Dynamic Changes in Location Choice and Fragmented Flying-Geese Theory: An Empirical Analysis Using Microdata from Japan and Thailand[1]

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Abstract

In this paper, we undertake both a static and dynamic analysis of the Thai economy and Japanese firms, drawing upon new economic geography and the flying geese theory. Specifically, utilizing micro-level data from both the host and investor countries, we aim to theoretically and econometrically elucidate the relative roles of local, foreign, and Japanese firms, along with their dynamic transformations at both the industry and provincial levels, with a focus on Thailand. As Thai manufacturing and trade structures evolve towards greater sophistication, agglomerations and regional value chains (RVCs), encompassing forward-backward linkage effects such as supplier and market access, have emerged as pivotal factors influencing the entry of Japanese firms into Thailand or the attraction of such firms to the region. Despite the phenomenon of foreign direct investment (FDI) relocating to less developed countries in pursuit of low-wage labor, as posited by the flying geese theory, the case of Thailand reveals a contrary trend: foreign investment, particularly from Japan, continues to rise despite increasing wage levels. This divergence can be attributed to the paramount importance of local supply and sales networks over wage considerations. Furthermore, the significance of these local networks is progressively magnifying over time.

Keywords: Dynamic shifts, New economic geography, Location choice, Flying geese, Thai manufacturing industry, Japanese foreign direct investment

1. Introduction

1.1. Thai manufacturing industry

Thailand has been developing steadily, second only to Malaysia among the ASEAN4 countries.[2] It is said that foreign firms, especially Japanese firms, have played an important role in the development of Thai manufacturing. In this section, we use microdata from the 2007, 2012, 2017, and 2022 editions of the *Thailand Industrial Census* (data for 2006, 2011, 2016, and 2021, respectively) to examine the development of Thai manufacturing, dividing it into local and foreign

[1] This is a working paper. If you wish to quote it, please contact the corresponding author via email.
[2] ASEAN4 refers to Malaysia, Thailand, Indonesia, and the Philippines.

firms.[3] Figure 1 shows the trends in real sales (all in baht) for each industry, divided into local and foreign firms (industry code: ISIC Rev.4).[4] Local firms have a particularly strong presence in industry 10, food manufacturing, while foreign firms have increased their real sales in industry 26, electronics, and industry 29, automobile manufacturing.

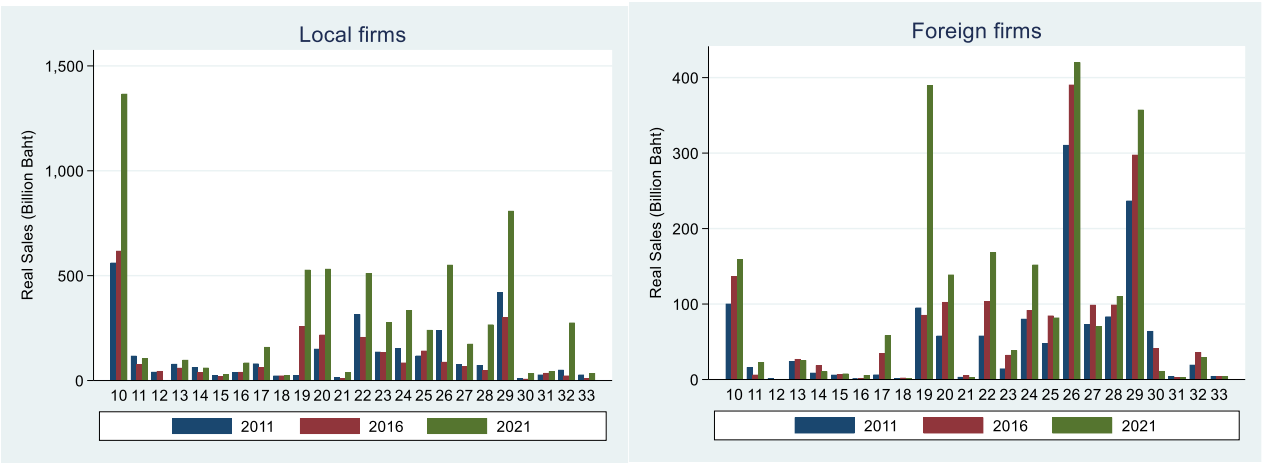

Figure 1. Changes in real sales by industry for local and foreign firms: 2011, 2016, 2021
Source: Thai National Statistical Office, *Thai Industrial Census*, 2012, 2017, 2022.

In addition, looking at the growth rate of the number of workers by industry from 2011 to 2021 (Figure 2), in relatively labor-intensive and low value-added industries such as industry codes 13 to 15 (textiles, clothing, and leather), both local and foreign firms are reducing the number of workers. In contrast, in relatively capital-intensive and high value-added industries such as industry code 22

[3] The 2007 edition lists 73,931 establishments, the 2012 edition 98,482, the 2017 edition 118,639, and the 2022 edition 110,521. However, since multiple establishments within the same firm often report data for other establishments within the same firm, we removed samples that were considered to be the same establishments. Specifically, we excluded establishments with identical values for the following variables: amount of registered capital, total male employees, total female employees, raw materials and composite materials at the beginning and end of the year, product sales value, and net fixed assets at the beginning and end of the year. See Kohpaiboon (2009) for more details. We also focus on enumerated firms. As a result, the number of establishments used in the analysis is 62,567 for the 2007 edition, 73,047 for the 2012 edition, 85,387 for the 2017 edition, and 66,996 for the 2022 edition.

The 2007 edition corresponds to ISIC Rev.3, the 2012 and 2017 editions correspond to ISIC Rev.3 and TSIC 2009, and the 2022 edition corresponds to TSIC 2009, but in terms of two-digit codes, TSIC 2009 corresponds to ISIC Rev.4. ISIC Rev.3 stands for International Standard Industrial Classification, Revision 3, and TSIC stands for Thailand Standard Industrial Classification. The two-digit codes for manufacturing are 15 to 37 for ISIC Rev.3, and 10 to 33 for TSIC 2009 and ISIC Rev.4. Data from the 2007 edition is not used in Figures 1 and 2 because the industry codes are different. In line with the standards used in the *Thai Industrial Census*, any firm that contains even the slightest bit of foreign capital is considered a foreign firm. However, we also conduct robustness tests using different standards.

The Census does not provide firm IDs, making it difficult to verify changes in each firm.

[4] To calculate real values, we used the Manufacturing Producer Price Index (base year 2000) from the Trade Policy and Strategy Office of the Ministry of Commerce of Thailand.

to 29 (plastics, non-metallic minerals, metals, computers, electronic products, machinery, and automobiles), both local and foreign firms are increasing the number of workers, indicating that the industrial structure is becoming more advanced.[5] Furthermore, in industries such as 10 (food), 11 (beverages), 19 (petroleum), 21 (pharmaceuticals), 30 (other transportation equipment), and 32 (others), the growth rate of foreign firms is negative, while the growth rate of local firms is positive, indicating that the role of foreign firms in these industries is declining and the role of local firms is increasing.

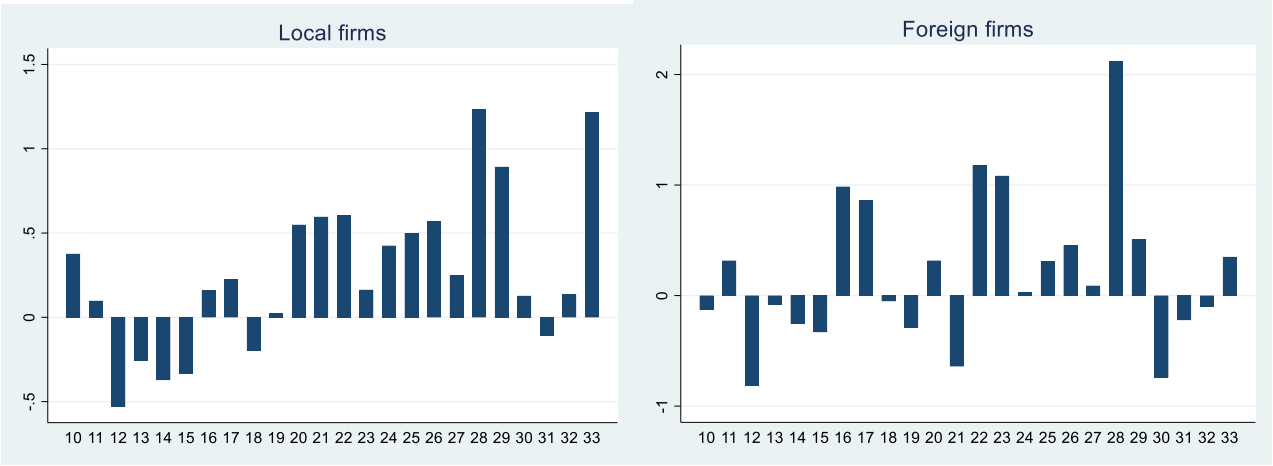

Figure 2. Growth rates of the number of workers by industry.
Source: Thai National Statistical Office, *Thai Industrial Census*, 2012, 2022.

Figure 3 shows the trend in real sales (baht) per worker across the entire manufacturing industry. Since there is no need to take into account differences in industry codes, data from 2006 is also included. While foreign firms have consistently been higher, the growth rate from 2006 to 2021 is much higher for local firms (119.1%) than for foreign firms (24.9%).

[5] The numbers of workers and total wages referenced below are for workers engaged in the production process. The tobacco industry (industry code 12) is excluded from this discussion due to its unique influencing factors.

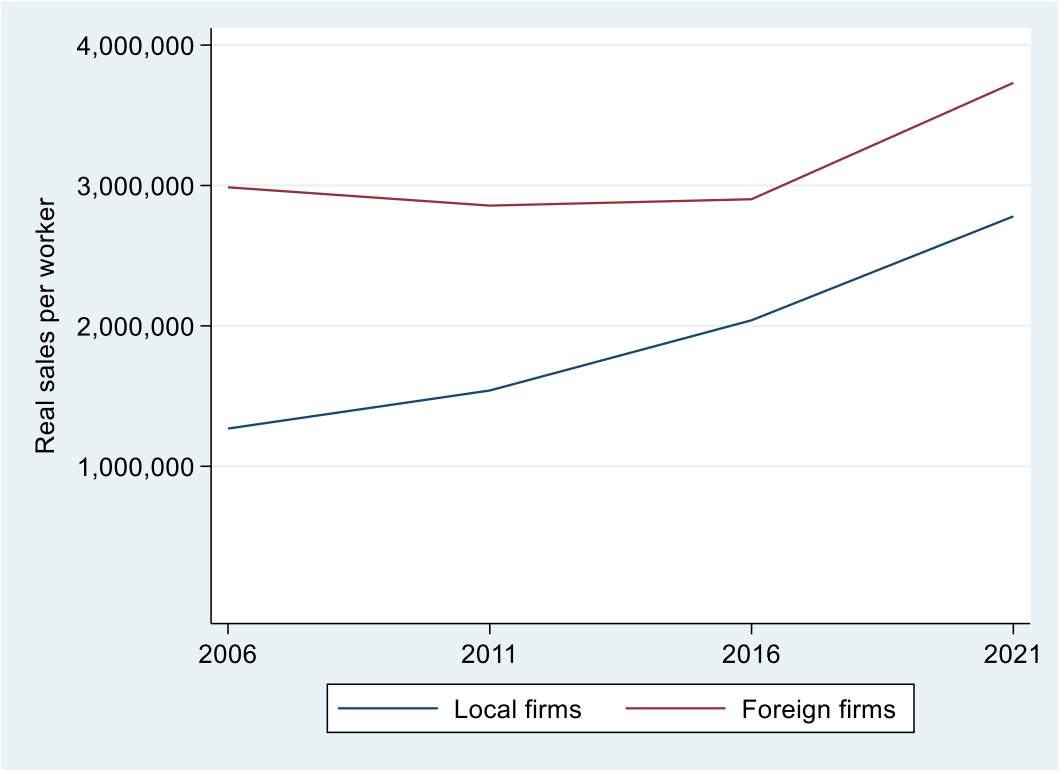

Figure 3. Real sales per worker in the manufacturing industry.

Source: Thai National Statistical Office, *Thai Industrial Census*, 2007, 2012, 2017, 2022.

1.2. Thai Trade

We also used the Product Complexity Index (PCI) to examine the quality and sophistication of Thai export goods.[6] Figure 4 shows the trends in the proportion of export value of goods exported by Thailand based on the five-digit PCI calculated for each year and product from UN Comtrade export data (SITC Rev.3).[7] The PCI values are categorized into five levels, with an equal number of PCIs in each level. As can be seen from this figure, the proportion of export goods at levels 1 and 2, which was very high in the 1990s, has declined year by year, and the proportion of export goods at level 3 increased in the 2000s, and then to level 4 and level 5, with the level of export goods with the highest proportion rising year by year. The flying geese theory has been criticized for being inadequate in the current context of advanced division of labor, as it focuses on industry-level analysis, but this figure shows the flying geese development at the product level in Thailand. Bui et al. (2022) call such

[6] PCI calculates precise values by repeated computations, but here we use the value calculated 17 times (kp17) as the indicator of product complexity. For more information on PCI, refer to Hausmann et al. (2013) and Hidalgo (2021). Other indicators, such as PRODY and EXPY (Hausmann, Hwang, and Rodrik 2007), have limitations, including their reliance on each country's income level in the calculation process. Therefore, we use PCI, which does not incorporate such data.

[7] SITC Rev.3 stands for Standard International Trade Classification, Revision 3. In practice, import data is used in place of export data to ensure accuracy. Since PCI values fluctuate annually, they are calculated using a five-year backward moving average, and in this figure, the average value for 2015 (average value from 2011 to 2015) is used as the basis.

development fragmented flying geese (FFG) pattern, but this is the first time that FFG has been revealed using PCI.

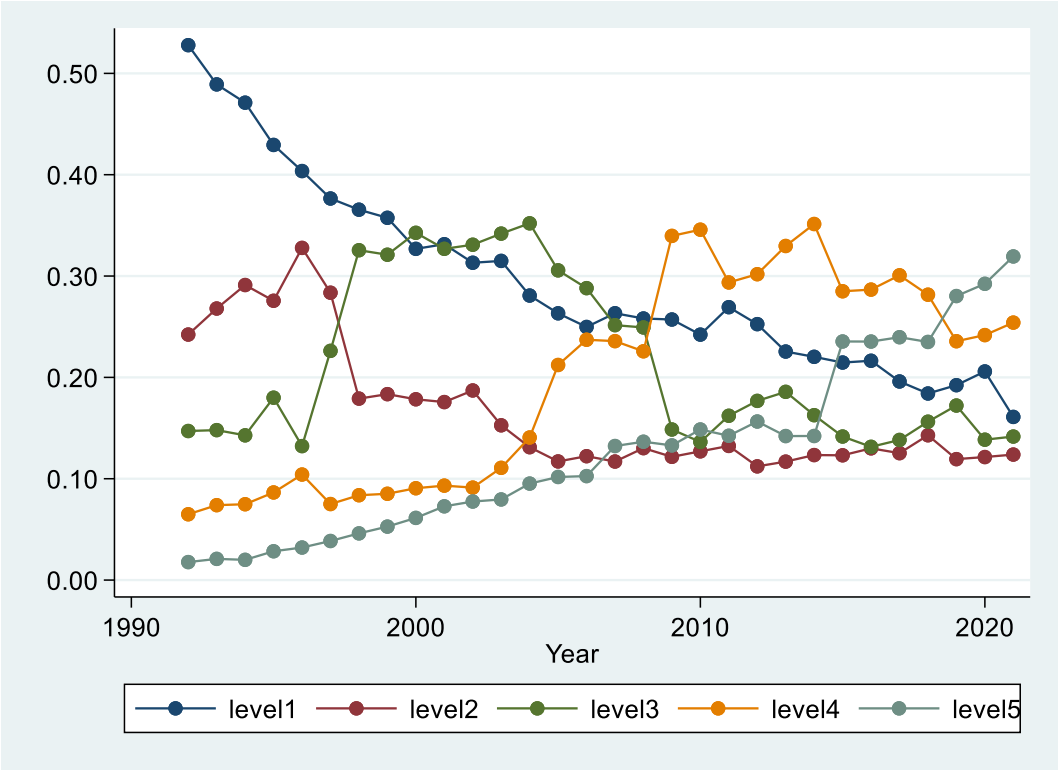

Figure 4. Trends in Thai export goods by PCI level
Source: UN Comtrade, SITC Rev.3

While Thai export goods to other countries are becoming more sophisticated, what is the current state of trade relations between Japan and Thailand? Figure 5 illustrates the trade structure between two countries. Here, using UN Comtrade's trade value data (three-digit SITC Rev.2) for each industry (each good), one-way trade between the two countries is defined as inter-industry trade (OWT: One-Way Trade) and two-way trade is defined as intra-industry trade (IIT: Intra-Industry Trade), and the price (quality) of each trade good is evaluated using trade value and volume data to examine the quality of trade between the two countries. Specifically, if the export value of a particular industry is less than 10% of the import value (or the import value is less than 10% of the export value), it is classified as OWT; otherwise, it is classified as IIT. Among IITs, if the price (trade value/volume) difference between the two countries is within 15%, it is classified as Horizontal IIT; otherwise, it is classified as Vertical IIT. Furthermore, among Vertical IITs, industries with a price difference (for Japan) of more than 15% are classified as UVIIT (Upper Vertical IIT), while industries with a price difference of less than -15% (in other words, the price of exports from Japan to Thailand

is more than 15% lower than the price of exports from Thailand to Japan) are classified as LVIIT (Lower Vertical IIT).[8]

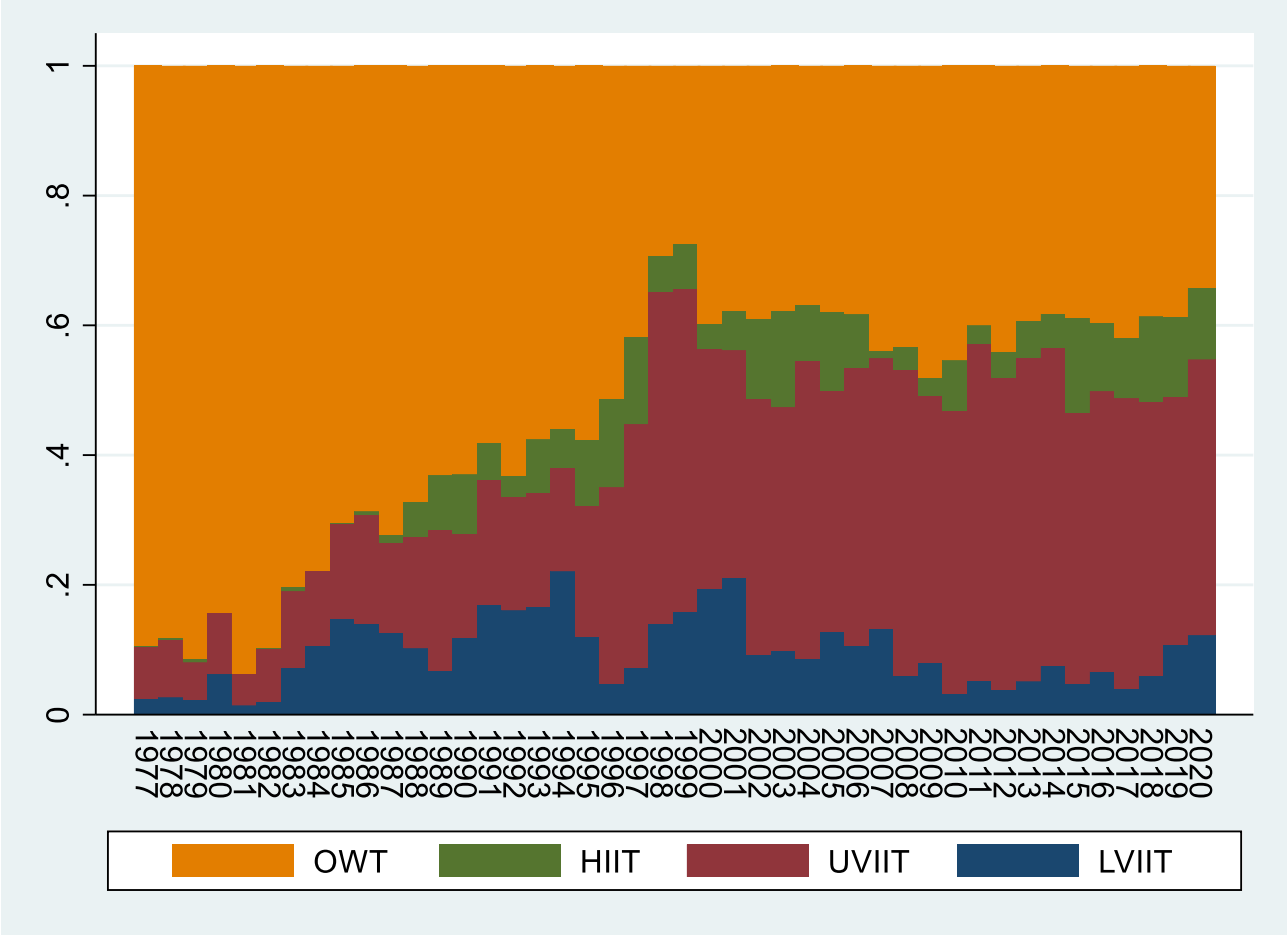

Figure 5. Analysis of the trade structure between Japan and Thailand using intra-industry trade index

Source: UN Comtrade, SITC Rev.2

While OWT declined sharply from the 1970s through the 1990s, the trade structure has stabilized since 2000, with steady exports of UVIIT (high value-added products) from Japan to Thailand. This indicates that FDI has flowed from Japan to Thailand, leading to a more advanced Thai industrial and trade structure. Concurrently, Japan is exporting high value-added goods to Thailand and Thailand is exporting low value-added goods to Japan, and the trade structure between Japan and Thailand has become more or less fixed.[9]

[8] For indicators of intra-industry trade, refer to Grubel and Lloyd (1971) and Fontagné and Freudenberg (1997). However, the concepts of UVIIT and LVIIT are newly constructed in this paper. In regions such as East Asia where vertical specialization takes advantage of differences in factor endowments, it is extremely important to distinguish between UVIIT and LVIIT.

[9] This trend is also evident in an analysis using PCI (see Figure A1). In fact, when we look at the changes in the level of export goods from Thailand to Japan, we can see a flying geese pattern of

1.3. FDI in Thailand

FDI, particularly from Japan, has played a crucial role in the development of Thai manufacturing industry. According to the Bank of Thailand's "Foreign Direct Investment Position Classified by Country," Japan's share of foreign direct investment (stock) in Thailand was 34.5% in 2006 and 31.7% in 2021, making it the highest share. As suggested by the flying geese theory (e.g., Ozawa 2016), the destinations of Japan's FDI in Asia have changed from Asian NIES to ASEAN4, China, and CLMV (especially Vietnam).[10] This shift occurred because, as wage levels (and the exchange rate) rose in Japan, labor-intensive industries, goods, and processes that became less price competitive were relocated to Asian countries with lower wage levels where they could maintain a certain level of quality. As wage levels in these destination countries increased, the industries were then relocated to even less developed countries with lower wage levels. Figure 6 shows the trend in the number of local subsidiaries of Japanese manufacturers in Asia (excluding China) listed in Toyo Keizai's *Kaigai Shinshutsu Kigyo Soran* (comprehensive list of firms expanding overseas). While until the 1980s, most of the expansion was to Asian NIES, after the Plaza Accord in 1985, the number of exports to ASEAN4 and, more recently, to CLMV (especially Vietnam) has increased. While most of the expansion was to Asian NIES until the 1980s, after the Plaza Accord in 1985, it can be seen that the expansion to ASEAN4 and more recently to CLMV (especially Vietnam) has been growing. However, despite these changes, the number of firms expanding into Thailand is continuing to grow in spite of rising wages.

development as in the previous figure, but the pattern is not as clear as in Figure 4, and there has been less fluctuation since 2000.

[10] Asian NIES refers to South Korea, Taiwan, Singapore, and Hong Kong, while CLMV refers to Cambodia, Laos, Myanmar and Vietnam.

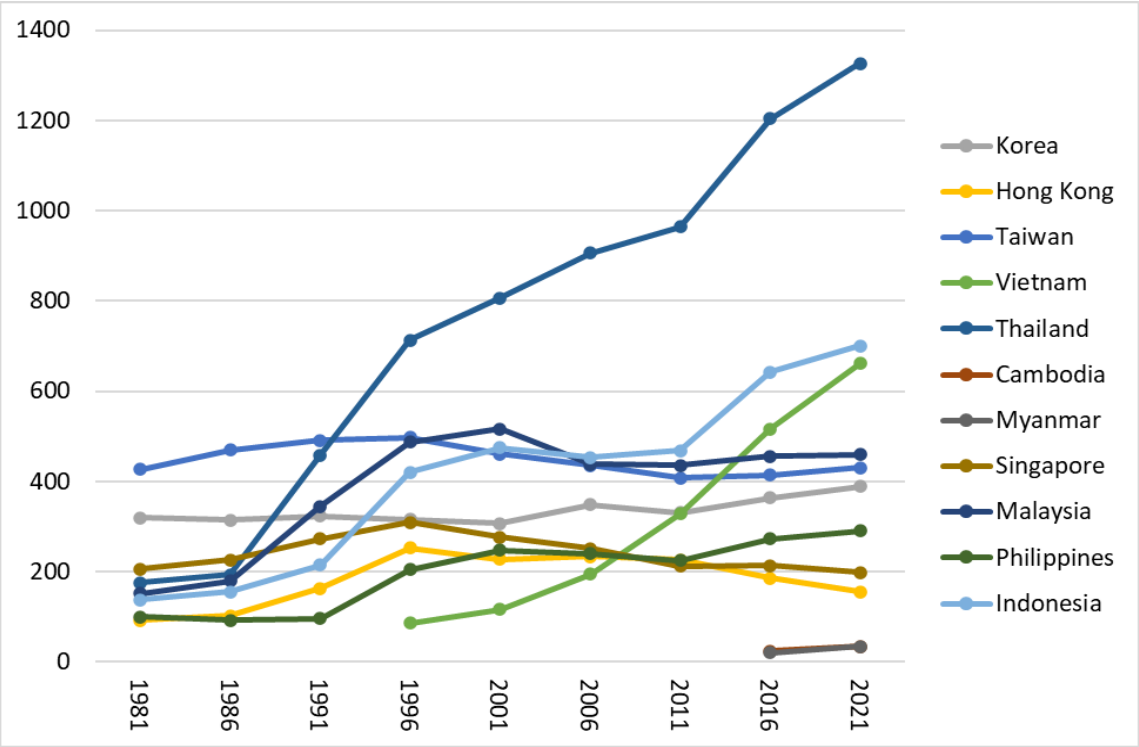

Figure 6. The number of Japanese affiliates working in manufacturing industry
Data: Toyo Keizai, various issues, *Kaigai Sinshutsu Kigyo Soran: Kuni Betsu Hen*, (Overseas Japanese Affiliated Companies: by Country), Toyo Keizai Shimposha.

The reason for this is that agglomeration in Thailand has made the country even more attractive, with an increasing number of Japanese firms moving there due to the presence of local production networks rather than the country's low wage levels.[11] According to Bui et al. (2022, especially Figure 14), in 2000, many Japanese firms in the electrical equipment industry in Thailand cited low wages and the domestic Thai market as reasons for moving into the country, but as of 2010 and 2020, there has been a significant increase in the number of firms citing the presence of production networks as a reason.

[11] The concept of agglomeration is often used ambiguously. Fujita et al. (1999) describe agglomeration as "the clustering of economic activity, created and sustained by some sort of circular logic" (p. 1). Supplier access and agglomeration are sometimes used in a similar sense, and when calculating indicators of agglomeration, the concentration of locations in terms of the number of employees is often used (e.g., Ellison and Glaeser, 1997). In this paper, we would like to take supply and sales networks, including sources and destinations of intermediate goods (but excluding final demand), as indicated by supplier and market access in the region as agglomerations, taking into account their measurability as objective figures. Such agglomerations may be limited to a small geographical area, but may also exist across a wider area as transportation costs (both narrow and broad) decline; the latter are sometimes called RVCs. See also Bui et al. (2022) on this point.

1. 4. Trade and Investment liberalization in Thailand

The expansion of FDI from Japan to Thailand can be partly attributed to the Thai government's promotion of trade liberalization and active policies to attract foreign investment. This subsection thus provides an overview of the trade and investment-related policies that have been implemented in Thailand since 2000.

Until the 2000s, the Thai government pursued a policy of economic development through the liberalization of trade and investment throughout the country. In line with the WTO and ASEAN agreements, the Thai government implemented liberalization policies, including the reduction of tariffs and the relaxation of restrictions on FDI. In 2000, the intra-regional tariffs on approximately 1,200 products were reduced to 0-0.5% in accordance with the ASEAN Free Trade Agreement (AFTA) tariff elimination schedule. In the AFTA, the process of tariff reduction commenced in earnest in 2003, with the majority of intra-regional tariffs reduced to below 5% in 2004.[12] Furthermore, local content requirements were abolished in 2000 in accordance with the WTO Trade-Related Investment Measures (TRIM) Agreement.

The reduction of intra-ASEAN tariffs has resulted in a significant increase in intra-regional trade. The elimination of local content restrictions also removed the constraint of sourcing intermediate goods locally, thereby allowing firms to source from any country in the ASEAN region. Consequently, there has been an increase in the horizontal division of labor within ASEAN.

Conversely, the ASEAN Trade in Goods Agreement (ATIGA) imposed an intra-regional content requirement of 40%, which continued to impose certain restrictions on the importation of intermediate goods from outside the ASEAN region. Products with an intra-regional content below 40% are not considered to be intra-regional products and, as a result, are not subject to the lower intra-regional tariff rates of the AFTA. Consequently, the lifting of local content restrictions did not afford Japanese firms operating in Thailand the freedom to source intermediate goods from external sources. In order to benefit from the low preferential tariff rates offered by the AFTA, it was necessary for Japanese firms operating in Thailand to continue sourcing intermediate goods from within the ASEAN region. Despite the implementation of the Japan-Thailand Economic Partnership Agreement (JTEPA) in 2007, there was no immediate increase in the importation of parts from Japan. Instead, there was a sustained emphasis on sourcing from local firms, particularly for general parts.[13]

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[12] Until the 2000s, Thailand maintained a relatively high average applied tariff rate in comparison to its neighbors. In 2006, Thailand exhibited the third highest average applied tariff rate among ASEAN countries, after Vietnam and Cambodia, and comparable to China.

[13] Additional factors influencing the preference for local firms in the procurement of general components include considerations of foreign exchange risk and inventory management. Moreover, the following factors have been identified as contributing to the lack of substantial growth in exports from Japan to Thailand following the implementation of the JTEPA agreement (JETRO, 2005). Firstly, a considerable number of firms were already exempt from import duties under the Board of Investment of Thailand's (BOI) investment incentive scheme and other measures. Secondly, the JTEPA tariff reduction schedule is a long-term undertaking. Thirdly, the most-favored nation (MFN)

In this context, it has been frequently observed that each agreement must permit cumulation as an exception to the rules of origin. Moreover, the exponential growth in the number of bilateral agreements has led to a phenomenon known as a "spaghetti bowl," in which each agreement has adopted a distinct rule of origin, thereby complicating import and export procedures. Consequently, it was necessary to harmonize the rules of origin between the various agreements.

These issues are being addressed through the implementation of multilateral free trade agreements. The CPTPP, which was signed in 2018, introduced a system of full cumulation with the objective of mitigating any potential negative effects on production networks within the designated region. Moreover, the Regional Comprehensive Economic Partnership (RCEP), which was concluded in 2020, permits intra-regional cumulation. The ASEAN-plus-one FTAs have not resolved the aforementioned issues, because the ATIGA provisions restrict the transactions eligible for cumulation to those between ASEAN and countries that have signed an FTA. However, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the RCEP have provided a potential avenue for countries to benefit from FTAs without the necessity for significant alterations to existing production networks. To date, Thailand has not become a member of the CPTPP, which is regarded as the more liberal of the two. Although some have suggested that it will join at an early stage, there is considerable domestic opposition, and it has not yet applied to join.

Additionally, the deregulation of direct investment has made noteworthy advancements during this period. The Foreign Business Act, which was amended in 1999 and came into force the following year, resulted in the liberalization of the entry of foreign firms into 20 new business sectors. While the Foreign Business Act sets out general investment rules for foreign firms in Thailand, the Investment Promotion Act provides tax incentives and other benefits to investments that meet specific conditions. The Investment Promotion Act has been frequently updated since 2000 in response to changing circumstances in Thailand. In 2000, the restrictions on the locations in which investment could be made in priority industries were eased. In 2002, the existing location restrictions, which were designed to address regional disparities, were further relaxed. The Board of Investment of Thailand (BOI), which had previously offered substantial incentives for investment in relatively low-income areas outside of Bangkok, removed these location restrictions, with the exception of certain industries, and provided incentives for investments regardless of the region in which they were located.

In the mid-2000s, Thailand was undergoing a decline into what has been termed the 'middle-income trap.' This resulted in a shift in focus towards the implementation of measures designated to upgrade the country's industrial structure. In the aftermath of the 2006 coup d'état, the interim government adopted an inward-looking policy for a period of time. Subsequently, following the transfer of civilian administration, the new government commenced actively attracting investment

rates had already been reduced and were lower than the JTEPA preferential rates for certain products.

from 2008 onwards. In particular, new tax incentives were introduced with the objective of promoting energy efficiency, alternative energy sources, and the high-tech sector. Moreover, the "eco-car project" was initiated in 2010 with the objective of stimulating investment in the production of environmentally friendly vehicles. Despite a decline in FDI levels towards the end of 2013 and into 2014 due to renewed political instability, a selective policy to attract foreign investment was implemented from 2015 onwards, with a stronger focus on the upgrading of the industrial structure.

The Prayut interim government, which assumed power following the 2014 coup, unveiled the Thailand 4.0 initiative in 2015 as a long-term vision for economic development. The new Investment Promotion Act, which came into effect that year, established a framework of investment incentives that vary in detail by industry. The incentives are designed to provide generous incentives for priority industries and projects involving research and development, while excluding some labor-intensive and low-value-added industries from preferential treatment. Moreover, amendments to the Investment Promotion Act in January 2017 confer long-term corporate income tax exemptions upon firms that utilize high technology or are engaged in research and development.

The National Competitiveness Enhancement for Targeted Industries Act, which came into force in February of the same year, had the objective of supporting five existing industries, including next-generation vehicles and smart electronics, in the short to medium term, while developing five new industries in the long term, including automated machinery, industrial robots, aerospace, biotechnology, and digital industries. Moreover, the Eastern Economic Corridor Act, enacted in 2018, sought to attract investment in 12 specified industries, including those previously mentioned, to designated regions. The objective of this initiative is to attract the aforementioned 12 industries to three eastern provinces with industrial clusters, namely Rayong, Chonburi, and Chachoengsao provinces. The aim was to promote further concentration of these industries in order to facilitate their upgrading and addition of higher value. In addition to the generous investment incentives, such as corporate income tax exemptions and subsidies, measures have been implemented with the objective of enhancing the investment environment. Such measures include the development of infrastructure and the deregulation of relevant regions.

This paper examines the factors that influence the location choices of Japanese firms in Thailand. In addition to the aforementioned policies, another factor that may influence the location choice of such firms is the level of the minimum wage. Over the past two decades, Thailand has implemented a series of minimum wage increases in line with the country's economic growth and rising income levels. The most notable increase was observed in 2012, with a 40% surge in the minimum wage. In 2013, the minimum wage was increased across the country to 300 Baht per day, which was the same level as in Bangkok. The two increases have resulted in a near-90% increase in the minimum wage in some regions. As the Thai economy has expanded, the labor market has become increasingly tight, with the unemployment rate declining below 1% since 2010. The escalating costs of labor have constituted a substantial obstacle for businesses establishing operations, particularly in industrial

clusters. The implementation of a uniform national minimum wage in 2013 may have exerted a considerable influence on the location decisions of firms.

1.5. Aims and structure of this paper

As Thai industrial and trade structure has become more sophisticated, Japanese FDI has played an important role, but what kind of trends will we see in the future? Japanese FDI also tends to move to more developing countries, but in Thailand, the number of firms entering the country and the amount of investment continue to increase. What are the factors behind this? Are the importance of wages and existing production networks changing? Are the relative roles of local, foreign, and Japanese firms changing? What is the importance of infrastructure investment such as highways and ports? How should foreign policies such as FTAs be implemented? As the division of labor progresses, complex supply and sales networks are being constructed. In order to clarify this current situation, this paper focuses on Thailand's domestic manufacturing industry and Japanese FDI, and theoretically and econometrically clarifies the factors behind the development of the Thai economy and the entry of Japanese firms, as well as the dynamic changes in these factors. The focus on manufacturing is because it is at the heart of RVCs (Regional Value Chains) and dynamic change, and plays a key role in helping less developed countries catch up.[14]

This paper is structured as follows. In the next section, we review previous research, and in Section 3, we conduct theoretical analysis from the perspective of new economic geography and the theory of flying geese pattern. Section 4 discusses some of the data and measurements used in the econometric analysis. Section 5 examines the estimation results and concludes with a conclusion.

2. Literature Review

2.1. Production network, GVC, and FDI

From the industry level to the process level, the global production network has undergone a dramatic transformation in recent decades. In particular, the process-level production network, also known as the Global Value Chain (GVC), has been linked to economic development in terms of income growth, especially for developing economies (The World Bank, 2020). Despite experiencing severe disruption during the COVID-19 pandemic, the GVC is still considered as the backbone of the current global production network, with FDI at its core.

Given the positive impact on job creation and the drive for economic growth, developing countries have prioritized policies to attract more FDI, support businesses entering GVC and upgrade to higher-value activities.[15] Simultaneously, on the flip side of the coin, the location decisions of multinational enterprises (MNEs) from developed countries—when establishing foreign affiliates in

[14] On the latter, see also Rodrik (2013).

[15] For the effect of FDI on economic growth, see Almfraji and Almsafir (2014), Choe (2003), Roy and Van den Berg (2006), Solomon (2011), and Tang et al. (2008), among others. While the authors agree with the view of the positive relationship between FDI and economic growth, we should note that there are also works of literature indicating otherwise.

developing nations—have become a significant topic of academic and practical business interest.[16] In the case of Asia, recent data highlights that developing countries in the region continue to attract the largest FDI inflows, with Japan being a major investor (UNCTAD, 2023). Focusing on Thailand, as discussed in the introduction, FDI has been a great contributor to the development of the manufacturing sector and despite the decline in the share, Japan remains one of the major FDI home countries. As depicted in Figure 6, an increasing number of Japanese MNEs are setting up their foreign affiliates in Thailand and the location choice within Thailand is naturally of crucial importance.

When examining the location choice of MNEs, the traditional approach often centers around the concept of "location advantage" (Dunning, 1981, 1993). Location advantage encompasses various factors that influence MNEs' decisions of location choice, including wages, taxes, labor force availability, and natural resources, etc. Intuitively, locations with abundant resources attract more FDI and foreign affiliates of MNEs. Empirical studies have consistently confirmed the significance of these traditional factors as determinants of MNE location choices (e.g., Bartik, 1985; Carlton, 1993; Coughlin et al., 1991, Norman and Woodward, 1988, among others). However, to be discussed in detail in the later section, the emergence of the New Economic Geography (NEG) has shifted attention toward additional factors such as agglomeration, supplier access and market potential (or market access in some literature).

2.2. Location choice of MNEs[17]

Agglomeration was first introduced by Woodward (1992) in the analysis of location choices made by Japanese MNEs in the United States. In addition to factors such as population density and education, agglomeration of the manufacturing sector was also found to be statistically and economically significant. This importance of agglomeration in the location choice decisions of Japanese MNEs in the United States is further supported by a body of literature (Head et al., 1995; Kotabe, 1993; Smith and Florida, 1994). Additionally, Cheng and Stough (2006) emphasize the role of agglomeration in FDI by Japanese MNEs in China. Furthermore, multi-country analyses conducted by Fukao and Yue (1997), Wakasugi (1997), and Urata and Kawai (2000) reveal that both traditional factors and agglomeration play significant roles in shaping the location choices of Japanese MNEs.

Market potential, initially introduced as an index by Harris (1954), has consistently emerged as a significant factor influencing the location choices of MNEs in various studies. For instance, Head

[16] As Bretas et al. (2022) pointed out, the number of pieces of literature studying the location choice of MNEs and inward FDI has increased exponentially, especially after the Global Financial Crisis in 2008. From the experience of the COVID-19 pandemic and decoupling amid U.S.-China tensions, we expect these topics to receive more attention going forward.

[17] There is a large body of literature on the location choice of MNEs from international business study and management perspectives. However, considering our paper is in line with the NEG approach, we focus our review on the NEG-related studies. For reviews focusing on international business management, please see Kim and Aguilera (2016) and Nielsen et al. (2017) among others.

and Mayer (2004) employed both Harris-type and Krugman-type (Krugman, 1991a, 1991b) market potential indices to explore Japanese MNE investments in the European Union.[18] The estimation results underscored the importance of market potential alongside agglomeration effects. Similarly, a body of literature investigated the location decisions of the Japanese food industry in East Asia, emphasizing the relevance of market potential, market size, and agglomeration (Akune et al., 2003; Akune and Tokunaga, 2007, 2012; Lu and Tokunaga, 2008, 2009; Sattaphon and Kiminami 2005). Another set of studies focused on the Japanese electronics industry, considering market potential, supplier access, and agglomeration within the context of East Asian countries. Their findings align with prior research while also highlighting the significance of supplier access and market potential (Tokunaga and Akune 2003; Tokunaga et al. 2017; Tokunaga and Ikegawa 2019; Tokunaga and Ishii 2000).

Turning to the studies that focus on intracountry analyses, Belderbos and Carree (2002), Kang and Lee (2004) and Wakasugi (2005) confirmed the benefits of agglomeration by examining the location choices of Japanese MNEs in China. Additionally, Cheng (2007, 2008) found that agglomeration significantly influences location decisions, while market potential plays a comparatively lesser role. By analyzing Japanese enterprise investment data alongside China's provincial data, Jin and Tokunaga (2006, 2007) and Tokunaga and Jin (2007, 2011) highlighted the importance of market potential, agglomeration, and purchasing power—alongside traditional factors like wages and infrastructure.[19] Furthermore, Wattanadumrong et al. (2010) investigated the regional distribution of FDI within Thailand, emphasizing the significance of the government's regional policies.

2.3. Inward FDI

Separating location choice studies from inward FDI studies presents a considerable challenge. The reason is, intuitively, the factors influencing MNEs' location decisions also impact inward FDI. Given this blurred boundary, our focus on this section will be on research motivated by exploring the factors affecting inward FDI, utilizing the NEG approach.

Agglomeration consistently emerges as a key factor in research motivated by exploring inward FDI determinants. Numerous studies examining inward FDI in China have highlighted agglomeration as a crucial explanatory factor (e.g., Boermans et al., 2010; Chang and Park, 2005; Du et al., 2008a, 2008b; Ng and Tuan, 2003; Zhang, 2001 among others). Other than China, the importance of agglomeration was also confirmed in studies focusing on Poland, Italy, Germany, Puerto Rico, Portugal, India, Mexico and African nations (Anynawu, 2012; Bronzini, 2007; Chidlow et al., 2009; Guimaraes et al., 1998; Guimaraes et al., 2000; Jordaan, 2008; Mukim and Nunnenkamp, 2012; Wagner and Timmins, 2009).

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[18] In the case of location choice of Japanese MNEs in Europe, Yamawaki (1993) confirmed the importance of traditional factors such as wage and market size.

[19] While there are mounting numbers of literature regarding FDI and location choice in China, in the light of the purpose of this paper, we focused on introducing the research of Japanese MNEs.

Market access has also been identified as a significant factor in numerous studies exploring the determinants of inward FDI. For instance, Adhikary (2017) focused on macroeconomic factors related to inward FDI in SAARC nations and emphasized the critical role of market access, particularly in the case of India.[20] Amiti and Javorcik (2008) highlighted the importance of market access and supplier access in China. Similarly, Song and Cieslik (2018) provided evidence supporting the significance of market access within China. Comparable evidence also exists for EU membership countries and Central and Eastern European (CEE) nations, as reported by Carstensen and Toubal (2004) and Casi and Resmini (2010).

2.4. Knowledge gap in existing literature and contributions of this paper

The existing literature on the location choices of multinational enterprises (MNEs), particularly those adopting NEG approaches, consistently emphasizes the significance of industrial clusters, the concentration of both domestic and international businesses, and agglomeration (Nielsen et al., 2017). However, knowledge gaps still persist within the literature concerning the location choice of MNEs.

2.4.1. Limited literature exploring industry-level data

Observing sectoral heterogeneity in location choice and inward FDI is straightforward and consequently, industry-level data plays a crucial role in understanding this characteristic. However, as highlighted by Islam and Beloucif (2024), most existing studies on location choice and inward FDI primarily rely on country-level data (or occasionally state or province level). Unfortunately, analyses based on sector-level data remain relatively scarce. When we narrow our focus to research specifically examining market and supplier access using sector-level data, the scarcity becomes even more pronounced. In our analysis, we explore a unique dataset that combines Thai census data with Toyo Keizai Shimpo data at the industry level, aiming to address this gap in the current literature.

2.4.2. Insufficient dynamic analysis of location choice determinants

While existing empirical literature draws from various data sources, including cross-section, time series, and panel data, surprisingly few studies delve into the dynamic changes of location choice determinants and inward FDI. One potential explanation for this gap lies in the prevalence of GVC models as the theoretical foundation for recent research. As highlighted by Yeung and Coe (2015), GVC models inherently lack a dynamic perspective. Consequently, studies rooted in GVC frameworks often overlook the need for dynamic analyses.

To address this limitation, Bui et al. (2022) propose a dynamic FFG model. The beauty of FFG lies in its ability to provide a dynamic framework for production networks, incorporating elements such as division of labor and intra-regional agglomeration. Our paper significantly contributes to the

[20] SAARC includes India, Pakistan, Bangladesh, Sri Lanka, and Nepal.

existing literature by conducting dynamic empirical analyses, leveraging the FFG model as our theoretical backdrop and emphasizing the study of dynamic changes in location choice factors.

2.4.3. Neglected Intracountry Analyses: A Focus on Thailand

While existing literature on location choice and inward foreign FDI predominantly centers on major economies like the United States and China, other nations often receive less attention and are clustered into regional analyses by focusing on regions with high economic growth or prospects, such as East/Southeast Asia, ASEAN, Central and Eastern Europe, and Africa. Intracountry analyses have extensively explored the location choices of MNEs in the U.S., with numerous dedicated studies. Similarly, the location choice of MNEs in China have garnered significant research interest due to its substantial economic potential and global impact. However, beyond these two countries, intracountry analyses remain sparse. Notably, research specifically examining location choices within Thailand is notably lacking. As pointed out earlier, given the rising number of foreign affiliates established in Thailand by Japanese MNEs, addressing this knowledge gap is crucial. Furthermore, cross-country analysis requires consideration of differences between countries, whereas a focus on a single country makes it possible to more simply compare factors in location selection without taking such differences into account. Our paper contributes valuable insights that benefit both academic research and real-world business management.

3. Theory[21]

The core of the analysis in this paper is the FFG theory of Bui et al. (2022), which incorporates knowledge from new economic geography and agglomeration theory. This theory does not use the traditional flying geese (TFG) theory based on industry, but focuses on the transfer of production bases at the parts and process level as the division of labor progresses, and describes how RVCs are being built and developing countries are catching up, while also being influenced by the effects of agglomeration and distance.

Regarding FDI, which is important in this paper, in the traditional TFG, wage increases associated with economic development had a significant impact on FDI from developed countries to developing countries, but in the new FFG, not only wages but also factors such as agglomeration and distance effects are important. And with regard to this agglomeration, factors such as the ability to purchase raw materials and intermediate goods locally (supplier access) and the ability to sell them (market access), as well as infrastructure, are also important. From the perspective of developing countries, while in the conventional TFG, catching up at the industry level or self-reliant catching up was important, the new FFG emphasizes the importance of “fragmented” catching up at the goods and process levels. In this new FFG, it is no longer necessary for one country to build an entire industry, and there is an increased tendency for a country to enter only specific goods or processes and build

[21] Due to various circumstances, the theoretical description has been omitted, but it is planned to be significantly expanded and revised at a later date.

an RVC with neighboring countries that are close by and can enjoy agglomeration effects. Also, the phenomenon of so-called "leapfrogging" will attract attention.

The variables that represent the economic situation are the wages, supplier access, market access, income, and infrastructure discussed above. In addition, in order to focus on the catch-up of less developed countries, we analyze the impact of foreign and local firms separately. We make this classification because, as wages rise in less developed countries, advanced countries move their production bases to even less developed countries, and the development of local firms in less developed countries is important for the less developed countries to build their long-term economic strength.

The key to this paper is to verify the dynamic process discussed in the FFG. Has the situation changed over time from that assumed by the TFG to that depicted by the FFG? Also, are local firms developing in less developed countries, rather than just relying on foreign firms? In particular, is the growth of local firms seen upstream of foreign firms (as indicated by the supplier access index for local firms) or downstream (as indicated by the market access index for local firms)? Below, we will verify this using an econometric model.

4. Data and measurement

4.1. Source of data

The data used in the analysis below in this paper are as follows. The first is the establishment-level micro data from the *Thai Industrial Census* collected by the National Statistical Office (NSO). Details are as described in 1.1. The 2007 version corresponds to ISIC Rev.3, the 2012 and 2017 versions correspond to ISIC Rev.3 and Rev.4, and the 2022 version corresponds to ISIC Rev.4. Therefore, a dataset for the 2007-2017 version corresponding to ISIC Rev.3 and a dataset for the 2012-2022 version corresponding to ISIC Rev.4 are constructed, and the overlapping period is also used to verify robustness. As a rule, two-digit industrial codes are used. Based on these data, supplier access (SA), market access (MA), and average wages (wages) by province and industry are calculated as described below.[22]

[22] As mentioned above, the *Industrial Census of Thailand* is published once every five years, and only one year's value of data is provided. For the four years in between, the data for 2006, 2011, 2016, and 2021 are used, and the difference is divided equally to calculate the values. If there are missing values, the average value for that province and industry is used. In all censuses, there are cases where the province- and industry-specific wages are not calculated because there are industries in which there are no business establishments in the province. In such cases, the average value for the entire year is used. In addition, there are cases where there are provinces and industries in which foreign or Japanese firms have not entered, so the values for supplier access and other variables for foreign firms in the province are zero. For these variables, the minimum value for each variable is added to the entire sample. In addition, the wages by province and industry are converted to real values using the consumer price index (exclude raw food and energy) of the Trade Policy and Strategy Office of the Ministry of Commerce of Thailand.

In addition, we use microdata from Toyo Keizai Inc.'s *Kaigai Shinshutsu Kigyo Soran* to gather data on Japanese manufacturing firms with operations in Thailand.[23] We assign two-digit ISIC Rev.3 and Rev.4 codes to each firm's actual production activities by checking the business details in the microdata and their websites, and then link these codes to values such as supplier access.

For Thai input-output tables, the 2015 and 2021 editions of the OECD Input-Output Tables (IOTs) are used. The 2015 edition is compatible with ISIC Rev.3, and data up to 2011 is available. Therefore, in datasets compatible with ISIC Rev.3, input coefficients for 2011 are also applicable to 2012 and beyond. The 2021 edition is compatible with ISIC Rev.4, and data up to 2018 is available. Therefore, in datasets compatible with ISIC Rev.4, input coefficients for 2018 are also applicable to 2019 and beyond. In the IOTs, in some cases, two or three industries are grouped into one item in the two-digit ISIC classification. In such cases, values such as input coefficients are simply divided by the number of industries.[24]

Other provincial characteristics include the nominal GRP (Gross Regional Product) by province published by the Office of the National Economic and Social Development Council, and the nominal minimum wage (mw) by province published by the Department of Labour Protection and Welfare, Ministry of Labour.[25] These are converted to real GRP (rGRP) and real minimum wage (rmw) respectively using the consumer price index (excluding raw food and energy) of the Trade Policy and Strategy Office of the Ministry of Commerce of Thailand. In addition, the trade volume (unit: TEU (Twenty-foot Equivalent Unit)) of major ports published by the Ministry of Transport and the Bangkok Shipowners and Agents Association is used to calculate the Port Access (PA) index described below.[26]

4.2. Supplier access

One of the factors that encourages Japanese firms to enter Thailand is the existence of supply and sales networks in Thailand. In this paper, we use concepts such as supplier and market access to examine the effects of supply and sales networks. These concepts can also be rephrased as backward and forward linkage, respectively, as defined by Hirschman (1958).[27] Amiti and Javorcik (2008)

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[23] The manufacturing industry covers firms in the following industries: food, textiles and clothing, pulp and paper, chemicals, pharmaceuticals, petroleum and coal, rubber products, glass and stone, iron and steel, non-ferrous metals, metal products, machinery, electrical equipment, transportation equipment, precision equipment, and other manufacturing industries. The firms listed may differ depending on the edition, but this paper uses data from the 2013, 2018, and 2023 editions. It is possible that firms that have withdrawn from the market may not have been captured, but the impact on the analysis results is thought to be minor.

[24] It is also possible to divide it according to the production value of each industry.

[25] The nominal minimum wage is based on the value as of June of each year. Bueng Kan province was separated from Nong Khai province on March 23, 2011, but since there was no data for 2011, data for Nong Khai province was used for that year. Note that Bueng Kan province is not included in the analysis before 2010.

[26] The trading volume for Ranong Port from 2006 to 2010 was not published, and since the trading volume from 2011 onwards has also been negligible, it has been excluded from the analysis here.

[27] On this point, see also Debaere, Lee and Paik (2010).

calculated supplier and market access separately for inner- and outer-provincial Chinese firms and attempted to estimate provincial border barriers, but in Thailand, provincial border barriers are not as important. Therefore, in this paper, while based on the definition of Amiti and Javorcik, we divide into local and foreign firms and focus on their relative roles and dynamic changes.

Supplier access is an index related to the availability of intermediate inputs and can be divided into $SA(I)^i_{p,t}$ within the province and $SA(O)^i_{p,t}$ outside the province. In this paper, however, it is classified into $SA(I)^i_{L,p,t}$ and $SA(O)^i_{L,p,t}$ related to local firms, and $SA(I)^i_{F,p,t}$ and $SA(O)^i_{F,p,t}$ related to foreign firms. Supplier access within the province is defined as follows:

$$SA(I)^i_{B,p,t} = \sum_{j=1}^{J} a_{ij} * \phi^j_{B,p,t} * D_{pp}^{-1}, where\ \phi^j_{B,p,t} = \frac{Y^j_{B,p,t}}{Y^j_{B,Thailand,t}}$$

Here, $\phi^j_{B,p,t}$ is the ratio of the production value of industry j produced in province p at time t to the total production value of industry j produced throughout Thailand, and if $B = L$, it is the value for local firms, and if $B = F$, it is the value for foreign firms. Since each industry uses multiple intermediate goods, the ratio of these production values is weighted by the coefficient a_{ij} of the output of industry j supplied to industry i as intermediate inputs, where a_{ij} is derived from Thai input-output table. In particular, for industries with high input-output coefficients with other industries, the agglomeration of related industries also has a very significant impact, so weighting by the input-output coefficients for all industries is very important when considering location. Then, to make it possible to compare with supplier access outside the province, we assume that the province is a circle, as in Leamer (1997), and adjust for the intra-provincial distance D_{pp}.[28]

$$D_{pp} = \sqrt{\frac{Area_p}{\pi}}.$$

Additionally, the availability of intermediate inputs from other provinces in Thailand is calculated as follows:

$$SA(O)^i_{B,p,t} = \sum_{j=1}^{J} a_{ij} \sum_{l \neq p}^{P} \phi^j_{B,l,t} * D_{lp}^{-1},$$

This equation is similar to the intra-provincial index, but the share of output produced in each province is weighted by the inverse of the distance from province p to province l, as in Harris (1954).

4.3. Market access

Market access is an indicator of the extent to which each industry in a province has sales destinations. It can be divided into $MA(I)^i_{p,t}$ within the province and $MA(O)^i_{p,t}$ outside the province. In this paper, it is classified into $MA(I)^i_{L,p,t}$ and $MA(O)^i_{L,p,t}$ for local firms, and $MA(I)^i_{F,p,t}$ and $MA(O)^i_{F,p,t}$ for foreign firms. Market access within a province is defined as follows:

[28] Assuming the province is a circle, D_{pp} is equal to the radius of the circle.

$$MA(I)^{i}_{B,p,t} = \left[\sum_{j=1}^{J} b_{ij} * \phi^{j}_{B,p,t} + b_i * \lambda_{p,t}\right] * D^{-1}_{pp}, with\ \lambda_{p,t} = \frac{GDP_{p,t}}{GDP_{Thailand,t}}$$

The share of output from industry i produced in province p is weighted by the proportion b_{ij} of output from industry i sold to industry j as intermediate inputs and the proportion b_i of output finally consumed by households. The coefficients b_{ij} and b_i are calculated based on the input-output table for Thailand. If $B = L$, it is the value for local firms, and if $B = F$, it is the value for foreign firms, but since λ is an indicator for final consumption by households, no distinction is made between local and foreign firms. Similarly, market access outside the province is defined as follows:

$$MA(O)^{i}_{B,p,t} = \sum_{j=1}^{J} b_{ij} \sum_{l \neq p}^{P} \phi^{j}_{B,l,t} * D^{-1}_{lp} + b_i \sum_{l \neq p}^{P} \lambda_{l,t} * D^{-1}_{lp}$$

Here, each province's consumption of industry i output is weighted by the inverse of the distance between provinces, similar to supplier access.

We also define the related indicators for supplier and market access as follows, with omitted symbols used where appropriate.

$$SA(I)^{i}_{L,p,t} + SA(I)^{i}_{F,p,t} = SA\_IL + SA\_IF = SA\_I$$
$$SA(O)^{i}_{L,p,t} + SA(O)^{i}_{F,p,t} = SA\_OL + SA\_OF = SA\_O$$
$$MA(I)^{i}_{L,p,t} + MA(I)^{i}_{F,p,t} = MA\_IL + MA\_IF = MA\_I$$
$$MA(O)^{i}_{L,p,t} + MA(O)^{i}_{F,p,t} = MA\_OL + MA\_OF = MA\_O$$

Here, SA_I is the supplier access of local and foreign firms within the province, and SA_O is the supplier access of local and foreign firms outside the province. The same is true for market access. Each value is calculated for each industry, province, and year.

4.4. Japanese access

The above supplier and market access were calculated by using data on foreign capital from the Thai Industrial Census to distinguish between local and foreign firms. However, when Japanese firms enter the market, foreign firms, especially Japanese firms that are already in the market, may have a significant impact.[29] Therefore, in this section, we calculate the supplier and market access of Japanese firms by using $\tau^{j}_{p,t}$ instead of $\phi^{j}_{F,p,t}$ based on the status of Japanese firms entering the market in the *Kaigai Shinshutsu Kigyo Soran*.

$$\tau^{j}_{p,t} = \frac{Y^{j}_{JPN,p,t}}{Y^{j}_{JPN,Thailand,t}}$$

Here, $\tau^{j}_{p,t}$ is the ratio of the production value of industry j produced in province p by Japanese firms at time t to the total production value of industry j produced throughout Thailand by

[29] The data from the *Thailand Industrial Census* includes information on whether foreign capital is included, but the nationality of the foreign capital is unknown, except for the 2007 edition. There are many studies on the significant impact of the presence of existing Japanese firms (especially affiliated firms). For example, see Belderbos and Carree (2002).

Japanese firms. However, since the production value of Japanese firms is often unknown, we will assume that the production value of all Japanese firms is the same.[30]

4.5. Port access

When choosing a location for a firm, it is very important to have infrastructure that makes it easy to export or import products. In particular, not only Bangkok Port, but also Laem Chabang Port, which was built in Chonburi Province in the Eastern Seaboard Industrial Zone, has contributed greatly to the development of the Thai economy and has greatly promoted the advancement of firms into the Eastern Seaboard Industrial Zone, such as Chonburi and Rayong Province. In addition, private ports such as Samut Prakan Province, which are not managed by the Port Authority, also have a large impact. Here, port access is defined as follows:

$$PA_{p,t} = \varphi_{p,t} * D_{pp}^{-1} + \sum_{l \neq p}^{P} \varphi_{l,t} * D_{lp}^{-1}, with\ \varphi_{p,t} = \frac{EX_{p,t}}{EX_{Thailand,t}}$$

Here, $\varphi_{p,t}$ is the ratio of the transport volume (total volume of exports and imports, unit: TEU) of the port in province p at time t to the handling volume of ports in Thailand as a whole. Even provinces that do not face the sea or large rivers are given a port access value according to the distance to the port.[31]

5. Estimation results

Panel data of local subsidiaries × provinces × years was used for the estimation. The dependent variable is whether or not a local subsidiaries of Japanese manufacturing firms in Thailand is located in province p in year t, and is set to 1 if it is located there and 0 if it is not. The data used is microdata from the *Kaigai Shinshutsu Kigyo Soran* mentioned in 4.1.The explanatory variables are the real average wage, supplier access, and market access in each province and industry, and real minimum wage, real GRP, and port access in each province, and their logarithmic values are taken.[32] The analysis of Japanese firms' entry into Thailand is divided into three periods, namely

[30] Of the sample firms, only about one-third had data on production value. Although it is possible to calculate the access index based on this data, the number of samples per industry is small, and sample bias is large.

[31] Although data on transport value should be used instead of transport volume, data on transport volume is used in light of data availability. The Ministry of Transport also publishes the import and export volumes (unit: ton) of Chiang Saen Commercial Port and Chiang Khong Port, which face the Mekong River in Chiang Rai Province in northern Thailand, but does not publish container volume (unit: TEU), probably because the riverbed is shallow and large container ships cannot navigate or dock there, and therefore it is not included in the calculation of port access. However, the import and export volumes are very small compared to other ports. Meanwhile, railways have been laid in industrial parks built in Udonthani Province in northern Thailand, connecting them to Laos and China, and it is expected that trade will expand through these routes and that FDI will increase accordingly.

[32] Although the real minimum wage and real wage are both indices related to the same wage, the former is prone to being influenced by political intentions. In addition, for firms that move into a

2006-2010 (Analysis 1), 2011-2015 (Analysis 2), and 2016-2020 (Analysis 3). These periods basically correspond to the periods of the *Thailand Industrial Census*, but analyses using different periods are also conducted to check robustness and analyze the effects of policies. The sample size is 34,960 in Analysis 1, 79,310 in Analysis 2, and 25,025 in Analysis 3.[33] By conducting analyses over these different time periods, we can examine not only the factors behind location choices, but also the dynamic changes in the Thai economy and Japanese firms.[34] In what follows, we use a conditional logit model to estimate the location choices of Japanese manufacturing subsidiaries in Thailand. Descriptive statistics are as follows:

Variable	Obs	Mean	Std. dev.	Min	Max
rwages	34,960	76177.06	33995.99	1212.222	284615.1
rmw	34,960	156.1119	13.94706	141.4141	198.8417
rGRP	34,960	119812.9	313851.8	7698.925	3001447
PA	34,960	.0040592	.0046139	.0008975	.0218971
SA_I	34,960	.000641	.0021917	1.79e-08	.0224462
SA_O	34,960	.0517204	.0583888	.0031438	.4728182
SA_IL	34,960	.0003195	.001143	1.79e-08	.0166081
SA_IF	34,960	.0003215	.0011961	3.70e-12	.0125074
MA_I	34,960	.0006098	.002117	2.61e-08	.036038
MA_O	34,960	.0046641	.005223	.0002	.0637553
MA_IL	34,960	.0003066	.0011328	1.39e-08	.0210023
MA_IF	34,960	.0003032	.0011235	4.87e-09	.0189127
SA_IJ	34,960	.0003123	.0011802	1.38e-08	.0115071
SA_OJ	34,960	.0024684	.0028651	.0001298	.0232737
MA_IJ	34,960	.0055907	.0173057	.0004026	.1136208
MA_OJ	34,960	.0023828	.0027706	.0000948	.0354659

Table 1. Descriptive statistics (Analysis 1)

country with the aim of low wages, the real minimum wage may be more important, while for firms that move into a country with the aim of producing higher added value, there are cases where higher wage levels are acceptable according to the level of ability, and the two wage indices may have different tendencies. Therefore, it is important to distinguish between the two and examine their economic and policy effects. The correlation coefficient between the real average wage and the real minimum wage was 0.5152 from 2006 to 2010, 0.1000 from 2011 to 2015, and 0.2768 from 2016 to 2020, which shows that not only is the correlation weak, but it is also susceptible to policy influences.

[33] For Analysis 2, we basically used ISIC Rev. 4, but also used Rev. 3 as a robustness test (see Table A1 in the Appendix). The results were almost the same.

[34] Some papers use data from one year ago as explanatory variables, but when a firm chooses a location, it may (or rather, is more common) make the decision while predicting future conditions rather than past conditions. However, since it is not easy to predict and verify future data, we have not generally included a time lag here. However, there is a possibility that problems with simultaneity or endogeneity may arise, and there is also the issue that Japanese firms are included in the foreign firms in the *Thailand Industrial Census*. But this is not thought to be a major problem because indices such as supplier and market access are intricately combined with data for all provinces and industries, so each firm's share of these variables is very small. We will also conduct an analysis that can address these issues later as a robustness test.

Variable	Obs	Mean	Std. dev.	Min	Max
rwages	79,310	87406.72	45533.37	1415.115	1067978
rmw	79,310	237.6169	41.14129	150	272.9233
rGRP	79,310	148911.5	412710.7	8103.206	3919910
PA	79,310	.0039419	.0044699	.0008918	.0225396
SA_I	79,310	.0006954	.0024086	2.30e-08	.0403487
SA_O	79,310	.0477923	.0536877	.0030375	.431802
SA_IL	79,310	.0003485	.0011297	2.30e-08	.0105715
SA_IF	79,310	.0003469	.0014024	1.42e-12	.0300127
MA_I	79,310	.0008083	.0036882	1.06e-06	.0829163
MA_O	79,310	.006223	.0106931	.0004985	.1704013
MA_IL	79,310	.0004146	.0018732	5.90e-07	.037352
MA_IF	79,310	.0003937	.0019423	4.28e-08	.0523491
SA_IJ	79,310	.0003363	.00123	6.54e-09	.016935
SA_OJ	79,310	.0315291	.0361459	.0019457	.3005199
MA_IJ	79,310	.0003573	.00213	4.65e-06	.0660491
MA_OJ	79,310	.0035847	.0057205	.000597	.0851217

Table 2. Descriptive statistics (Analysis 2)

Variable	Obs	Mean	Std. dev.	Min	Max
rwages	25,025	94146.48	52763.62	585.1324	986057.7
rmw	25,025	268.3861	6.098545	259.8546	286.6552
rGRP	25,025	176626	522498.2	10935.1	4881566
PA	25,025	.0038856	.0043914	.000897	.0228725
SA_I	25,025	.0004289	.0014014	1.30e-08	.0183431
SA_O	25,025	.0388324	.044015	.0004652	.3258606
SA_IL	25,025	.0002549	.0008846	1.30e-08	.0121061
SA_IF	25,025	.000174	.000627	1.42e-12	.0080491
MA_I	25,025	.0005661	.0021203	1.37e-06	.0511544
MA_O	25,025	.0042584	.0059384	.0003266	.1030892
MA_IL	25,025	.0003324	.0013013	7.23e-07	.0281904
MA_IF	25,025	.0002338	.0009286	3.85e-08	.022964
SA_IJ	25,025	.000266	.0010003	6.54e-09	.0109368
SA_OJ	25,025	.0257342	.0300158	.0002931	.2327158
MA_IJ	25,025	.0002933	.0013997	4.65e-06	.0340876
MA_OJ	25,025	.003147	.0040876	.0005628	.0571213

Table 3. Descriptive statistics (Analysis 3)

Table 4 shows the estimation results for Analysis 1 (2006-2010). Many explanatory variables are significant, and it can be seen that the higher the real wage, real GRP, and port access index by province and industry, the more likely Japanese firms are to locate in that province.[35] Particularly interesting is the fact that higher wage levels have a positive effect on location choice. For example, many studies, such as Amiti and Javorcik (2008), have shown that high wage levels often have a negative effect on location choice within the host country, which means that location choice is aimed at finding low-wage workers. However, in the case of Japanese firms in Thailand at this time, this is not necessarily due to the aim of finding low-wage workers.[36] On the other hand, the coefficient of the real minimum wage is significantly negative in many models, indicating that Japanese firms are moving into provinces with low real minimum wages. The real minimum wage is influenced by policies and historical developments, and we will re-examine this in Analyses 2 and 3. However, as mentioned in Section 1, this may be related to the fact that, between 2000 and 2010, the purpose of Japanese firms entering Thailand changed from low wages to the existence of production networks.

Comparing models (2) and (3) and models (6) and (7), we find that supplier and market access within a province are significantly positive, while those outside the province are significantly negative. This means that firms are expanding into provinces with high access indices within the province, rather than those with high supplier and market access outside the province. This suggests that supply and sales networks within the province, particularly within the same industry or related industries, are very important, while supply and sales networks across provincial borders are relatively small.

Furthermore, looking at models (4) and (5), supplier access is significantly positive for both local and foreign firms in the province. When Japanese firms enter a province, the underdevelopment of local firms that supply intermediate goods has sometimes been seen as an issue, but it can be seen

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[35] Real wages by province and industry were calculated from the *Thai Industrial Census*, but because there is an endogeneity issue, such as wage levels being affected by FDI, we hope to reduce this endogeneity by also estimating real wages by province calculated from real GRP and number of workers.

Furthermore, when speaking with people involved in industrial parks in Thailand, they said that access to Bangkok, Thailand's leading commercial city, and the presence of Japanese schools for children also play important roles in choosing a location. We also estimated these variables, and the results were similar to those in this paper.

[36] According to Nielsen et al. (2017), 49% of studies reported a significant negative association between low wages and FDI location choice, 17% reported an inverse association, and 34% reported no correlation. In addition, wage levels and unobserved characteristics may not be independent, but Liu et al. (2010) argued that wages have a negative effect on FDI by controlling for them using the cross term between wage levels and technology intensity. However, these studies often focus on China around 2000, which is different from the situation in Thailand during the period covered by this study. In this regard, a comparison with analyses using the 1997 and 2002 versions of the *Thai Industrial Census* is desirable.

In addition, if only firms with a foreign capital ratio of 50% or more are considered foreign firms, the wage level in model (5) becomes insignificant. This may mean that foreign firms that hold more than 50% of the capital do not place importance on high wage levels as a factor in location choice (see Table A2).

that the supply of intermediate goods from local firms, in addition to existing foreign firms, has become important. In other words, this suggests that there may be a spillover effect on local firms upstream of foreign firms.[37] This is related to the policy emphasis on procurement from local firms, as mentioned in Section 1.[38] However, comparing models (8) and (9), while market access for foreign firms is significantly positive, market access for local firms in the province is not significant. This tells us that when Japanese firms enter a province, they place importance on the possibility of selling to foreign firms, but selling to local firms is not as important. This illustrates that downstream spillover effects from foreign firms to local firms may not be occurring sufficiently.

In addition, to what extent does the presence of existing Japanese firms have an impact on new entrants in Thailand? In the above analysis, we looked at the impact of all foreign firms, including Japanese firms, but here we focus on Japanese firms to examine the differences.[39] However, because the nature of the data is different, comparisons should be made with caution.[40] The results of models (10) and (12) are similar to models (5) and (9), and show that the supply and sales networks of existing Japanese firms in the provinces where new ventures are being considered are extremely important.[41] Moreover, as shown in models (11) and (13), the supplier and market access of Japanese firms outside the province are significantly negative. This suggests that the supply and sales networks of Japanese firms in the industry or related industries concentrated in a particular province are very important, while the importance of networks across provincial borders is relatively low.

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[37] Regarding the upstream and downstream spillover effects, see also Javorcik (2004). We plan to conduct a detailed analysis of the spillover effects of foreign firms in Thailand in other paper.

[38] It is possible to examine the impact of policies such as tariffs on specific provinces, but since there are as many studies showing a positive correlation as there are studies showing a negative correlation with the impact of such policies on FDI, and it would be difficult to examine differences by province, this is not addressed in this paper. See also Nielsen et al. (2017) on this point.

[39] There are no significant differences between foreign firms overall and Japanese firms, but some differences are observed in Analysis 3, which we will re-examine later.

[40] Japanese share of FDI in Thailand is as mentioned in Section 1, but according to the 2007 *Thai Industrial Census*, which lists the nationalities of foreign firms, of the 1,972 business establishments containing foreign capital, Japanese firms hold the largest number of shares in 791 establishments.

[41] Since a simple comparison is not possible, it is not appropriate to calculate and compare marginal effects, but we will examine this point in more detail later.

VARIABLES	(1) Basic enter_y	(2) lnSA_I enter_y	(3) lnSA_O enter_y	(4) lnSA_IL enter_y	(5) lnSA_IF enter_y	(6) lnMA_I enter_y	(7) lnMA_O enter_y	(8) lnMA_IL enter_y	(9) lnMA_IF enter_y	(10) lnSA_IJ enter_y	(11) lnSA_OJ enter_y	(12) lnMA_IJ enter_y	(13) lnMA_OJ enter_y
lnrwages	1.996***	1.223***	1.721***	1.752***	0.922***	1.380***	1.861***	1.938***	0.928***	0.559	1.863***	1.258***	1.820***
	(0.319)	(0.345)	(0.339)	(0.332)	(0.348)	(0.339)	(0.328)	(0.325)	(0.346)	(0.369)	(0.340)	(0.336)	(0.341)
lnrmw	-6.477***	-8.642***	-1.073	-7.582***	-8.260***	-8.214***	-3.080**	-6.821***	-8.651***	-6.963***	-0.292	-6.947***	-0.129
	(0.997)	(1.032)	(1.292)	(1.074)	(0.981)	(1.032)	(1.260)	(1.044)	(1.023)	(0.967)	(1.301)	(0.993)	(1.260)
lnrGRP	0.683***	0.420***	0.590***	0.582***	0.393***	0.472***	0.601***	0.643***	0.428***	0.0729	0.438***	0.225**	0.450***
	(0.0797)	(0.0902)	(0.0868)	(0.0879)	(0.0883)	(0.0884)	(0.0847)	(0.0881)	(0.0870)	(0.0946)	(0.0913)	(0.102)	(0.0907)
lnPA	1.463***	1.106***	2.279***	1.255***	1.176***	1.035***	1.925***	1.351***	1.167***	0.754***	2.499***	1.086***	2.492***
	(0.143)	(0.152)	(0.183)	(0.160)	(0.146)	(0.159)	(0.171)	(0.176)	(0.148)	(0.155)	(0.195)	(0.156)	(0.184)
lnSA_I		0.503***											
		(0.0856)											
lnSA_O			-1.759***										
			(0.255)										
lnSA_IL				0.218***									
				(0.0813)									
lnSA_IF					0.449***								
					(0.0656)								
lnMA_I						0.473***							
						(0.0878)							
lnMA_O							-1.049***						
							(0.228)						
lnMA_IL								0.0896					
								(0.0831)					
lnMA_IF									0.523***				
									(0.0721)				
lnSA_IJ										0.744***			
										(0.0797)			
lnSA_OJ											-1.923***		
											(0.248)		
lnMA_IJ												0.633***	
												(0.0928)	
lnMA_OJ													-2.030***
													(0.236)
Observations	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960
Pseudo R-squared	0.367	0.379	0.383	0.369	0.386	0.376	0.374	0.367	0.384	0.426	0.387	0.383	0.392

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Estimation results (Analysis 1)

Secondly, regarding analysis 2 (2011-2015) (see Table 5), as in analysis 1, real wages and real GRP are significantly positive. Furthermore, when comparing models (2) and (3) and models (6) and (7), as in analysis 1, supplier and market access within the province are significantly positive, while those outside the province are significantly negative. However, while models (4) and (5) are similar to analysis 1, models (8) and (9) show that market access not only for foreign firms in the province but also for local firms is significantly positive at the 10% level, though not at the 1% level, indicating that sales to local firms are becoming increasingly important.

On the other hand, the coefficient of the real minimum wage is significantly positive, which is the opposite of Analysis 1. This is related to the fact that, as mentioned in Section 1, the Thai government raised the nominal minimum wage in 2012 to reduce the disparity between provinces, and unified the nominal minimum wage nationwide to 300 baht per day from 2013 to 2016.[42] In any case, it is suggested that Japanese firms have expanded into provinces with higher real minimum wages during this period, and that expansion for the purpose of low wages has further decreased. This may be related to the advancement of industries, goods, and processes from labor-intensive industries, goods, and processes that utilize low-wage workers to capital-intensive industries, goods, and processes that utilize higher skills, as suggested by the flying geese theory. Regarding the port access index, there are several models in which it is not significant or has a negative sign, contrary to the assumption, only in this Analysis 2. This is related to the fact that the ports of Bangkok and Samut Prakan became unusable due to the major floods in 2011, which led to a decline in the port access index of both provinces. Regarding the influence of Japanese firms, the trends seen are roughly the same as in Analysis 1.

[42] Furthermore, if the estimation period in Analysis 1 is extended to 2011 or 2012, the significance of the real minimum wage gradually disappears and the number of models with a positive coefficient increases.

VARIABLES	(1) Basic enter_y	(2) lnSA_I enter_y	(3) lnSA_O enter_y	(4) lnSA_IL enter_y	(5) lnSA_IF enter_y	(6) lnMA_I enter_y	(7) lnMA_O enter_y	(8) lnMA_IL enter_y	(9) lnMA_IF enter_y	(10) lnSA_IJ enter_y	(11) lnSA_OJ enter_y	(12) lnMA_IJ enter_y	(13) lnMA_OJ enter_y
lnrwages	2.486***	2.584***	1.966***	2.718***	2.455***	2.635***	2.114***	2.521***	2.627***	2.087***	2.155***	2.096***	1.992***
	(0.138)	(0.204)	(0.169)	(0.170)	(0.239)	(0.168)	(0.154)	(0.142)	(0.219)	(0.241)	(0.151)	(0.227)	(0.151)
lnrmw	2.692***	2.583***	3.043***	2.609***	2.595***	2.666***	3.032***	2.678***	2.735***	2.796***	3.031***	2.941***	3.211***
	(0.417)	(0.420)	(0.428)	(0.418)	(0.423)	(0.419)	(0.427)	(0.417)	(0.422)	(0.423)	(0.426)	(0.424)	(0.430)
lnrGRP	0.674***	0.489***	0.842***	0.513***	0.504***	0.400***	0.743***	0.616***	0.310***	0.232***	0.683***	0.124**	0.679***
	(0.0429)	(0.0491)	(0.0495)	(0.0482)	(0.0488)	(0.0534)	(0.0459)	(0.0528)	(0.0545)	(0.0543)	(0.0449)	(0.0578)	(0.0454)
lnPA	0.706***	-0.0366	1.629***	0.208**	-0.0186	0.196**	1.404***	0.592***	0.171*	-0.317***	1.549***	-0.108	1.625***
	(0.0802)	(0.101)	(0.110)	(0.0988)	(0.0960)	(0.0958)	(0.105)	(0.101)	(0.0885)	(0.103)	(0.114)	(0.0966)	(0.108)
lnSA_I		0.466***											
		(0.0431)											
lnSA_O			-1.555***										
			(0.133)										
lnSA_IL				0.336***									
				(0.0396)									
lnSA_IF					0.387***								
					(0.0384)								
lnMA_I						0.461***							
						(0.0519)							
lnMA_O							-1.144***						
							(0.121)						
lnMA_IL								0.0951*					
								(0.0509)					
lnMA_IF									0.542***				
									(0.0471)				
lnSA_IJ										0.608***			
										(0.0535)			
lnSA_OJ											-1.230***		
											(0.129)		
lnMA_IJ												0.739***	
												(0.0470)	
lnMA_OJ													-1.573***
													(0.138)
Observations	79,310	79,310	79,310	79,310	79,310	79,310	79,310	79,310	79,310	79,310	79,310	79,310	79,310
Pseudo R-squared	0.377	0.397	0.397	0.388	0.401	0.388	0.390	0.377	0.400	0.423	0.390	0.423	0.396

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Estimation results (Analysis 2)

Thirdly, in analysis 3 (2016-2020) (see Table 6), the real minimum wage, real GRP, and port access are significantly positive, similar to analysis 2. However, the real wage is no longer significant, especially in models that incorporate the access index within the province, suggesting that the importance of wage levels has decreased.[43] This may mean that the importance of supply and sales networks has further increased. In addition, looking at models (3) and (7), supplier and market access outside the province were significantly negative at the 1% level in analyses 1 and 2, but were significantly negative at the 5% level in analysis 3, suggesting that supply and sales networks across province borders have expanded somewhat more than before. In particular, when comparing models (11) and (13) with previous analyses, the significance level has dropped significantly, suggesting that Japanese firms are expanding their supply and sales networks with Japanese firms not only within the province but also outside the province.[44] In addition, when comparing models (8) from Analysis 1 to Analysis 3, market access for local firms in the province was not significant in Analysis 1, but was significantly positive at the 10% level in Analysis 2 and was significantly positive at the 1% level in Analysis 3, illustrating that as local firms developed, this became important for the entry of Japanese firms into the province. This suggests that spillover effects may be occurring not only upstream but also downstream of foreign firms.

[43] In addition, to test robustness, if we use the real wages by province calculated from the *Thailand Statistical Yearbook* instead of the real wages by province and industry calculated from the *Thai Industrial Census*, the results in even more models in Analysis 3 become insignificant (see Table A3). This not only shows that the importance of wage levels is declining, but also shows the importance of verifying at the industry level. Incidentally, the correlation coefficient between the two wages (real wages by province and industry and real wages by province) during this period (2016-2020) was 0.45.

[44] Although not shown in the table, for all foreign firms, including Japanese firms, the coefficient was significantly negative in all analyses 1 to 3, which indicates that foreign firms other than Japanese firms do not have extensive networks with foreign firms outside the province.

VARIABLES	(1) Basic enter_y	(2) lnSA_I enter_y	(3) lnSA_O enter_y	(4) lnSA_IL enter_y	(5) lnSA_IF enter_y	(6) lnMA_I enter_y	(7) lnMA_O enter_y	(8) lnMA_IL enter_y	(9) lnMA_IF enter_y	(10) lnSA_IJ enter_y	(11) lnSA_OJ enter_y	(12) lnMA_IJ enter_y	(13) lnMA_OJ enter_y
lnrwages	1.211***	-0.0872	0.983***	0.532	0.0944	0.867**	0.994***	1.090***	0.499	-0.138	1.168***	0.0768	1.131***
	(0.351)	(0.437)	(0.354)	(0.418)	(0.442)	(0.399)	(0.349)	(0.375)	(0.425)	(0.436)	(0.349)	(0.411)	(0.348)
lnrmw	11.11***	13.53***	10.22***	11.13***	13.93***	12.68***	8.039***	11.27***	14.90***	11.77***	10.85***	12.25***	10.80***
	(2.560)	(2.553)	(2.528)	(2.546)	(2.579)	(2.620)	(2.786)	(2.575)	(2.724)	(2.550)	(2.550)	(2.580)	(2.542)
lnrGRP	0.651***	0.509***	0.723***	0.520***	0.567***	0.428***	0.690***	0.506***	0.334***	0.205**	0.649***	0.138	0.647***
	(0.0704)	(0.0776)	(0.0781)	(0.0769)	(0.0759)	(0.0930)	(0.0735)	(0.0880)	(0.0973)	(0.0919)	(0.0708)	(0.0924)	(0.0709)
lnPA	1.166***	0.782***	1.461***	0.936***	0.815***	0.969***	1.493***	1.004***	1.030***	0.409**	1.296***	0.491**	1.333***
	(0.160)	(0.179)	(0.192)	(0.177)	(0.170)	(0.175)	(0.201)	(0.176)	(0.170)	(0.189)	(0.194)	(0.192)	(0.189)
lnSA_I		0.533***											
		(0.0896)											
lnSA_O			-0.559**										
			(0.219)										
lnSA_IL				0.350***									
				(0.0791)									
lnSA_IF					0.335***								
					(0.0659)								
lnMA_I						0.364***							
						(0.103)							
lnMA_O							-0.538**						
							(0.214)						
lnMA_IL								0.237***					
								(0.0905)					
lnMA_IF									0.455***				
									(0.0993)				
lnSA_IJ										0.550***			
										(0.0852)			
lnSA_OJ											-0.216		
											(0.193)		
lnMA_IJ												0.727***	
												(0.0892)	
lnMA_OJ													-0.315
													(0.205)
Observations	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025
Pseudo R-squared	0.403	0.420	0.406	0.412	0.416	0.408	0.406	0.406	0.412	0.436	0.403	0.440	0.404

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Estimation results (Analysis 3)

Furthermore, because the nature of the data underlying the access index differs, care must be taken when simply comparing the pseudo-R^2 coefficients between models. However, it is possible to examine the dynamic changes from Analysis 1 to 3. Comparing models (4) and (8) from Analysis 1 to 3 with models (5) and (9), the pseudo-R^2 coefficient of the former, i.e., the model using the supplier and market access of local firms within the province, shows a larger increase, denoting the growing importance of local firms. Comparing models (5) and (10) from Analysis 1 to 3, the pseudo-R^2 coefficient of the former, which uses the supplier and market access of local firms within the province, increases, while the pseudo-R^2 coefficient of the latter, which uses the supplier access of foreign firms within the province, does not change much, indicating that Japanese firms are becoming more dependent on foreign firms other than Japanese firms for the supply of intermediate goods, rather than connecting with other Japanese firms.[45] Moreover, except for model (10) using supplier access within the province for Japanese firms, in which the pseudo-R^2 coefficient did not change much, the pseudo-R^2 coefficient has been increasing year by year in all models. This suggests that the analytical framework used in this paper is becoming increasingly effective year by year.

Although this is an analysis of a short period (2006-2020), the fact that supplier and market access for local firms have become important is consistent with the advancement of Thai manufacturing as revealed in Section 1. In addition, Japanese firms have strengthened their supply networks not only with other Japanese firms but also with other foreign firms, and supply and sales networks are expanding not only within specific provinces but also across provincial borders. The trade structure between Japan and Thailand has tended to become fixed since 2000, but while networks with local and foreign firms other than Japanese firms have gradually developed, the importance of the agglomeration of existing Japanese firms has declined relatively, and supply and sales networks involving local and foreign firms both within and outside the province have gradually been built. These indicate that while distance and agglomeration, which new economic geography emphasizes, are important, as supply and sales networks gradually expand and division of labor progresses, a flying-geese pattern of development at the parts level (see Figures 4 and 3) is progressing, involving local firms as well.

6. Concluding remarks

In this paper, we conducted static and dynamic analysis of the Thai economy and Japanese firms based on new economic geography and flying geese theory. As Thai manufacturing industry and trade structure become more sophisticated, agglomerations, including forward and backward linkage effects such as supplier and market access, and RVCs have played an important role in attracting Japanese firms to Thailand. As the flying geese theory suggests, while there is FDI

[45] The trends in the pseudo-R^2 coefficient for several models from Analysis 1 to 3 are summarized below.
Model 4 (SA_IL): 0.369, 0.388, 0.412, Model 5 (SA_IF): 0.386, 0.401, 0.416
Model 8 (MA_IL): 0.367, 0.377, 0.406, Model 9 (MA_IF): 0.384, 0.400, 0.412
Model 10 (SA_IJ): 0.426, 0.423, 0.436, Model 12 (MA_IJ): 0.383, 0.423, 0.440

relocating to less developed countries in pursuit of low-wage labor, foreign capital (especially Japanese) is increasing in Thailand despite rising wage levels, and the reason for this is the increasing importance of local supply and sales networks rather than wages. In addition, the role of local firms is also increasing, and supply and sales networks involving local firms are being built along with the development of Thai manufacturing. Furthermore, networks with foreign firms other than Japanese and outside the province are also expanding, and it has become clear that the productivity of local firms is increasing, and the productivity gap with foreign firms is shrinking in this environment.

On the other hand, diseconomies of agglomeration and the advancement of economies also give rise to dispersion mechanisms. As wage levels rise, labor-intensive industries, goods, and processes tend to relocate to less developed countries or regions, and excessive concentration in Bangkok is also a factor encouraging dispersion to other countries and regions.

China, which had attracted huge amounts of foreign capital, is now dramatically reducing its acceptance of FDI due to political and economic factors, and firms that have set up operations there are withdrawing from the country one after another. As the conflict between the United States and China intensifies, decoupling and the creation of new supply and sales networks are becoming increasingly important from political, economic, and military perspectives. In particular, the containment and networking of exposure equipment, foundry, and related industries in the semiconductor industry is an issue that requires particular attention from the perspectives of economics, policy, and corporate strategy, as it further complicates the vertically non-integrated production networks that have been built up until now as the division of labor has progressed.[46]

Furthermore, as firms are withdrawing from China and other countries, one of the important countries that is newly accepting firms and investments is Vietnam, as noted in Figure 6. This trend is the inter-district dispersion discussed in Section 3, and while dispersion is occurring at the product and process level, firms are being incorporated into wider regional supply and sales networks, forming intra-regional agglomerations that cross borders across multiple regions.

Will the Thai economy continue to develop in the future, or will it fall into the so-called middle-income trap? In addition, the disruption of supply and sales networks and the restraint of overseas expansion caused by the impact of Covid-19 make the future even more uncertain. However, it will be essential for Thailand to advance its industrial and trade structure by involving not only foreign firms but also local firms, and to expand its supply and sales networks (or RVCs) throughout the Indochina Peninsula, including the CLMV countries. This paper has also shown what direction the governments and firms of Japan and Thailand should aim for as the division of labor and RVCs progress, but rather than repeatedly relocating to pursue low-wage labor, it is becoming increasingly important to build supply and sales networks in specific countries and regions, as well as in wider regions (such as East and Southeast Asia).

[46] On this point, see also Suenaga (2010).

The analysis in this paper has shed light on the process of building supply and sales networks, with a focus on Thailand, but at the same time, it also shows that this process does not proceed overnight. Excessive policy intervention in supply and sales networks will entail short-term economic and social losses, but it goes without saying that we should analyze various countries and industries while also considering the direction of future policies and corporate strategies, based on the framework of theoretical and econometrical analysis such as this paper and its analytical results.

The contribution of this paper is that it uses micro data from both the host country and the firms that have moved there to theoretically and econometrically elucidate the relative roles of local, foreign, and Japanese firms, with a focus on Thailand, and the dynamic changes occurring there. In addition, the fact that the dynamic changes are clarified structurally using indicators such as PCI and IIT, rather than just econometrical analysis, is an essential and original contribution.[47]

It has been suggested that the flying geese theory has become less effective as the division of labor advances, but as the division of labor advances, not only intra-district agglomerations but also intra-regional agglomerations spanning multiple countries have been established, and RVCs have been established rather than GVCs (Baldwin and Okubo, 2013). In this context, capital and technology transfers from advanced countries to less advanced countries, and flying geese development at the goods level, as clarified in Section 1, are occurring. These are consistent with the theory of FFG discussed in Section 3, but systematic and detailed analysis at the regional level including more countries than just specific countries is desired.

In addition, the econometric analysis in this paper is limited to a period of 15 years, and it would be desirable to conduct analyses earlier or later. Also, due to time constraints, we have not been able to go into the details of the analysis, and we plan to carry out these steps as soon as possible.

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Data availability statement: Although some of the data that support the findings of this study are available online, some of it require a contract with the publisher.

Conflict of interests: The authors declare that they have no conflict of interest.

Declarations: They comply with ethical standards.

[47] The port access index is a minor contributor.

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Appendix

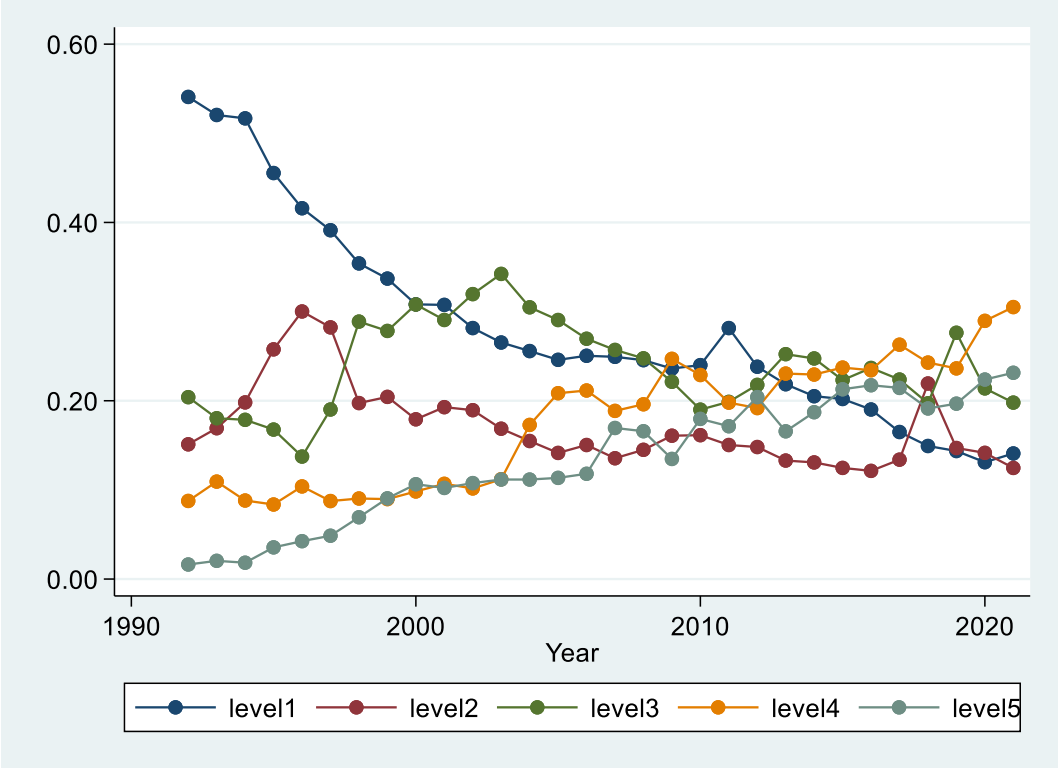

Figure A1. Trends in export goods from Thailand to Japan by PCI level

Source: UN Comtrade, SITC Rev.3

VARIABLES	(1) Basic enter_y	(2) lnSA_I enter_y	(3) lnSA_O enter_y	(4) lnSA_IL enter_y	(5) lnSA_IF enter_y	(6) lnMA_I enter_y	(7) lnMA_O enter_y	(8) lnMA_IL enter_y	(9) lnMA_IF enter_y	(10) lnSA_IJ enter_y	(11) lnSA_OJ enter_y	(12) lnMA_IJ enter_y	(13) lnMA_OJ enter_y
lnrwages	3.545***	2.851***	2.632***	3.291***	2.555***	3.038***	2.829***	3.476***	2.648***	2.013***	2.911***	2.069***	2.881***
	(0.217)	(0.240)	(0.229)	(0.228)	(0.246)	(0.233)	(0.228)	(0.221)	(0.243)	(0.250)	(0.223)	(0.246)	(0.223)
lnrmw	2.520***	2.542***	2.930***	2.531***	2.569***	2.618***	2.802***	2.530***	2.689***	2.729***	2.940***	2.744***	3.012***
	(0.422)	(0.422)	(0.432)	(0.421)	(0.424)	(0.422)	(0.430)	(0.422)	(0.423)	(0.425)	(0.430)	(0.425)	(0.432)
lnrGRP	0.634***	0.481***	0.754***	0.519***	0.506***	0.447***	0.689***	0.585***	0.414***	0.238***	0.645***	0.243***	0.655***
	(0.0441)	(0.0490)	(0.0494)	(0.0496)	(0.0482)	(0.0514)	(0.0469)	(0.0526)	(0.0504)	(0.0545)	(0.0462)	(0.0541)	(0.0467)
lnPA	0.443***	0.0240	1.358***	0.220**	0.0282	0.100	1.201***	0.348***	0.147	-0.273***	1.313***	-0.348***	1.298***
	(0.0832)	(0.0971)	(0.120)	(0.0947)	(0.0934)	(0.0953)	(0.119)	(0.0997)	(0.0905)	(0.0965)	(0.124)	(0.102)	(0.119)
lnSA_I		0.406***											
		(0.0473)											
lnSA_O			-1.313***										
			(0.133)										
lnSA_IL				0.229***									
				(0.0440)									
lnSA_IF					0.369***								
					(0.0391)								
lnMA_I						0.389***							
						(0.0541)							
lnMA_O							-1.073***						
							(0.127)						
lnMA_IL								0.0905*					
								(0.0527)					
lnMA_IF									0.438***				
									(0.0451)				
lnSA_IJ										0.608***			
										(0.0522)			
lnSA_OJ											-1.151***		
											(0.130)		
lnMA_IJ												0.775***	
												(0.0580)	
lnMA_OJ													-1.159***
													(0.125)
Observations	79,695	79,695	79,695	79,695	79,695	79,695	79,695	79,695	79,695	79,695	79,695	79,695	79,695
Pseudo R-squared	0.385	0.397	0.400	0.389	0.401	0.393	0.396	0.386	0.399	0.423	0.397	0.417	0.398

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A1. Estimation results (Analysis 2 based on ISIC Rev.3)

VARIABLES	(1) Basic enter_y	(2) lnSA_I enter_y	(3) lnSA_O enter_y	(4) lnSA_IL enter_y	(5) lnSA_IF enter_y	(6) lnMA_I enter_y	(7) lnMA_O enter_y	(8) lnMA_IL enter_y	(9) lnMA_IF enter_y	(10) lnSA_IJ enter_y	(11) lnSA_OJ enter_y	(12) lnMA_IJ enter_y	(13) lnMA_OJ enter_y
lnrwages	1.996***	0.964***	1.719***	1.674***	0.523	1.240***	1.837***	1.837***	0.797**	0.559	1.863***	1.258***	1.820***
	(0.319)	(0.351)	(0.339)	(0.335)	(0.360)	(0.344)	(0.329)	(0.330)	(0.351)	(0.369)	(0.340)	(0.336)	(0.341)
lnrmw	-6.477***	-8.596***	-1.645	-7.977***	-7.006***	-8.327***	-3.120**	-7.326***	-7.621***	-6.963***	-0.292	-6.947***	-0.129
	(0.997)	(1.000)	(1.250)	(1.099)	(0.929)	(1.032)	(1.231)	(1.084)	(0.972)	(0.967)	(1.301)	(0.993)	(1.260)
lnrGRP	0.683***	0.388***	0.616***	0.557***	0.424***	0.469***	0.616***	0.621***	0.397***	0.0729	0.438***	0.225**	0.450***
	(0.0797)	(0.0897)	(0.0863)	(0.0884)	(0.0868)	(0.0874)	(0.0844)	(0.0855)	(0.0875)	(0.0946)	(0.0913)	(0.102)	(0.0907)
lnPA	1.463***	1.090***	2.241***	1.244***	1.151***	1.037***	1.938***	1.292***	1.119***	0.754***	2.499***	1.086***	2.492***
	(0.143)	(0.149)	(0.181)	(0.157)	(0.142)	(0.157)	(0.170)	(0.167)	(0.147)	(0.155)	(0.195)	(0.156)	(0.184)
lnSA_I		0.566***											
		(0.0818)											
lnSA_O			-1.690***										
			(0.251)										
lnSA_IL				0.262***									
				(0.0832)									
lnSA_IF					0.410***								
					(0.0558)								
lnMA_I						0.498***							
						(0.0864)							
lnMA_O							-1.091***						
							(0.223)						
lnMA_IL								0.159**					
								(0.0807)					
lnMA_IF									0.541***				
									(0.0689)				
lnSA_IJ										0.744***			
										(0.0797)			
lnSA_OJ											-1.923***		
											(0.248)		
lnMA_IJ												0.633***	
												(0.0928)	
lnMA_OJ													-2.030***
													(0.236)
Observations	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960	34,960
Pseudo R-squared	0.367	0.384	0.382	0.370	0.393	0.378	0.375	0.368	0.388	0.426	0.387	0.383	0.392

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2. Estimation results (Analysis 1: foreign capital standard is set at 50% or more)

VARIABLES	(1) Basic enter_y	(2) lnSA_I enter_y	(3) lnSA_O enter_y	(4) lnSA_IL enter_y	(5) lnSA_IF enter_y	(6) lnMA_I enter_y	(7) lnMA_O enter_y	(8) lnMA_IL enter_y	(9) lnMA_IF enter_y	(10) lnSA_IJ enter_y	(11) lnSA_OJ enter_y	(12) lnMA_IJ enter_y	(13) lnMA_OJ enter_y
lngdppw	0.103	-0.442**	-0.375	-0.0953	-0.649***	0.0183	-0.292	0.161	-0.284	-0.506**	-0.0213	-0.250	-0.0887
	(0.203)	(0.210)	(0.242)	(0.199)	(0.222)	(0.201)	(0.236)	(0.202)	(0.211)	(0.204)	(0.228)	(0.200)	(0.230)
lnrmw	12.21***	14.68***	11.35***	11.93***	16.29***	13.87***	7.968***	12.25***	16.71***	12.61***	12.07***	12.78***	12.07***
	(2.603)	(2.597)	(2.568)	(2.575)	(2.677)	(2.634)	(2.862)	(2.600)	(2.758)	(2.585)	(2.594)	(2.603)	(2.590)
lnrGRP	0.669***	0.611***	0.895***	0.546***	0.709***	0.415***	0.816***	0.476***	0.361***	0.312***	0.696***	0.196*	0.709***
	(0.0832)	(0.0912)	(0.107)	(0.0895)	(0.0902)	(0.101)	(0.0951)	(0.101)	(0.100)	(0.0984)	(0.0861)	(0.102)	(0.0860)
lnPA	1.347***	0.705***	1.882***	0.973***	0.728***	1.053***	1.881***	1.108***	1.082***	0.381**	1.523***	0.487**	1.594***
	(0.157)	(0.182)	(0.214)	(0.177)	(0.171)	(0.174)	(0.223)	(0.176)	(0.165)	(0.189)	(0.211)	(0.190)	(0.205)
lnSA_I		0.588***											
		(0.0839)											
lnSA_O			-0.920***										
			(0.261)										
lnSA_IL				0.401***									
				(0.0737)									
lnSA_IF					0.434***								
					(0.0682)								
lnMA_I						0.429***							
						(0.0988)							
lnMA_O							-0.818***						
							(0.248)						
lnMA_IL								0.290***					
								(0.0894)					
lnMA_IF									0.542***				
									(0.0950)				
lnSA_IJ										0.561***			
										(0.0772)			
lnSA_OJ											-0.262		
											(0.215)		
lnMA_IJ												0.742***	
												(0.0836)	
lnMA_OJ													-0.418*
													(0.230)
Observations	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025	25,025
Pseudo R-squared	0.398	0.422	0.403	0.411	0.420	0.406	0.403	0.403	0.413	0.438	0.399	0.441	0.399

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3. Estimation results (Analysis 3: Use lngdppw instead of lnrwages)