferred from foreign customers to the local firms through collaboration [67].

Table 5. Effects of different supply chain ownership structures on product innovation.

Product Innovation		Sum of Squares	df	Mean Square	F	Sig.
Introducing a new product by redesigning packaging of an existing product	Between Groups	16.0	4	4.0	5.6	0.000 ***
	Within Groups	538.6	748	0.7		
	Total	554.6	752			
Introducing a new product by significantly improving an existing product	Between Groups	11.2	4	2.8	4.0	0.003 **
	Within Groups	519.8	742	0.7		
	Total	531.0	746			
Developing a new product based on the existing technologies	Between Groups	21.2	4	5.3	8.1	0.000 ***
	Within Groups	490.1	745	0.7		
	Total	511.3	749			
Developing a new product based on new technologies	Between Groups	14.9	4	3.7	6.0	0.000 ***
	Within Groups	456.7	744	0.6		
	Total	471.5	748			

Note: ** $p \leq 0.01$; *** $p \leq 0.001$.

Table 6. Effects of supply chain ownership structures on product innovation (Post hoc).

Product Innovation	I	J	I-J	Std. Error	Sig.	95% CI	
						LB	UB
Introducing a new product by redesigning packaging of an existing product	Pure JV Chain	Pure Domestic Chain	0.508	0.178	0.004 **	0.16	0.86
	Pure MNC Chain	Pure Domestic Chain	0.567	0.194	0.004 **	0.19	0.95
	Export Chain	Pure Domestic Chain	0.224	0.081	0.006 **	0.06	0.38
	Import Chain	Pure Domestic Chain	0.192	0.087	0.027 *	0.02	0.36
Introducing a new product by significantly improving an existing product	Pure JV Chain	Pure Domestic Chain	0.433	0.175	0.014 *	0.09	0.78
	Pure MNC Chain	Pure Domestic Chain	0.475	0.191	0.013 *	0.10	0.85
	Export Chain	Pure Domestic Chain	0.204	0.081	0.012 *	0.05	0.36
Developing a new product based on the existing technologies	Pure JV Chain	Pure Domestic Chain	0.561	0.170	0.001 ***	0.23	0.89
		Import Chain	0.406	0.181	0.025 *	0.05	0.76
	Pure MNC Chain	Pure Domestic Chain	0.569	0.185	0.002 **	0.21	0.93
		Import Chain	0.415	0.196	0.034 *	0.03	0.80
	Export Chain	Pure Domestic Chain	0.326	0.078	0.000 ***	0.17	0.48
Developing a new product based on new technologies	Pure JV Chain	Pure Domestic Chain	0.514	0.164	0.002 **	0.19	0.84
		Import Chain	0.378	0.175	0.031 *	0.03	0.72
	Pure MNC Chain	Pure Domestic Chain	0.581	0.179	0.001 ***	0.23	0.93
		Export Chain	0.375	0.187	0.045 *	0.01	0.74
		Import Chain	0.445	0.189	0.019 *	0.07	0.82
	Export Chain	Pure Domestic Chain	0.205	0.076	0.007 **	0.06	0.35

Note: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

Judging by the mean differences (I-J) in each type, firms in a Pure MNC Chain tended to have the highest product innovation. This was followed by firms in the Pure JV Chain, Export Chain, Import Chain, and Pure Domestic Chain, in descending order. This showed that firms that were in global supply chain networks (Pure MNC Chain and Pure JV Chain) tended to have a higher level of product innovation. One of the reasons was that firms in the Pure MNC Chain and Pure JV Chain were mostly large firms with higher capabilities in engineering for product innovation. They may have effectively adopted knowledge management practices to enhance competitiveness and organizational performance [68]. The local firms in the Pure Domestic Chain and Import Chain tended to have lower capabilities for product innovation. They should participate in global supply chain networks so that they can acquire new knowledge to improve their products. These findings are consistent with Buckley, Clegg, and Wang [69], where an increase of foreign investors positively improved the innovation performance of local firms in China. The inward MNCs, regardless of their original country, improved the export performance for foreign firms and local firms, especially in a labor-intensive industry [70]. Thus, it is critical to create a competitive environment for foreign firms and to strengthen local firms' capabilities to absorb knowledge spillover from MNCs more efficiently and effectively [71].

4.3. Process Innovation (H2)

Process innovation consisted of eight types: (1) reducing defects during a manufacturing process, (2) reducing labor input (person-hours), (3) reducing unscheduled line stops, (4) reducing workers' injuries, (5) reducing plant accidents, (6) reducing delivery delays, (7) reducing dispersion in product quality, and (8) reducing time for a changeover of a production line. From our empirical analysis, there was a significant difference in process innovation among the supply chain ownership structures, as shown in Table 7.

Table 7. Effects of different supply chain ownership structures on process innovation.

Process Innovation	Sum of Squares	df	Mean Square	F	Sig.
Reducing defects during a manufacturing process	Between Groups	15.3	4	3.8	4.5	0.001 ***
	Within Groups	722.4	848	0.9		
	Total	737.7	852			
Reducing labor input (person-hours)	Between Groups	10.5	4	2.6	2.8	0.027 *
	Within Groups	810.6	850	1.0		
	Total	821.2	854			
Reducing unscheduled line stops	Between Groups	13.0	4	3.2	3.5	0.007 **
	Within Groups	781.0	849	0.9		
	Total	794.0	853			
Reducing workers' injuries	Between Groups	29.7	4	7.4	7.0	0.000 ***
	Within Groups	902.4	850	1.1		
	Total	932.2	854			
Reducing plant accidents	Between Groups	39.0	4	9.7	9.0	0.000 ***
	Within Groups	925.6	850	1.1		
	Total	964.5	854			
Reducing delivery delays	Between Groups	26.9	4	6.7	7.2	0.000 ***
	Within Groups	798.1	850	0.9		
	Total	825.1	854			
Reducing dispersion in product quality	Between Groups	25.2	4	6.3	6.5	0.000 ***
	Within Groups	817.7	849	1.0		
	Total	842.9	853			
Reducing time for a changeover of a production line	Between Groups	20.5	4	5.1	5.2	0.000 ***
	Within Groups	785.4	789	1.0		
	Total	805.9	793			

Note: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

From Table 8, firms in the Pure MNC Chain and Export Chain had better process innovation (post hoc) than firms in the Pure Domestic Chain and Import Chain in each type of process innovation. Firms in the Pure MNC Chain and Export Chain were also better than firms in the Pure JV Chain in (5) reducing plant accidents and (6) reducing delivery delays. Firms in the Pure MNC Chain, moreover, were better than firms in the Export Chain in (3) reducing unscheduled line stops and (5) reducing plant accidents.

Table 8. Effects of supply chain ownership structures on process innovation (Post hoc).

Process Innovation	I	J	I-J	Std. Error	Sig.	95% CI	
						LB	UB
Reducing defects during a manufacturing process	Pure MNC Chain	Pure Domestic Chain	0.474	0.197	0.016 *	0.09	0.86
		Import Chain	0.532	0.209	0.011 *	0.12	0.94
	Export Chain	Pure Domestic Chain	0.275	0.083	0.001 ***	0.11	0.44
		Import Chain	0.334	0.108	0.002 **	0.12	0.55
Reducing labor input (person-hours)	Export Chain	Pure Domestic Chain	0.276	0.088	0.002 **	0.10	0.45
		Import Chain	0.262	0.114	0.022 *	0.04	0.49
Reducing unscheduled line stops	Pure MNC Chain	Pure Domestic Chain	0.638	0.204	0.002 **	0.24	1.04
		Export Chain	0.441	0.214	0.039 *	0.02	0.86
		Import Chain	0.531	0.217	0.014 *	0.11	0.96
	Export Chain	Pure Domestic Chain	0.197	0.087	0.023 *	0.03	0.37
Reducing workers' injuries	Pure MNC Chain	Pure Domestic Chain	0.769	0.220	0.000 ***	0.34	1.20
		Import Chain	0.766	0.233	0.001 ***	0.31	1.22
	Export Chain	Pure Domestic Chain	0.372	0.093	0.000 ***	0.19	0.55
		Import Chain	0.368	0.120	0.002 **	0.13	0.60
Reducing plant accidents	Pure MNC Chain	Pure Domestic Chain	0.906	0.222	0.000 ***	0.47	1.34
		Pure JV Chain	0.589	0.296	0.047 *	0.01	1.17
		Export Chain	0.472	0.233	0.043 *	0.02	0.93
		Import Chain	0.851	0.236	0.000 ***	0.39	1.31
	Export Chain	Pure Domestic Chain	0.434	0.094	0.000 ***	0.25	0.62
		Import Chain	0.379	0.122	0.002 **	0.14	0.62
Reducing delivery delays	Pure MNC Chain	Pure Domestic Chain	0.644	0.207	0.002 **	0.24	1.05
		Pure JV Chain	0.675	0.275	0.014 *	0.14	1.21
		Import Chain	0.528	0.219	0.016 *	0.10	0.96
	Export Chain	Pure Domestic Chain	0.401	0.088	0.000 ***	0.23	0.57
		Pure JV Chain	0.432	0.202	0.032 *	0.04	0.83
		Import Chain	0.286	0.113	0.012 *	0.06	0.51
Reducing dispersion in product quality	Pure MNC Chain	Pure Domestic Chain	0.550	0.209	0.009 **	0.14	0.96
	Export Chain	Pure Domestic Chain	0.407	0.089	0.000 ***	0.23	0.58
		Import Chain	0.269	0.115	0.019 *	0.04	0.49
Reducing time for a changeover of a production line	Pure MNC Chain	Pure Domestic Chain	0.648	0.213	0.002 **	0.23	1.07
		Import Chain	0.555	0.227	0.014 *	0.11	1.00
	Export Chain	Pure Domestic Chain	0.319	0.091	0.001 ***	0.14	0.50

Note: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

The results showed that firms had better process innovation when they had foreign customers, as seen in the Pure MNC Chain and Export Chain. This means that knowledge for improving process innovation might be co-created and transferred through collaborating with foreign customers rather than local customers. From our case study, we also found that local firms can improve their process innovation when there are requirements for standardization such as ISO, 5S, and/or Kaizen from their foreign customers [67]. The customers are a key partner for idea initiation. Thus, the firms need to find qualified suppliers to improve their current production systems.

The Pure MNC Chain had the highest level of process innovation, followed by firms in the Export Chain, Pure JV Chain, Import Chain, and Pure Domestic Chain, in descending order. One of the reasons was that firms in the Pure MNC Chain, Pure JV Chain, and Export Chain had higher capabilities in engineering. They may have adopted various knowledge creation practices, where these practices might have been transferred from their foreign supply chain partners or their foreign customers. The local firms in the Pure Domestic Chain and Import Chain tended to have lower capabilities for process innovation because they could access only the knowledge from their local supply chain partners

or their local customers. This knowledge was inadequate for effective and efficient process innovation. Some firms in the Import Chain may have had foreign suppliers to improve production processes, but these foreign suppliers were not directly involved in improving process innovation. They needed to know the problem specifications from the firm's owners, while a problem may have come from standard requirements from overseas customers.

Hence, a local firm should participate in global supply chain networks for knowledge transfer and knowledge co-creation. This helps to improve process innovation. This finding is consistent with Reichstein, Salter, and Gann [48] and Reichstein and Salter [72], where collaboration with foreign customers and suppliers improved process innovation inside the firms. This was because knowledge flowed from leading firms to improve local firm capability in the GVC context [7]. The presence of foreign firms improved local firms' capabilities through the capital, technology, skill, and knowledge spillover [73].

The empirical results also aligned with our field interview with the Thai Summit Company—a supplier of Toyota, Thailand. At first, this local firm had very limited capabilities in terms of innovation, production systems, human resources, and standards. After joining Toyota's network as a supplier, the Thai Summit Company received knowledge transferred from Toyota, e.g., Just In Time (JIT), Toyota Production System (TPS), Kaizen, Quality Control Circles (QCCs), and 5S. The knowledge of its customers helped the Thai Summit Company to improve its capabilities in all sectors. These capabilities also helped the Thai Summit Company to move ahead of their competitors. Currently, the Thai Summit Company is one of the leading automotive parts suppliers in Thailand.

5. Conclusions and Further Studies

This research provides empirical evidence of the benefits of joining global supply chain networks, where each partner in the supply chain network possesses only one type of ownership structure. From these, five types of supply chain ownership structures are categorized, i.e., Pure Domestic Chain, Pure JV Chain, Pure MNC Chain, Export Chain, and Import Chain. Thus, this study investigates the differences in innovation performance among the five types of supply chain ownership structures. The results of this study are summarized as presented in Table 9.

Table 9. Results summary of product and process innovation.

Types of Innovation		Sig.
Product Innovation (H1)	Introducing a new product by redesigning packaging of an existing product	0.000 ***
	Introducing a new product by significantly improving an existing product	0.003 **
	Developing a new product based on the existing technologies	0.000 ***
	Developing a new product based on new technologies	0.000 ***
Process Innovation (H2)	Reducing defects during a manufacturing process	0.001 ***
	Reducing labor input (person-hours)	0.027 *
	Reducing unscheduled line stops	0.007 **
	Reducing workers' injuries	0.000 ***
	Reducing plant accidents	0.000 ***
	Reducing delivery delays	0.000 ***
	Reducing dispersion in product quality	0.000 ***
	Reducing time for a changeover of a production line	0.000 ***

Note: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

From the data analysis, the results indicate that there are significant differences in product and process innovation among firms with different types of ownership structures. From the post hoc analysis, the Pure MNC Chain has the highest levels of product and process innovation. Firm innovation is lower for the Pure JV Chain, Export Chain, Import Chain, and Pure Domestic Chain, in decreasing order. This means that the firms in global supply chain networks have innovation capabilities higher than the firms in the local supply chain network. Local firms can improve and enhance their innovation capability by joining global supply chain networks because overseas or international supply chain partners embrace knowledge that is invisible to the local firms. If local firms have international

suppliers, they tend to send their engineers abroad to learn how to operate and maintain machines, and if the local firms have international customers, the country of destination requires the local firms to adopt higher standards. Thus, interaction and linkages with overseas partners assist the local firms to create and co-create new knowledge for product and process innovation. New knowledge may be transferred from overseas partners to improve firms' capabilities because foreign firms tend to have a higher innovation performance, compared to local firms [44].

To participate in global supply chain networks, firms need to improve their absorptive capacity [8,34] so that they can benefit from knowledge acquisition, knowledge transfer, and knowledge co-creation with partners in the supply chain networks. With the active support of leading firms in the GVC, the local firms tend to upgrade innovation capability [26].

In this paper, there are three main limitations. First, respondents were limited to providing information on their current ownership structures and the ownership structures of their main customer and the main supplier. This was because we could not ask for the ownership structure of the respondent's main customer and supplier directly. Thus, the information that we got from each respondent on the ownership structures of their main customer and supplier might have been different from the real ownership structures of their main customer and supplier. Second, we also did not investigate changes of firms' ownership structures, e.g., a firm at first may have had an ownership structure as a 100% locally owned firm. Then this firm moved to a joint venture firm through joint investment with foreign customers/suppliers. Third, this result may have represented only an emerging economy, e.g., Thailand, where the local firms, especially SMEs, had limited technological capabilities. The Thai firms did not invest in R&D, but they invested in technological learning through knowledge acquisition of existing technology, reverse engineering, design, testing, and quality control from customers [40]. The local Thai firms mainly relied on external supply chain partners, e.g., customers and suppliers, for knowledge and technology transfers. This may be different from the developed nations, e.g., European Union, United State of America, or Japan, where SMEs in these developed countries may have invested in technology and adopted systematic management. The benefits of joining global supply chain networks may not be realized, as they already have more innovation. For further studies, we can investigate (1) innovation performance before and after the changing of firms' ownership structures, (2) innovation performance among different types of supply chain ownership structures in developed nations, and (3) what makes firms innovate after joining global supply chain networks and why?

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