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Outward Foreign Direct Investment and its impact on Trade: Japan and ASEAN economies

Student: Andrew Kei Benito Ito (595306)

Supervisor: Prof. dr. Felix Ward

Second Assessor: Prof. dr. Agnieszka Markiewicz

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ABSTRACT

This empirical research analyzes what sort of effects Japanese outward foreign direct investments presents over the trade of its 10 major manufacturing industries with the 6 main ASEAN economies for the periods of 2005 to 2019, period in which outward FDI in the manufacturing sector has shown clear signs of stagnation, as investments from the non-manufacturing sector has gained importance. For this study I work with a gravity model, using the Poisson Pseudo Maximum Likelihood method, as it is considered to be an ideal gravity model estimator when working with panel data and gravity equations. Our results suggests that Japanese outward FDI still have a positive and significant impact over the trade of many of its major manufacturing industries, suggesting that vertical investment is still a preferred strategy amongst Japanese multinationals in the ASEAN market. However, some industries such as the Textile and Glass and Ceramic industries, that have been historically dominant in the ASEAN market until the late 90´s, does not appear to be significant. This might be caused by the recent shifting of Japanese investments towards other developing regions of Southeast Asian due to the rise of overall production cost in some of the ASEAN economies, and the shifting of investments between its manufacturing industries, from natural resources industries towards the machinery-based industries.

Key words: Outward Foreign Direct Investment, complementary relationship, Poisson Pseudo Maximum Lakewood.

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1.Introduction

One of the main questions that policymakers have been looking to answer since the 1960´s is whether or not outward foreign direct investment (OFDI) has a positive or negative impact over the country´s trade and what sort of impact is expected over the industrialization or des-industrialization of the affected economies. The main concern of policymakers regarding the impact of outward FDI lies on the overall effect they present over the economies in question, especially on how they might affect domestic production and employment, as outward FDI might lead to the shift of domestic production abroad and therefore shrink production in their home economy (Kim and Kang, 1997). As we are aware, this decision of shifting production depends on many factors, however, the multinationals are the ones that decide on how they look to serve the markets. Whether they find it optimal to produce and sale from abroad by opening affiliates in the foreign market due to lower production cost, easy access to their desired market, minimize trade costs, amongst others. Or if they find it optimal to produce in their home economy and then export towards their target market. There are many different strategies, and depending on the strategy they take, the impact of outward FDI over their home economy, and consequently the foreign economy, might differ.

With this empirical study I look to expand the existing literature regarding the relation of outward FDI and trade, as it appears that the relation between outward FDI and trade can differ depending on the economies, sector, or industries in question, so there is no conclusive answer on how these outward investments might impact trade, whether it acts as a compliment or supplement. There have been different studies analyzing this relationship, however most of these studies have focused exclusively on trade relations between advanced and developed nations, as these economies historically have been the main source of outward FDI, due to their technological advancements, efficient institutions, and financial capabilities. With this in mind, in this paper we look to analyze what sort of impact Japanese outward FDI presents over the bilateral trade between Japan and the ASEAN nations, specifically in the major manufacturing industries of Japan, as not many studies have been conducted for this region at an industrial level and specially for the last two decades of the 21st century, period in which overall outward FDI in the manufacturing sectors shows clear signs of stagnations or even decline. Therefore, the impact that outward FDI presents over trade might not be as significant as they once used to. Due to this, in this paper we focus our study at an industry level, in order to capture the recent effects that outward FDI have over trade in each manufacturing industry, and analyze whether the effects they present differs between industry and if these effects are significant.

The motivation behind this empirical study is due to the important economic impact and political influence that Japan has had, and still has, over the economies of the Southeast Asia region. Over the years, Japan has increased not only its trade and political relations, but also has become one of the

most important sources of FDI for the ASEAN economies, due to their rich natural resources, low production cost, trade and investment enhancing policies, amongst others, which has consequently attracted many Japanese multinationals over the past years. Even though Japan´s FDI are mainly towards the developed nations of Europe and the US, the Southeast Asian economies receives most of its FDI´s from Japan. It is true that in recent years South Korea and China has also started investing significantly towards these economies, however, Japanese firms are still the major investors of the ASEAN economies, even though outward investments in the manufacturing sector are not as substantial as they were in the last decades of the 20th century, when the manufacturing industry of Japan grew exponentially and played an important role over the development and growth of Japan. So, in regards of this recent changes in the outwards investments, where manufacturing FDI started to decline as the non-manufacturing investments gained importance over the recent years, I look to capture how outward FDI towards the ASEAN countries impacts Japan´s recent trade with this region, focusing on the major manufacturing industries of Japan, in order to analyze if these investments of the manufacturing sector present different effects, and if their impacts are still significant. And as our empirical findings suggest, we do in fact appreciate different type of effects for each industry in question, capturing different trade structures.

The rest of this empirical paper is organized as follows. In Section 2, we briefly explain the trade and investment relation that Japan has had with the ASEAN economies in the past decades, as well as the evolution of FDI and trade of Japan in the Southeast Asian region. Section 3 reviews some of the theoretical an empirical findings regarding the possible relationship between FDI and trade, capturing those that find a substitute effect, complementary effect, and those that are focused on Japan. Section 4 presents the empirical model we work with, followed by a description of the data we use in our study, and a detailed description of the empirical approach we take. Section 5 summarizes the results and findings of our gravity model, capturing the overall impact that outward FDI presents over the manufacturing sectors and the impact they have over each manufacturing industry separately. And in Section 6 we present our final conclusions.

2. Japan and ASEAN relations: Trade and FDI

In order to have a better understanding of the trade and investment relation between Japan and the ASEAN economies, in the fallowing section we look at some historical background on how the relationship between Japan and the South East Asian region developed and strengthen over the past years, as Japan´s government and specially the private sector increased their influence over the different ASEAN economies. We will then look at the recent evolution of trade and investment between these nations, focusing mainly on the manufacturing sector.

2.1. Brief history of Japan´s relationship with the ASEAN economies

Over the past decades Japan and the ASEAN countries have established a strong diplomatic and economic relationship. As Atarashi (1985) argues, the base of Japan-ASEAN relationship has always been trade and investment. Historically, Southeast Asia has been an important region for the development and growth of the Japanese economy, due to its vast natural resources and geographical location, as the shipping lanes through this region has been crucial for Japan's development, security and stability. However, over the past years, Japan has also played an important role over the economic growth of many Southeast Asian countries, especially during the last decades of the 20th century, thanks to its investments, trade, and economical aid (Singh, B. 2002; Oba, M. 2014). The relation between Japan and the soon to become ASEAN countries started prior to the Second World War, however, this relationship would strengthen years after Japan's defeat in 1945 and its demilitarization. After the end of the war, many economies closed their markets towards Japan, among them China, that would not fully open its market until both countries signed the Treaty of Peace and Friendship in 1978 (Beeson, M. 2013). The ties between Japan and the future nations of the ASEAN group were also quite sensitive after the war, and the relation they had at the moment were mainly characterized by reparations and diplomatic normalization. However, the Southeast Asian market would not take long to open up, and with economic and political aid from the United States, Japan would soon experience a fast economic recovery, reestablishing its international relations, and returning to the international market (Akrasanee, N. and Prasert, A. 2003).

The political and economic union of ASEAN[1] was created in 1967. And the relationship between Japan and the ASEAN economies would not be formally established until 1977, year in which the Japanese government and private sectors would start strengthening their partnership by establishing new bilateral and regional trade agreements and other forms of political, social and security agreements. From this year on, different Japanese multinationals would look to expand their trade and investment ties with these ASEAN nations. These would not only have a positive impact over the ongoing economic growth of Japan, but will also improve the development and economic growth of the ASEAN economies, mutually benefiting both counterparts (Sudo, S. 1988; Severino, R.C. 2014). As the Ministry of Foreign Affairs of Japan states, the ASEAN nations played an important role over Japan's major manufacturing industries, as many Japanese production bases[2] are currently located in this region, due to its easy access towards the global supply chains and low production cost, which has consequently improved Japanese international competitiveness. Now, the manufacturing sector is not

[1]ASEAN was founded in 1967, becoming the oldest regional grouping in the world. This regional union was originally founded by Indonesia, Malaysia, Philippines, Singapore and Thailand, with the main objective of enhancing economic growth, social progress and cultural development.

[2] According to the Ministry of Foreign Affairs of Japan, by 2018, there were up to 13.000 operational bases in the ASEAN economies.

the only sector that played an important role over the Japan-ASEAN relationship, in recent years, we also started appreciating the non-manufacturing sectors expanding towards the ASEAN market (Figure 1), supporting the different manufacturing industries through logistics, finance, security and other forms of services, that overall improved trade and diplomatic ties between Japan and this region.

We can argue that the ASEAN-Japan partnership has been in constant change and has evolve through time. Going through a relation of economic reparations after the war, to a better diplomatic understanding, to a financial aid and investment relation in order to enhance trade and promote economic and political stability of the region.

2.2. Evolution of Japanese outward FDI and Trade in the East Asian market

We would not appreciate much Japanese FDI on the international market until the late 1960´s, due to governmental restrictions, lack of foreign exchange caused by different governmental regulations, great investment opportunities inside of the Japanese growing economy, among other reasons that discouraged the outward investment of the Japanese private sector (Urata, S. 1993). However, the limited Japanese FDI that we could appreciate during this period was mainly focused on the natural resources of the Southeast Asian region[3], as Japan lacked these factor endowments that where in high demand for the development of its manufacturing industry. Japan also had a small amount of FDI focused in commerce, specifically in the developed nations of Europe and North America, in order to promote Japanese goods in the international markets (Kenneth, A.F., 1991).

As Japanese liberalization policies were established, from the early 1970´s, Japan would experience its first FDI "boom". This rise of Japanese FDI can be explained due to the decline of Japanese competitiveness. As Japanese products become more expensive to manufacture on their home economy, and it was getting harder to export overseas, many Japanese multinationals shifted their production towards those developing nations in which overall production could be done at a lower cost. Most of the Japanese foreign investments were therefore focused in the newly industrializing nations (NIE)[4] of the Asian market. This region was attractive to the Japanese private sector due to the low wage labor, and also due to the attractive FDI policies and export promoting policies applied to foreign investors, making it an ideal spot for Japanese multinationals (Urata, S. 1993; Nemoto,Y and Nakagawa, S., 2014). However, the Japanese FDI´s would decrease considerably after the first Oil Crisis of 1973, and would not experience another FDI "boom" until the early 1980´s. During this period, Japanese FDI distribution will shift from the NIE towards the newly formed ASEAN nations, mainly due to the rise of wages in the NIE which made it unattractive for Japanese firms to keep investing in this

[3] The majority of Japanese outward FDI in the Southeast Asia region in the late 1960´s, was focused on the extraction of petroleum in Indonesia, iron and steel in Malaysia, and other metals in the Philippines.

[4] The Newly Industrialized Economies (NIE) in Asia include economies such as Hong Kong, South Korea, Singapore, and Taiwan.

region. From here on, the ASEAN-Japan relation would develop and strengthen, as Japanese firms increased their investments in the manufacturing sector, and trade between them enhanced exponentially (Elsbree, W.H. and Hoong, K.K., 1985).

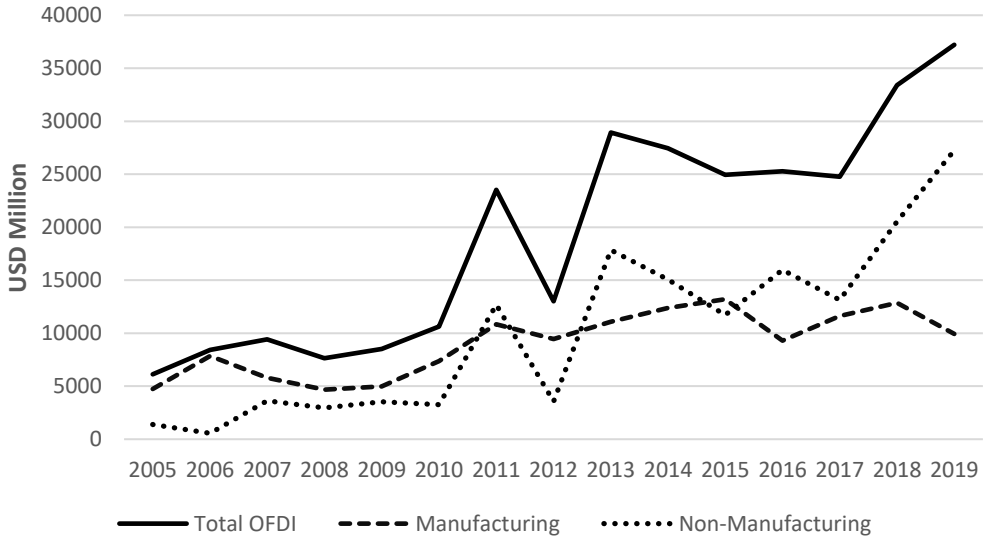
According to the Japanese Ministry of Finance, the final and major FDI "boom" would not come until the late 1980´s, where the average annual growth rate of Japanese FDI was above 53%. This increase was mainly due to the Japanese Yen appreciation and the liberalization policies stablished in the developing nations. However, this rise of FDI was notable not only on the developing nations of the Asian market, but also in the major economies of Europe and North America, where Japanese FDI increased from 54% in 1980-85 to 74% in 1986-89, especially in the growing automobilist industry. Overall, the Japanese FDI during these decades were still mainly focused on the manufacturing sector, however, during the late 1990´s and early 2000´s we would start to appreciate an important shift from the manufacturing sector towards the non-manufacturing sector[5]. In fact, we can argue that ever since the Japanese firms started expanding their investments towards the developed nations in the 1980's, the share of Japanese FDI towards the developing economies have been slightly declining, and with it the investments towards the manufacturing sector. However, Japanese FDI in the developing countries of the Southeast Asian region stayed high, especially among the ASEAN economies and China, which by the year 1989, about 98% of the total Japanese FDI of this region was concentrated in these mentioned economies, shifting away from economies such as South Korea or Taiwan (Chachavalpongpun, P. 2014). But as stated previously, even though most of the Japanese FDI has been in the manufacturing sector, the share in the non-manufacturing sector has increased rapidly since the mid 1990´s, due to a rise of Japanese demand for non-manufacturing services, liberalization and des-regularization of the Asian financial sector, rise of the real estate market, among other factors.

Although the Japanese FDI share on the manufacturing sector has been declining since the late 1980´s and early 1990´s, the share of this sector has stayed dominant in the Asian continent. In fact, according to the data provided by the Japanese Ministry of Finance and the Bank of Japan, by 1989, the share of Japanese FDI over the manufacturing sector in the Asian market hold about 38.5%. Regardless of the overall FDI decline in the manufacturing sector, the ASEAN countries where still highly attractive among the Japanese private firms, due to the low wages and the liberalization policies they established towards foreign investments. Even though Japan started to focus more on capital intensive industries, investments towards industries such as the iron and steel, textile or other forms of natural resources where still considerable among the ASEAN economies (Sivalingam, G. 2014).

[5] According to the finds of UNCTAD, the rise of OFDI in the services sector, especially among the developed nations, which is used as market seeking strategy, does not appear to have an important impact over exports. However, there is evidence that this strategy might actually increase the efficiency of firms and increase its production.

Nevertheless, by mid latte 1990´s, it was clear that Japanese FDI in the ASEAN countries was also starting to shift from these natural resources industries towards more capital-intensive industries, such as electronics and other machinery-based industries. This can be observed in the last 2 decades of the 21st century, where is clear that for most countries of the ASEAN group, Japanese FDI´s in the manufacturing sector have a larger and growing share over capital intensive industries, while the natural resources industries present a smaller share and for some cases it has been in decline (Table A2 in Appendix).

Figure 1: Japan's Total FDI outflows and Total Manufacturing and Non-Manufacturing FDI outflow towards ASEAN, 2005 to 2019.



Source: Bank of Japan, Balance of Payments Related Statistics.

In the first two decades of the 21st century, Japanese FDI over the manufacturing sector started to show clear signs of stagnation. The Asian market still hold the largest share of FDI in this sector, with about 42% in 2005 (15% in the ASEAN economies). Nevertheless, as we can appreciate in Figure 1, this share would start to slowly decline, as by 2009 the share in the Asian market dropped to 32.8% (12.5% in ASEAN), and in 2019 the FDI share in the manufacturing sector dropped to about 20% (7.9% in ASEAN). This slow decline of Japanese investments on the manufacturing sector came accompanied by a rise of FDI in the non-manufacturing sector. As stated above, by mid-1990´s, Japanese foreign investments in the Asian market were starting to shift from the manufacturing sector towards the non-manufacturing due to the increasing demand for other type of services. However, as we mentioned, FDI in the manufacturing sector among the ASEAN economies has stayed high compared to other regions, maintaining a slow but positive growth. But as captured in Figure 1, by 2013, Japanese investments in the ASEAN economies experienced a clear shift, were the shares in the non-manufacturing sector become larger than those observed in the manufacturing sector. Regardless of this change, Japanese FDI in the manufacturing sector are still considerable among the ASEAN

economies. Nonetheless, the signs of stagnation cannot go unnoticed. In fact, as we capture in the Table 1, the shares of Japanese FDI, for most of the ASEAN economies, have barely grown in the last decades, observing also a shift among the shares of manufacturing investments. These changes can be attributed to changes in the labor cost in countries such as Singapore, Thailand and Indonesia, forcing Japanese investors to consider other developing nations such as Vietnam, the Philippines, and recently emerging economies such as Laos, Cambodia and Myanmar (Cuyvers, L., 2019).

Table 1: Japan manufacturing outward FDI share (%) - ASEAN distribution

	2005	2010	2015	2019
Singapore	16,02	41,69	28,33	22,19
Thailand	30,73	29,97	25,48	21,82
Indonesia	25,81	5,90	17,30	22,22
Malaysia	8,11	10,28	8,32	7,31
Philippines	14,18	5,64	8,19	12,22
Vietnam	4,67	6,46	11,32	12,25
Others	0,47	0,05	1,07	1,98

Source: Bank of Japan, Balance of Payments Related Statistics

3. Literature review

Ever since international trade and capital flows increased exponentially years after the end of the Second World War, the relation between foreign direct investments (FDI) and international trade become a topic largely discussed and has been the main focus of many economic studies, especially among policy makers, that looked to comprehend what sort of relation outward investments presents over bilateral trade. This relation between FDI and trade is not as conclusive as one might believe, as it does not appear to be same for every country or sector. Over the years, there have been many empirical and theoretical studies that found diverse evidences, suggesting that FDI acts as a compliment of trade, as a substitute of trade, or even a mix of both. Many empirical studies suggest that inward FDI might be more likely to enhance the exports of the host economies. And the impact of outward FDI on exports appears to be rather mixed. But as stated above, the relation appears to differ, not only between nations, but also between sectors and industries. Many suggesting that the overall impact depends mainly on the multinationals strategy to improve their production efficiency and sales.

3.1. FDI as a Supplement of Trade

One of the first theoretical literatures that analyzed the relation between of FDI and trade was Mundell (1957), who used the basic Heckscher–Ohlin model to demonstrate that a rise of FDI would consequently decrease trade. Therefore, arguing that FDI´s acts as a substitute of trade and not as a compliment. He defends that trade between nations is observed due to existing differences in factor endowments and comparative advantages. However, if these factors become mobile and more

accessible, these differences between economies would decrease and therefore decrease trade. Over the years, there have been many empirical and theoretical papers that supported and refuted the findings of Mundell. Some empirical findings that support this idea of FDI acting as a substitute of trade are from authors such as Horst, T. (1972), Brainard, S.L. (1997), Paim, N. and Wakelin, K. (1998), and Lee, H.Y., Lin, K.S., and Tsui, H.C. (2009), to mention a few.

Horst, T. (1972) focused his study on 1191 different US manufacturing firms and their foreign subsidiaries located in Canada for the year 1967. By considering the different characteristics of the manufacturing firms, such as if they are multinationals or not, whether they invest towards Canada or not, amongst other, Horst looked to study the impact that outward investments have over the exports of these manufacturing firms. His empirical findings suggests that, among those US manufacturing multinational that invests in Canada, there is clear evidence suggesting that outward FDI acts as a substitute of export rather than as a compliment, as exports appear to decrease when outward investments increase.

Brainard, S.L. (1997) introduced the "proximity-concentration" theory, where he looked to study what is behind the multinationals decision to reallocate abroad. He argued that the decision of reallocation depends mainly on the gains that proximity to consumers offers and the gains they would achieve with concentration. In other words, firms would need to face a trade-off, and their final decision would be based on what strategy profits them the most. If trade cost increased due to higher transportation cost or due to the implementation of trade barriers, firms would be more propense to reallocate their production towards their final consumers and therefore trade-off concentration for proximity. This strategy, according to Brainard, would consequently lead towards a substitution relationship between trade and FDI. In order to study this, Brainard worked with a 1989 cross section data at an industry level between the US and 27 different countries. Basing his work on the gravity model and working with the ordinary least square estimator, he obtained results supporting his argument, finding evidence that FDI presents a substitution effect over the exports.

Pain, N., and Wakelin, K. (1998) focused their study at a country level, studying the time series relationship between manufacturing exports and FDI for 11 OECD economies from 1971 to 1992. Using a basic panel regression, their findings where rather mixed, they found evidence suggesting that for some economies the rise of inward investment improved their export performance. But on the other hand, they also found evidence that outward FDI had a small but negative impact over the domestic exports of some economies, and a positive impact over the exports of other countries such as Italy, Japan and Denmark.

Lee, H.Y., Lin, K.S., and Tsui, H.C. (2009) also focused their study at a country level, examining the effect of outward investments from Japan, US and the Four Tigers (Hong Kong, Singapore, South Korea, and Taiwan) towards China from the years 1979 to 2005. By working with a panel data and using the

fixed effects model, they found evidence that outward FDI towards China enhanced the exports of the large economies but had a different effect over the small source countries, suggesting that outward FDI acted as a substitute of trade for the smaller source economies but as a compliment for the large source economies.

3.2. FDI as a Compliment of Trade

Helpman (1984) and Helpman and Krugman (1985) argued that depending on the costs and access of factor endowments, firms would decide whether to reallocate their production abroad or not by opening plants outside their home economy. They argue that firms from developed nations might find attractive to open plants and/or affiliates in developing nations in order to take advantage of their low production costs and easy access to other factor endowments. Having this in mind, they defend that vertical investments abroad should enhance intra-industry trade, as we would appreciate more trade between the headquarters of the firms located in the home economy (developed nation) with the different plants and/or affiliates that they opened in the developing nations. Therefore, they argued that outward FDI should enhance trade between firms and economies. Some empirical findings that support this idea of FDI acting as a compliment of trade are from authors such as Lipsey and Weiss (1984), Clausing K.A. (2000), Hejazi and Safarian (2001), Hailu, Z.A. (2010), Martinez, V., et al. (2012), to mention a few.

Lipsey and Weiss (1984) analyzed the impact of FDI at a firm level for the US, working with cross-section data of individual firms and their affiliates in 14 different industries for the year 1970. The results they obtained captured strong evidence of outward FDI not acting as a substitute, but enhancing the exports of the domestic firms towards their affiliates, where production takes place. This evidence appears to be strong not only for the exports of intermediate goods but also for the final goods coming from the parent firms located in the US.

Clausing K.A. (2000) worked with two panel data sets in order to study the relation between exports and US multinational activities in 29 different countries between the years 1977 and 1994, the second data set was used to study the relation between US imports and the operations of foreign firms in US soil for the same period of time. The objective was to capture what sort of relation might be observed between trade and the multinational activities. By working with the gravity model, this empirical study found evidence that supports the idea of multinational activities, specifically outward FDI, enhancing trade and therefore acting as a compliment of trade. The results they found for the relation between inward FDI and US imports were less conclusive, however, they did not find evidence of FDI acting as a substitute of trade.

Hejazi and Safarian (2001) measured the international spillovers coming from trade and FDI from the G6 countries, specifically Canada, Italy, Germany, Japan, the United Kingdom and the United States

to all OECD countries and Israel for the year 1990. Applying and extending the theories of Coe and Helpman (1995) at a macroeconomic level, they found evidence that spillovers from trade appear to be coming largely from FDI´s, and productivity spillovers also seems to be occurring through the FDI´s. The results they obtain also led them to believe that this impacts over domestic productivity seems to be stronger on the G6 economies and less on the OECD nations. Nonetheless, the evidence they found suggests that outward FDI had a positive impact over the exports of the home economies.

Hailu, Z.A. (2010) focused on the African continent, by analyzed what sort of relation export and import have with the FDI flows. They focused on 16 different African countries for the periods of 1980 to 2007. By working with the random effects technique and the least square regression method, they found evidence that the multinationals of this continent are export oriented and import depended. However, their major findings capture a positive and significant FDI elasticity of export, suggesting that FDI enhanced the subsector exports of the continent.

Martinez, V., Calvo M. and Sanchez, B. (2012) examines whether the reduction of trade barriers among the European Union economies has increased trade flows and FDI for intra Europe FDI, and for FDI to the EU members from non-EU economies. With it, they looked to analyze what sort of relation is observed between trade and FDI. By estimating a gravity model using the Hausman-Taylor estimation technique, they found empirical evidence suggesting that commercial integration in the EU and FDI had a complementary relation. This relation is captured for both intra EU FDI and also for investment coming from non-EU nations.

3.3. Findings for Japan´s FDI-Trade relation

As Japan experienced a fast economic growth from 1960 to 1980, and become a major economy power, there have been different empirical studies that analyzed the impact that Japanese outward FDI had over its trade at a country level, sector or industry level, and at a firm level. While most cases find a complimentary relation, the finding has also been diverse, with no definitive answer whether outward FDI enhances or decreases trade for Japan. As captured by the mentioned empirical studies, the effect of outward FDI also appears to vary respect the countries, sectors and firms in question. Some of the recent empirical studies that focused on Japan, are from authors such as Eaton, J. and Tamura, A. (1994), Head K. and Riespanel, J. (2001), Pantulu J. and Poon, J. (2003), Nishitateno, S. (2013), Chiappini, R. (2015) among others.

Eaton, J. and Tamura, A. (1994) worked with a gravity model taking into consideration the importance factor endowments. They focused their study at a country level with the objective of analyzing the Japanese and US bilateral trade and FDI relation. Accounting for more than 100 countries for the periods of 1985-1990, their results captured evidence suggesting that outward FDI acted as a compliment of trade in most countries, increasing exports for both Japan and the US.

Head K. and Riespanel, J. (2001) analyzed the effect of FDI and exports of 932 Japanese manufacturing firms for the period of 1966 to 1990. The estimates they captured using the fixed effect method showed a complimentary relation between FDI and exports, however, they found important differences across firms. The foreign investments of smaller firms are less likely to experience an increase in their exports, while major multinationals such as those from the automobile sector appears to experience an important increase in trade with their supplying firms located abroad.

Pantulu J. and Poon, J. (2003) examined and compared the relation between trade and outward FDI coming from the US and Japan towards 29 and 32 economies respectively for the periods of 1996 to 1999. They worked with the spatial affinity's gravity model developed by Johansson and Westin (1994). The results they obtained captured that trade appears to increase thanks to the outward FDI, however, the impact they had varied across nations. In the case of Japan, they captured that outward FDI had an important impact over trade with the East Asia economies and the advanced industrialized European nations, however, this impact was lower and almost non-existent in the Latin American continent and the small nations of Europe.

Nishitateno, S. (2013) focused on the Japanese automobile industry, his objective was to analyze whether FDI by upstreaming firms replaced or not exports. Using product-level data, accounting for 32 different products and 49 countries for the period 1993 to 2008, he worked with the gravity model using the Poisson Pseudo Maximum Likelihood estimator. His results captured evidence suggesting that overseas operations of Japanese upstream automobile multinationals could in fact strengthen trade relations between home and host countries.

Chiappini, R. (2015) focused his study at the sectoral level, analyzing the relationship between outward FDI and trade from Japan to 30 different countries for the periods of 2005 to 2011. Working with the standard gravity model estimating his regressions with different techniques such as the negative binomial and the Gamma Pseudo Maximum Likelihood, he obtained mixed results, where Japanese outward FDI enhanced Japanese bilateral trade in specific manufacturing industries such as the food and beverages, electric machinery, primary metals, and precision machinery, but also found evidence suggesting that Japanese outward FDI acted as a supplement of trade in industries such as the chemical and general machinery.

As we can observe, the relation between outward FDI and trade does not appear to have a conclusive answer, as there have been many empirical studies finding relationships of substitution, complementary or mixed. It appears that the type of relation we might observe depends on many factors, mainly on the strategies that the domestic firms takes when it comes to invest in other economies in order to maximize their profits. Whether they look to increase their production and efficiency by opening plants or affiliates in low-wage countries in order to produce at a lower cost (vertical multinationals), whether they look for ways to avoid trade barriers, gain better access to the

foreign economy, or obtain technological advances by reallocating abroad (horizontal multinational), or both, establishing the so called hybrid strategies, which is a combination market and efficiency seeking, where they look to assemble firms in major foreign markets and additionally obtain resources for other firms by opening plants in locations with easy access to this production factors.

4. Empirical model specifications, Data description and Methodology

4.1. Empirical Model Specification

In order to capture and analyze the ties between trade and outward FDI, this paper will work with the gravity model of trade which was first implemented by Jan Timber (1962). This model was based on the Newton's law of gravitation, where after replacing mass with country size (measured by the country's GDP) it was able to predict the intensity of trade between two nations. This model captures bilateral trade flows being proportional to country size and inversely proportional to geographical distance between the two economies.

The basic gravity equation used by Jan Timber takes the following form:

$$T_{ij} = G \cdot \frac{{Y_i}^{\beta_1} {Y_j}^{\beta_2}}{{D_{ij}}^{\beta_3}}$$

Where G is a constant that captures the gravitation; T_{ij} is the bilateral trade flow; Y_i and Y_j captures country size in GDP; and D_{ij} stands for the distance between country i and j (can be geographical distance, language, culture or any other factor that can proxy trade cost); and β_1, β_2, and β_3 are the unknown parameters. This model has been widely used in different economic studies since its introduction, especially in empirical studies regarding international trade, due to its high accuracy when it comes to predict bilateral trade flows (Bayoumi and Eichengree, 1997). For the purpose of studying international trade, the gravity equation has suffered some alterations over the years. However, the main idea of the equation still holds, as it still captures the relationship between trade flows, income, and trade resistance on average. The gravity equation predicted by the theory is more commonly known as the following:

$$T_{ij} = \beta_0 {Y_i}^{\beta_1} {Y_j}^{B_2} {D_{ij}}^{\beta_3}$$

Now, different authors, such as Anderson and Van Wincoop (2003), argue that this specification is not able to capture perfectly the multilateral resistance terms, so it does not fully describe trade flows between two nations. Because of this, the gravity equation can be rewritten as:

$$E\{T_{ij}|Y_i, Y_j, D_{ij}\} = \beta_0 {Y_i}^{\beta_1} {Y_j}^{B_2} {D_{ij}}^{\beta_3} e_{ij} \text{ where } e_{ij} = T_{ij} / E\{T_{ij}|Y_i, Y_j, D_{ij}\}$$

The variable e_{ij} captures the deviation of trade flows, it is what we do not observe from the model.

Following the steps of previous empirical studies (Egger, 2001; M.Kawai et al., 2004; Türkcan, 2007; S.Khoon Goh et al., 2013; Chiappini, 2016) that analyzed the type of relation we observe between

trade and FDI, and has been largely influenced by the works of Helpman and Krugman (1985), this paper will work with the following gravity equation captured in logarithmic form:

$$Ln(X_{ijkt}) = \beta_0 + \beta_1 Ln(OFDI_{ijkt}) + \beta_2 Ln(SimGDP_{ijt}) + \beta_3 Ln(SumGDP_{ijt}) + \beta_4 Ln(DifGDP_{ijt}) + \beta_5 Ln(DifGDPpc_{ijt}) + \beta_6 RealExRate_{ijt} + \beta_7 FTA_{ijt} + \beta_8 Ln(Distance_{ijt}) + \beta_9 Island_{jt} + \delta_k + \delta_t + \varepsilon_{ijt}$$

$$Ln(M_{ijkt}) = \beta_0 + \beta_1 Ln(OFDI_{ijkt}) + \beta_2 Ln(SimGDP_{ijt}) + \beta_3 Ln(SumGDP_{ijt}) + \beta_4 Ln(DifGDP_{ijt}) + \beta_5 Ln(DifGDPpc_{ijt}) + \beta_6 RealExRate_{ijt} + \beta_7 FTA_{ijt} + \beta_8 Ln(Distance_{ijt}) + \beta_9 Island_{jt} + \delta_k + \delta_t + \varepsilon_{ijt}$$

The depended variables are X_{ijt} and M_{ijt}, where X_{ijt} captures the exports from Japan (country i) towards an ASEAN country (country j) in industry k at time t. And M_{ijt} captures the imports from Japan towards country j in industry k at time t. For our independent variables we have $OFDI_{ijk}$ which stands for the Japanese real Outward FDI in country j in industry k at time t; $SimGDP_{ijt}$ is the similarity index between Japan and its trading partner at time t, which measures how similar both countries are in terms of size; $SumGDP_{ijt}$ captures the GDP sum of Japan and country j at period t. This variable measures the bilateral country size; $DifGDP_{ijt}$ captures the absolute difference in GDP of Japan and country j at period t, which measures the variation in demand and supply; $DifGDPpc_{ijt}$ captures the absolute difference of Japan´s GDPp.c. and country´s j GDPp.c. at period t. This variable measures the differences in consumers preferences in relation to differences in factor endowments; $RealExRate_{ijt}$ stands for the real exchange rate[6] between Japan and its trading partner (Direct quote) at period t. FTA_{ijt} is a dummy variable that takes the value of 1 for those years in which country j enjoys free trade agreement with Japan, and takes the value of 0 otherwise. $Distance_{ijt}$ acts as a proxy for trade cost, which captures the geographical distance in kilometers between the capital of Japan and the capital of its trading partners[7]. Dummy variables such as common language, colonial history or contiguity, which are also commonly used as proxy for trade cost, were not accounted into this study due to Japan not sharing neither a common language, colonial history or borders with any of the 6 ASEAN countries in question; $Island_{jt}$ is a dummy variable that takes the value of 1 when country j is an island, and takes the value of 0 otherwise. The variables δ_k, δ_t captures industry and year fixed effects respectively. And ε_{ijt} represents the error term of the regression.

[6] Similar to previous literature, the variable $RealExRate_{ijt}$ will not be captured in logarithms, in order to avoid getting infinity values due to low values that some of our exchange rates present. Taking the inverse of exchange rates is not an option in this setting, since either way we will have some exchange rates with low values.

[7] The variable $Distance_{ijt}$ captures the geographical distance between the capitals. This measurement of distance was chosen since most of the population and major multinationals are currently located in the country's capitals of our dataset.

Regarding the independent variable of real exchange rate ($RealExRate_{ijt}$), we expect it have a positive impact over the Japanese exports when the Yen experiences a depreciation, and a negative impact over exports when it suffers an appreciation respect its trading counterpart. On the other hand, we expect $RealExRate_{ijt}$ to have a positive impact over imports when the Yen suffers an appreciation and a negative impact when it experiences a depreciation. The dummy variable that captures free trade agreement with Japan (FTA_{ijt}) is expected to have a positive effect over trade, specifically for those years in which the FTA comes into force. The independent variable of distance between nations ($Distance_{ijt}$) and the dummy variable that captures whether the countries are islands or not ($Island_{jt}$), are expected to have a negative impact over trade, as they proxy for trade cost. The remaining independent variables of the model will be described in more depth on the following section.

4.2. Data Description

In order to analyze the existing relation between trade and outward FDI on the Japanese economy, and capture the role that the ASEAN countries had over the Japanese economy in the past decades, we work with a panel data that captures the bilateral trade flows between Japan and the 6 largest economies of the ASEAN group[8] in the 10 major manufacturing industries[9], which are known as the driving force of the Japanese economy. For it, this paper will be focusing on the annual periods of 2005 to 2019[10].

The bilateral trade data (exports and imports) at industry level was obtained from the UN Comtrade database in current US dollars. This data was adjusted into real terms using the consumer price index (CPI) obtained from the IMF International Financial Statistics. The Outward FDI (OFDI) data at industry level from Japan towards its trading partners captured in current Yen was obtained from the Bank of Japan database, this data was adjusted into real terms and expressed in US dollar using the CPI and the bilateral exchange rate Yen/Dollar. The bilateral exchange rate Yen/Dollar and the different real exchange rates between Japan and its trading partners were obtained from the IMF Exchange Rate Archives. The GDP and GDP per capita data of Japan and the 6 ASEAN countries captured in constant US dollars were obtained from the World Bank´s World Development Indicators. Information regarding when the free trade agreements were established between Japan and each of

[8] The 6 ASEAN countries used in the estimation are Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam. The remaining ASEAN member states, Brunei, Cambodia, Laos and Myanmar were excluded from the study due to lack of information on Outward FDI and bilateral trade due to confidentiality.

[9] The manufacturing industries we work with are the food, textile, chemicals and pharmaceuticals, rubber and leather, glass and ceramics, iron and metals, general machinery, electric machinery, transportation equipment, and precision machinery industries.

[10] The chosen period for our study is due to the availability of Japan's Outward FDI data towards its trading partner, which are available from the years 2005 to 2019.

the ASEAN countries were obtained from the Ministry of Foreign Affairs of Japan. The years in which each country signed the FTA with Japan can be appreciated in the Table A1 located in the Appendix. Data on distance between the capitals of the ASEAN countries and Japan captured in kilometers were acquired from the GeoDist database of The Centre d'Études Prospectives et d'Informations Internationales (CEPII)[11].

As mentioned above, in order to capture and control for country and market size characteristics, we will follow the steps of recent empirical studies which has been largely influenced by the works of Helpman and Krugman (1985), and Hummels and Levinsohn (1995). With the data obtained from the World Bank´s World Development Indicators, we formalize following series of control variables.

The overall bilateral size of the market will be captured by the sum of the real GDPs:

$$SumGDP_{ijt} = GDP_{it} + GDP_{jt}$$

According to Helpman and Krugman (1985) trade should increase as the bilateral size of the market increases due to the presence of economies of scale. The larger the markets, the larger the opportunities of production and trade. Hummels and Levinsohn (1995), also defend that those countries that share large bilateral market size should experience higher bilateral trade relations. In other word, we should expect a positive impact of this variable over the imports and exports for those countries with large bilateral market size.

In order capture how similar two countries are in terms of size, development and demand, Helpman (1987) defined the following equation:

$$SimGDP_{ijt} = \left[1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}}\right)^2\right]$$

This similarity index ($SimGDP_{ijt}$) will take values between 0 and 0.5. Meaning that the closer $SimGDP_{ijt}$ is to 0.5, the more similar the countries are. According to Helpman (1987), this variable should have a positive impact over the exports and imports. In other words, is expected to appreciate higher levels of trade between countries that have a similarity index close to 0.5, and lower levels of trade between those countries with a similarity index close to 0. It is argued that similar countries in terms of income and development does not only trade more, but also tend to have relatively similar demand and production structures.

The absolute difference of market size its captured by the following equation:

$$DifGDP_{ijt} = \left|GDP_{it} - GDP_{jt}\right|$$

[11] GeoDist provides several geographical variables for 225 countries, used in Mayer and Zignago (2011).

Helpman and Krugman (1985) argue that the differences in market size allow us to capture how manufacturing capabilities differ between nations when it comes to produce different varieties of a product. Therefore, as countries size differences decreases it's expected to appreciate an increase of demand for differentiated goods. So, in accordance to Helpman and Krugman, we should expect $DifGDP_{ijt}$ to have a negative impact over trade. However, there is reason to believe that this is not always the case. KruDgman (1980) argues that consumers of large economies would demand domestic products rather than import them from abroad, due to the vast availability of good a large economy provides. In other words, large economies would not necessarily need to depend on the foreign markets to obtain different goods as much as a small economy would. Therefore, country size differences might present uncertain effects over trade, especially on imports.

The absolute difference of the per capita market size is given by:

$$DifGDPpc_{ijt} = \left|GDPpc_{it} - GDPpc_{jt}\right|$$

This last variable captured the differences in factor endowments. Large differences in GDP per capita between two countries indicates that there are great differences of factor endowments. Helpman and Krugman (1985) argued that large differences in factor endowments would consequently lead to a decrease of intra-industry trade. Therefore, we should expect lower intra-industry trade among those countries with large absolute differences of GDP per capita.

4.3. Methodology

When working with the gravity model of trade, recent empirical studies recommend the use of panel data regressions, as this approach allow us to avoid certain issues that cross-sectional estimates might present, such as biased estimates on trade due to the lack of heterogeneity allowed in this type of regressions (Baltagi, 2001; Egger, 2005).

Traditionally, with panel data the most common approaches when it comes to estimate the gravity model of trade, is to work with standard empirical methods such as the Pooled Ordinary Least Square (POLS), Fixed-Effects (FE), Random-Effects (RE), amongst others. However, in recent years, as the literature expanded, the Poisson Pseudo Maximum Likelihood (PPML) regression has been the recommended method to approach this topic. Over the years there have been some empirical debates regarding the validity of some of these standard methods used to estimate the gravity equation, especially when the model is estimated using the ordinary least square method. We know that Jensen's inequality states that $\mathrm{E}\{Ln(\mathrm{y})\} \neq Ln(E\{\mathrm{y}\})$, where the expected value of the logarithm of a random variable is different from the logarithm of its expected value. Santos Silva and Tenreyro (2006) argue that, when there is evidence of heteroskedasticity in the errors, the expected value of the log-linearized error of the gravity equation will not equal the logarithm of its expected value, which consequently the log-linearization of the model could lead to misleading estimates. In other words,

due to the presence of heteroskedasticity in gravity models, the OLS estimator yields inconsistent estimators. Another major concern when working with the gravity models, is the possibility of encountering zero values in the trade data. It is important to consider these zero values, as we might come across bilateral trade relations where only one of the country's export or imports from the other (Haveman and Hummels, 2004). Not accounting for these zero values would lead us to face selection bias and omitted variable bias, meaning that we would end up with inconsistent and biased estimates (Helpman, Melitz, and Rubinstein 2008). However, under this setting, the log-linearization of the gravity model would be incompatible due to $Ln(0)$ not existing. In order to face this issue, some suggest to redefine the dependent variable of trade to something like $Ln(T_{ij}+1)$, or similarly, use the Ad-Hoc solution[12]. Even though this approach avoids the zero-value problem, it still does not solve the concern of heteroskedasticity. Santos Silva and Tenreyro (2006) propose a simple solution in order to deal with all the mentioned issues that the POLS method faces, which is to work instead with the Poisson Pseudo Maximum Likelihood (PPML) method introduced by Gourieroux et al. (1984). Santos Silva and Tenreyro (2006) defend that this method not only outperforms other standard methods of estimation when facing heteroskedasticity, but it is also effective when it comes to deal with the zero trade value observations that we might encounter in our panel data.

Having said this, in order to estimate the parameters of interest and obtain conclusive results regarding the impact that outward FDI from Japan have over its exports and imports with the ASEAN countries at an industry level, I will approach this topic with different econometric methods for comparative purposes, account for the mentioned issues, and obtain robust results. Before we analyze the impact of outward FDI on the manufacturing sector at an industry level, we will start by analyzing the overall impact that outward FDI have over the total exports and imports of the Japanese manufacturing sector. For it, we will compare the estimates obtained from the different empirical methods.

4.3.1. Empirical Approach

Our starting point will be estimating the parameters with a pooled ordinary least square, as it has been the most common method over the past years. As mention above, this method comes with a series of issues, such as having correlation between the explanatory variables and the unobserved variables which consequently lead to bias estimates (Cheng and Wall, 2005), and also comes with the problem of working with zero trade values. We will then estimate the gravity model with our main econometrical approach, the Poisson Pseudo Maximum Likelihood (PPML) fixed effect estimator, being the preferred estimation method when working with gravity equations due to its numerous

[12] The Ad-Hoc solution main idea consist in adding a small and positive number to all trade flows, since $Ln(0)$ is undefined, but $Ln(0+0.0001)$ for example is not.

advantages over the previous mentioned methods. As we already stated, the PPML method not only enables us to deal with zero values on the dependent variable, but it is also considered to be an ideal workhorse estimator for gravity equations even though zero values are not a concern in the data[13]. The Poisson estimator is not only consistent in the presence of fixed effects, which is a rare property of non-linear maximum likelihood estimator (Shepherd, 2016), but unlike the log linear ordinary least square, the PPML method provides us with consistent estimates of the original nonlinear model which is robust to heteroskedasticity (Santos Silva and Tenreyro, 2006).

4.3.2. Poisson Pseudo Maximum Likelihood criticism

Some may believe that the interpretation of the coefficients from the PPML are in a certain way confusing, due to the dependent variable being specified in levels rather than in logarithms. However, the interpretation is rather straightforward, as it follows the exact same pattern as an OLS and can still be interpreted as standard elasticities (Santos Silva and Tenreyro, 2006).

As noted by Ben Shepherd (2016), in recent years the efficiency of Poisson Pseudo Maximum Likelihood has also been questioned by some researchers. Some defend the use of the negative binomial models as an alternative to the Poisson estimator when working with trade data due to the possibility of encountering overdispersion. However, this alternative approach has been proven wrong, since the Poisson method is consistent as a pseudo-maximum likelihood estimator regardless of how the data is distributed and therefore allows for overdispersion. Additionally, the use of the negative binomial estimator can present some issues, such as that is not scale invariant, which can become problematic when working with a gravity model. Having said this, when working with gravity models, the use of negative binomial model should not be considered as an alternative to the Poisson Pseudo Maximum Likelihood estimator.

Another concern regarding the use of the Poisson method was due to its efficiency when facing large amounts of zero trade values. However, Santos Silva and Tenreyro (2011) showed that Poisson performs strongly even with datasets with large numbers of zeros trade values.

Considering all the above, the use of Poisson Pseudo Maximum Likelihood method is considered by many to be an ideal gravity model estimator when working with panel data and gravity equations.

5. Empirical Results

Before we focus on the impact that the Japanese outward FDI have over its trade with the ASEAN countries on the different manufacturing industries, we will start by briefly analyzing the overall impact that the total outward FDI has over the total trade in the manufacturing sector. By doing so, we are able to capture and have an initial understanding of what sort of impact the FDI might presents over

[13] We do not encounter zero trade values in our bilateral trade data between Japan and its trading partners. However, in order to face the heteroskedasticity problem and obtain consistent estimates, our main method of estimation will be the Poisson Pseudo Maximum Likelihood (PPML) as recommended by different authors.

the Japanese trade with its trading partners. This will also allow us to study and compare the different estimation methods mentioned above before we engage on the core of this paper.

5.1. Outward FDI impact over the total exports and imports of the manufacturing sector

In this section we present the results regarding the overall impact that Japanese OFDI has over the total trade of the manufacturing sector as a whole. The estimated results captured in Table 1 reports the coefficients of the gravity equations for the total exports and total imports. These estimates were obtained using linear and non-linear estimators, specifically the Pooled Ordinary Least Square (POLS) estimator (Colum 1), and the Poisson Pseudo Maximum Likelihood (PPML) fixed-effect estimator (Colum 2).

First thing to notice is that the estimates for both gravity equations (Exports and Imports) are relatively similar among the different estimation methods we work with. We can appreciate that the Japanese trade is positively affected by the outward investments ($OFDI_{ijt}$). Captured by the different estimation methods, at the 1% level of significance, the outward FDI appear to have a positive and significant impact over the total exports and imports. What this mean, is that the foreign investments that Japan has over the ASEAN economies have a positive influence over trade and therefore acts as a complement in the manufacturing sector. Regarding the similarity between the economies ($SimGDP_{ijt}$), we also observe from the different estimation methods that this variable plays a positive and significant role over the bilateral trade. The results capture that, with 1% significance level, as the economies grow and become more "alike" in terms of economical size, bilateral trade among them appear increase. On the other hand, the absolute difference of market size ($DifGDP_{ijt}$) also presents a positive impact over trade. The impact they have over exports is not statistically significant, however, they do present a significant effect over the imports. On the contrary, the absolute difference of the per capita market size ($DifGDPpc_{ijt}$) appear to have a strong negative and significant effect over trade, suggesting that differences in relative factor endowments plays an important role over the bilateral trade, and as Helpman and Krugman (1985) argued, large differences in factor endowments could lead to a decrease of intra-industry trade. Now, regarding the free trade agreement (FTA_{ijt}) established between Japan and its trading partners does not appear to have a strong impact over trade. The effect they have is small but positive, however it is not statistically significant. We can argue that this result might be due to the long relation that Japan and the ASEAN countries have, having strong trading ties prior to the establishment of the FTA. In other words, trade among them could have been quite consistent prior to the establishment of the FTA´s, and therefore these agreements do not present a significant impact over trade. Regarding the real exchange rate ($RealExRate_{ijt}$), as expected, we can observe that the appreciation of the Japanese Yen has a negative impact over their exports and a positive impact over their imports. However, the effects it has over trade, even though

statistically significant, is considerably small. On the other hand, the geographical distance between economies ($Distance_{ijt}$) and the dummy variable that captures whether the Japanese trading partner is an island or not ($Island_{jt}$), captures a negative and significant effect over both exports and imports, suggesting that trade resistance factors play an important role over the manufacturing trade of Japan.

Table 2: Results for Manufacturing Sector Total Exports and Imports

	POLS (1)		PPML (2)	
Independent Variables	Exports	Imports	Exports	Imports
$Ln(OFDI_{ijt})$	0.238***	0.099**	0.273***	0.117***
	(0.337)	(0.176)	(0.031)	(0.011)
$Ln(SimGDP_{ijt})$	1.563**	2.052***	1.573***	1.937***
	(0.291)	(0.254)	(0.206)	(0.274)
$Ln(SumGDP_{ijt})$	4.196**	6.345**	4.225***	6.125***
	(0.979)	(1.541)	(0.652)	(1.592)
$Ln(DifGDP_{ijt})$	1.805	6.583*	1.155	5.912**
	(1.981)	(2.108)	(1.522)	(2.198)
$Ln(DifGDPpc_{ijt})$	-1.201***	-0.498*	-1.258***	-0.459***
	(0.178)	(0.159)	(0.085)	(0.136)
FTA_{ijt}	0.0817	0.133	0.019	0.055
	(0.132)	(0.101)	(0.102)	(0.092)
$RealExRate_{ijt}$	-0.0062**	0.0014*	-0.0057**	0.0016*
	(0.002)	(0.0006)	(0.0012)	(0.0007)
$Ln(Distance_{ijt})$	-0.955	-0.747	-1.109***	-0.817*
	(0.391)	(0.383)	(0.219)	(0.351)
$Island_{jt}$	-0.671***	-0.747**	-0.722***	-0.753***
	(0.163)	(0.142)	(0.738)	(0.131)
$Constant$	61.722	17.151	74.635**	25.001
	(32.271)	(22.494)	(21.841)	(18.097)
Observations	90	90	90	90
Number of Groups	6	6	6	6
FE	Yes	Yes	Yes	Yes
R^2	0.77	0.87	0.81	0.88

Notes: Stars give significance at 1% (***), 5% (**) and 10% (*) level. Standard errors in parenthesis.
Total exports and imports, expressed in logarithms, are the dependent variable for the POLS estimators. The dependent variables in the PPML are not expressed in logarithms.
POLS model (1) and PPML fixed-effects estimation (2) has clustered standard errors.

As noted, this Table 2 allow us to analyze the overall impact that Japanese outward FDI of the manufacturing sector has over its trade. As the results capture, the semi-elasticity related to the outward FDI is significant at the 1% level in all regressions, suggesting that the outward FDI acts as a compliment of trade and not as a supplement. We can appreciate that the estimates of the outward FDI ranges between 0.203 to 0.273 for the exports, and for imports it ranges between 0.069 to 0.117. Focusing on the PPML estimator (Colum 2), these results suggests that if Japan invest 1 billion US dollars towards the manufacturing sector of the ASEAN economies, Japan would experience an increase of exports of around 27% and would experience an increase of imports of about 12%. Even

though Japanese exports appears to be more sensitive to these investments, we can argue that overall, FDI enhances trade. These results reach similar conclusions as previous empirical studies done by authors such as June-Dong Kim, et al. (1997); Urata, S. and Kawai, H. (1998); Kawai, M. and Urata, S. (2010) and Raphaël Chiappini (2016), which they study the impact of Japanese outward FDI over its trade with different trading partners at a country level, sector level, or firm level for the manufacturing sector, which most of them focused on the late decades of the 20th century.

This paper focuses exclusively on the south east Asian market. We have shown that Japanese outward investments still presents a positive effect over Japanese trade with the major economies of the ASEAN group. However, our main interest is to analyze how trade of each major manufacturing industry is affected by these Japanese outward investments, since the effects may differ amongst them. The results for this are captured in the following section.

5.2. Outward FDI impact over trade at industry level

In the following section we will focus on the 10 major industries of the Japanese manufacturing sector, analyzing what sort of impact the Japanese outward FDI have over the trade of each one of these industries in the ASEAN market for the periods of 2005 to 2019. The results captured in the Table 2 are the estimates obtained using the Poisson Pseudo Maximum Likelihood (PPML), as this method is the ideal estimator for our gravity equations, due to it being consistent in the presence of fixed effects and also being able to provide consistent estimates that are robust to heteroskedasticity, as explained in the section 4.3. Methodology.

The estimates captured in Table 3, show that outward FDI have a positive impact over both exports and imports in all of our industries, with the exception for the Glass and Ceramics industry, where we can argue that the outward investment in this particular industry acts as a supplement rather than as a compliment. However, as the estimates show, these outward investments only have a positive and significant impact over the exports of the following industries: Chemicals and Pharmaceuticals, General Machinery, Electronic Machinery, Rubber and Leather, and Iron and Steel, where the outward FDI acts as a compliment. Similarly, Japanese outward investments also have a positive and significant effect over the imports of the Food industry, Rubber and Leather industry, and the General Machinery industry. On the other hand, we also appreciate that, in accordance to the findings of Urata, S. and Kawai, H. (1998), Ryoji Koike (2004), Sakamoto, K. (2013), our estimates capture that the Japanese outward investments do not present a significant impact over the exports and imports of certain industries, such as the Transportation Equipment industry and the Precision Machinery industry. These results may suggest that the relationship between Japanese outward FDI and trade with the ASEAN economies, for the mentioned industries, have been decreasing over the past decades, due to the dramatic change in trade relationships observed in the Asian market. As the

Chinese economy grew, intra-industry trade between Japan and China have significantly increased, specifically in the Transportation and Precision Machinery industry, were the Japanese outward FDI towards this country has grown over the past decades and has played an important role over the intra-industry trade (Katsuhiro Sasuga, 2013). However, we also need to keep in mind that for many years, Japanese foreign investments for the Transportation Equipment and Machinery industries have been considerable in the developed nations of Europe and North America (Nishitateno, 2013). Now, these are not the only industries in which we do not observe a significant impact of the outward FDI. Contrary to the findings of Urata and Kawai (1998) but in accordance with the findings of Chiappini (2016), we capture that trade of the Textile and Glass industry are not significantly affected by the Japanese foreign investments, which might suggest that the impact that the outward FDI have over these industries has been decreasing over the recent years, and the production process might be shifting towards other economies where production cost is lower. As we mentioned in section 2.2., in recent years, outward investments towards natural resources industries have been in decline amongst the ASEAN economies, as labor cost has been increasing in countries such as Thailand, Singapore and Indonesia, forcing Japanese multinationals to shift their investments towards new emerging economies of Southeast Asian market.

Now, the industries in which we appreciate that outward FDI has a significant impact over exports and imports, specifically at the 1% level of significance, are the General machinery, Rubber and Iron-Steal industries. As our estimates capture, we can argue that if Japan invest 1 billion US dollars towards the General Machinery industry, Japan would experience an increase of exports of about 14% and an increase of imports of about 10%. Similarly, for the Rubber and Leather industry, we would appreciate an increase in exports of about 8.4% and 11% in imports. For the Iron and Steel industry, an additional investment of a billion dollars would also increase its exports in about 18%. At the 10% level of significance, an additional billion US dollar investment towards the Chemicals and Pharmaceuticals industry, and Electronic Machinery industry, would increase their exports in about 9% and 6% respectively. And at the 5% level of significance, we can appreciate that a billion US dollar investment towards the Food industry results in an increase of imports close to 16%. Having these results and comparing them to the findings of other authors that analyzed this topic for the periods of the 1980´s, 1990´s and early 2000´s (Urata and Kawai (1998); Koike (2004); Sakamoto (2013)) we can argue that over the past years, Japanese outward investments in the ASEAN economies have played an important role over the trade for many manufacturing industries, enhancing both exports and imports. However, we also capture that for specific industries, the outward FDI does not present much of a strong impact over trade as it once used to, suggesting that in these past years, there have been some changes or shifts in the trade relations between Japan and the ASEAN economies.

Focusing on the other independent variables of our model, for all of the manufacturing industries, we can appreciate that the estimates for the similarity index ($SimGDP_{ijt}$) are all positive and in most cases are highly significant at the 1% level. As captured in the section 5.1, we can once again observe that, as countries become more alike in terms of income and development, trade among them not only increases in the different industries, but also, as Helpman (1987) argued, countries start to have a relatively similar demand and production structures, which as a result, it enhances trade between the economies. For the industrial exports, this variable takes values between 1.23 and 3.41, being the Glass and Ceramic industry the one that is affected the most by the similarity variable. And for the imports, this variable ranges between 3.07 and 6.46, being the Textile industry the one that holds the highest value.

In accordance to what Helpman and Krugman (1985) defend, we observe in our results that the overall bilateral size of the market ($SumGDP_{ijt}$) presents a positive and significant impact over trade for most of the manufacturing industries, suggesting that over the years, this increase of trade comes as a consequence of bilateral size of the market increasing due to the presence of economies of scale. Now, there are a few industries in which this variable does not present a significant impact neither in exports or imports, specifically the Food, Chemicals and Pharmaceuticals, and the Iron and Steel industries.

According to our results, we can also appreciate that the absolute difference of market size ($DifGDP_{ijt}$) has a positive impact over both exports and imports in most industries. However, these effects are not statistically significant in most of the industries. We do appreciate a significant impact, at the 1% level of significance, in the Iron and Steel industry where the market size difference has a negative impact over its exports, but it enhances considerably its imports.

The estimates obtained for the absolute difference of GDP per capita ($DifGDPpc_{ijt}$) allow us to observe that differences in factor endowments between Japan and the ASEAN economies are present in our sample. As argued by Helpman and Krugman (1985), having differences in factor endowments should lead to a decrease of intra-industry trade, and as we capture in our estimates, this variable has a negative and significant impact over trade in most of our industries. The estimates for this difference of the per capita market size, at the 1% level of significance, ranges between 0.72 to 1.64 for the industry exports, being the Iron and Steel industry the one that holds the highest value. For the imports, at 1% level of significance, the estimates range between 1.3 and 2.9, being the Food industry the one holding the highest value.

Table 3: Results for each Manufacturing Industry Exports and Imports

Independent Variables	Food (1)		Textile (2)		Chemicals and Pharmaceuticals (3)		General Machinery (4)		Glass and Ceramics (5)	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
$Ln(OFDI_{ijt})$	0.091	0.162**	0.016	-0.025	0.092*	0.0301	0.146***	0.106***	-0.057	-0.011
	(0.057)	(0.070)	(0.027)	(0.055)	(0.045)	(0.038)	(0.038)	(0.033)	(0.062)	(0.661)
$Ln(SimGDP_{ijt})$	1.723***	4.860**	2.307***	6.463***	3.059**	4.764	1.996***	2.899***	3.412***	3.071***
	(0.374)	(1.596)	(0.404)	(0.641)	(0.965)	(5.277)	(0.339)	(0.395)	(0.821)	(0.390)
$Ln(SumGDP_{ijt})$	2.254	8.046	8.516**	29.209***	1.949	24.808	3.898***	6.271***	20.244**	16.622**
	(2.167)	(8.127)	(2.511)	(5.194)	(4.380)	(29.723)	(0.976)	(1.533)	(7.482)	(4.802)
$Ln(DifGDP_{ijt})$	4.383	0.676	2.082	5.813	-0.634	17.186	-1.411	2.559	16.447*	10.046*
	(4.843)	(9.062)	(2.188)	(4.048)	(6.313)	(26.881)	(1.747)	(3.093)	(7.436)	(3.951)
$Ln(DifGDPpc_{ijt})$	-0.720**	-2.901***	4.737	27.250*	-1.174*	0.872	-1.351***	-1.684***	-1.073***	1.294**
	(0.258)	(0.725)	(3.611)	(10.749)	(0.534)	(2.189)	(0.190)	(0.166)	(0.275)	(0.450)
FTA_{ijt}	0.312	0.460	0.259	0.637	0.055	2.084	0.208	0.457**	0.276	0.366***
	(0.258)	(0.328)	(0.184)	(0.446)	(0.294)	(1.564)	(0.148)	(0.155)	(0.166)	(0.115)
$RealExRate_{ijt}$	-0.014	0.036***	-0.021	0.114***	-0.021**	0.035	-0.0073**	0.0139***	-0.0057	0.0028
	(0.0078)	(0.0085)	(0.017)	(0.019)	(0.008)	(0.021)	(0.0024)	(0.0026)	(0.0076)	(0.0035)
$Ln(Distance_{ijt})$	-2.226	-5.446*	-4.784**	-1.139	-3.958*	-2.615	-2.035**	-3.434***	-0.148	-0.352
	(0.074)	(2.289)	(1.714)	(6.803)	(2.011)	(4.677)	(0.643)	(0.681)	(1.161)	(0.752)
$Island_{jt}$	-0.952**	-2.850***	-0.531	-1.887	-1.906***	-1.805	-0.862***	-1.339***	-0.924*	-1.275***
	(0.338)	(0.657)	(0.644)	(2.196)	(0.454)	(1.771)	(0.170)	(0.135)	(0.376)	(0.226)
$Constant$	-11.121	188.158**	170.469*	173.946	88.599	127.847*	122.887***	108.089*	83.472***	135.959**
	(0.887)	(70.767)	(67.735)	(86.711)	(73.272)	(53.627)	(24.683)	(42.436)	(24.905)	(48.837)
Observations	90	90	90	90	90	90	90	90	90	90
Number of Groups	6	6	6	6	6	6	6	6	6	6
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.61	0.73	0.88	0.78	0.67	0.89	0.70	0.71	0.74	0.70

Notes: Standard errors in parenthesis. Stars give significance at 1% (***), 5% (**) and 10% (*) level. Standard errors in parenthesis.

Total exports and imports, expressed in logarithms, are the dependent variable. PPML fixed-effects estimation has clustered standard errors.

Table 3: Results for the Manufacturing Exports and Imports (Continuation)

Independent Variables	Electronic Machinery (6)		Transportation Equipment (7)		Precision Machinery (8)		Rubber and Leather (9)		Iron and Steal (10)	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
$Ln(OFDI_{ijt})$	0.060*	-0.0022	0.0034	0.751	0.092	0.0054	0.084***	0.108**	0.185***	-0.034
	(0.262)	(0.014)	(0.062)	(0.057)	(0.067)	(0.0173)	(0.0205)	(0.039)	(0.038)	(0.142)
$Ln(SimGDP_{ijt})$	2.093***	1.638**	2.903***	2.128***	2.245***	3.076***	1.237***	3.568***	1.392***	1.367*
	(0.557)	(0.635)	(0.683)	(0.371)	(0.226)	(0.208)	(0.152)	(0.584)	(0.351)	(0.646)
$Ln(SumGDP_{ijt})$	9.829**	8.142	6.848***	1.673	4.279*	9.266**	1.075**	11.749***	1.278	7.984
	(3.500)	(5.190)	(1.625)	(1.253)	(1.684)	(2.932)	(0.419)	(1.572)	(1.476)	(4.385)
$Ln(DifGDP_{ijt})$	8.037	11.282*	2.867	4.411**	0.272	8.652**	0.698	4.131	1.160***	22.358***
	(4.493)	(5.435)	(1.850)	(1.712)	(3.015)	(3.201)	(1.316)	(2.320)	(2.087)	(3.879)
$Ln(DifGDPpc_{ijt})$	-1.163***	-0.247	-1.073***	-1.863	-1.302***	-0.539	-1.085***	1.925***	-1.639***	-1.118
	(0.273)	(0.376)	(0.316)	(1.828)	(0.292)	(0.313)	(0.216)	(0.391)	(0.493)	(0.845)
FTA_{ijt}	0.115	0.354***	0.157	0.487***	0.0721	0.043	0.344*	0.059	0.017	1.053
	(0.157)	(0.106)	(0.174)	(0.096)	(0.123)	(0.121)	(0.141)	(0.237)	(0.146)	(0.581)
$Ln(RealExRate_{ijt})$	-0.0013	0.0091	-0.00063*	0.068*	-0.013***	0.021***	-0.015**	0.018**	-0.0118	0.044***
	(0.005)	(0.0069)	(0.0039)	(0.0302)	(0.0033)	(0.0054)	(0.0056)	(0.0065)	(0.0127)	(0.0097)
$Ln(Distance_{ijt})$	-0.728	-0.352	-1.167*	-1.118	-2.728***	-2.391**	-0.117	-2.257***	-1.212	-3.490*
	(0.847)	(1.110)	(0.523)	(0.654)	(0.685)	(0.926)	(0.463)	(0.452)	(0.863)	(1.686)
$Island_{jt}$	-0.505	-0.413	-0.997***	-1.371***	-1.201***	-1.358***	-0.725***	-1.551***	-1.289***	-0.0502
	(0.318)	(0.336)	(0.146)	(0.194)	(0.246)	(0.356)	(0.096)	(0.138)	(0.125)	(0.474)
$Constant$	51.817	-43.392	95.014**	-28.295	114.675*	46.278	38.803	134.016***	62.673	-172.610
	(34.258)	(23.695)	(33.025)	(52.144)	(48.801)	(25.054)	(21.155)	(33.509)	(34.783)	(85.103)
Observations	90	90	90	90	90	90	90	90	90	90
Number of Groups	6	6	6	6	6	6	6	6	6	6
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.76	0.75	0.77	0.93	0.70	0.90	0.89	0.92	0.84	0.55

Notes: Standard errors in parenthesis. Stars give significance at 1% (***), 5% (**) and 10% (*) level. Standard errors in parenthesis.

Total exports and imports, expressed in logarithms, are the dependent variable. PPML fixed-effects estimation has clustered standard errors.

Regarding the impact that free trade agreements (FTA_{ijt}) have over the exports and imports of each industry, we can argue that it is trade enhancing. These effects, however, are not statistically significant for most of the industries in question, in fact, it is only statistically significant at the 1% level for the imports coming from industries such as the General Machinery, Transportation Equipment, Electronic Machinery, and the Glass and Ceramics industry. Similar to the results obtained in the Table 2, the reason behind why we might not appreciate much of a significant impact of FTA on the industrial trade, such as for the Chemicals and Pharmaceuticals or the Iron and Steel industry among others, might be due to the fact that Japan already presented high levels of trade with the ASEAN economies prior to the establishment of the free trade agreements, and therefore, when the FTA entered into force, the effect it had over trade was not as significant as one might expect.

In regards of the real exchange rate ($RealExRate_{ijt}$), the results show that as the Japanese Yen suffers an appreciation respect the foreign currency of its trading partner, this causes a negative impact over the Japanese exports, due to Japanese goods becoming relatively more expensive. However, this appreciation of the Yen also enhances its imports, as good from abroad become cheaper for the Japanese industries. Now, as captured by our estimates, we can appreciate that the real exchange rate, overall, has a small impact over the Japanese industry trade. We only observe a strong and significant impact, in both exports and imports, for the General Machinery, Rubber and Precision Machinery industries.

As expected, the coefficients that act as a trade cost proxy, captured by the distance between two nations ($Distance_{ijt}$), and the dummy variable that capture whether a country is an island or not ($Island_{jt}$), presents a negative effect over both exports and imports in all of the manufacturing industries. However, the estimates show that not all industries are affected significantly by these variables. In fact, distance only appears to present a significant impact, at the 1% level significance, in both exports and imports of the Precision Machinery and General Machinery industry. While trade on industries such as the Glass and Ceramics or Electronic Machinery are not significantly affected by the geographical distance between nations. On the other hand, regarding the fact that an economy is an island or not, we can observe that the industries in which trade is negatively and significantly affected at the 1% level, are the Transportation Equipment, Precision Machinery, Rubber and Leather, Food and General Machinery industries, suggesting that the transportation of goods coming from these particular industries might be costlier when trade is done between islands. We can also argue that, according to the results, it appears that imports are relatively more sensitive to the fact that a country is an island.

With these results, we can argue that for most of the Japanese manufacturing industries, there is a strong presence of vertical outward investment. In other words, Japanese multinational firms find profitable to open plants and/or affiliates in the developing nations of the ASEAN economies in order to take advantage of their low production costs and easy access to different factor endowments, while keeping its headquarters in Japan. This strategy, as mentioned, enhances intra-industry trade, and this can be captured in our results. Even though this strategy has been present in the ASEAN economies for the past decades, it appears that Japanese multinationals are staring to shift its vertical investments towards other emerging economies, as production cost has increased in some of the ASEAN countries. That's the reason we observe that for some industries such as the Textile and the Glass and Ceramic, where outward FDI used to have a strong presence, does not appear to have a significant effect. However, vertical investments in industries such as the General machinery, Iron and Steel, and Rubber and leather, still appears to have a strong presence as it used to have in the past decades.

6.Conclusions

This paper expands the literature regarding the relation between trade and FDI. The main objective of this paper was to capture the recent relation we observe between Japanese outward investments and trade with the ASEAN economies for the manufacturing sector, as the ASEAN market once played an important role over the development of many Japanese multinationals that looked to maximize their profits and minimize their production cost by opening plants and affiliates in this region. Now, this relation was dominant in the decades of the 1980´s and 1990´s, years in which the ASEAN economies were not as developed as today, and Japan was a growing economic power. However, in the last few decades the ASEAN economies grew exponentially, and production cost over this region has consequently increased, forcing Japanese multinationals to shifting their investment patterns. Even though the manufacturing sector has lost importance to other sectors such as the service one, Japan is still one of the major sources of manufacturing investment for this region. With this paper I looked to capture whether Japanese outward FDI still plays an important role over the trade with the ASEAN economies, focusing on the major manufacturing industries that once dominated the Japanese economy, and see how the effect of FDI differs between industries.

The results we capture by working with the Poisson Pseudo Maximum Likelihood method, suggests that Japanese outward FDI still have a positive and significant impact over the trade of many of its major manufacturing industries, suggesting that vertical investment is still a preferred strategy amongst Japanese multinationals in the ASEAN market. These results capture a small but significant impact over the trade of the Food, Chemicals and Pharmaceuticals, General Machinery, Electronic Machinery, Rubber and Leather, and Iron and Steel. The impact,

however, appears to be stronger in industries such as the General Machinery, Iron and Steel, and Rubber and Leather. On the other hand, we capture those Japanese outward investments do not present a significant impact over the exports and imports of certain industries, such as the Transportation Equipment, Precision Machinery, Textile and Glass and Ceramic industries. The outward investments of the Transportation Equipment and Precision Machinery industries have always been more dominant in developing nations of Europe and North America, so this result is not surprising. However, industries such as the Textile and Glass and Ceramic industries, that have been historically dominant in the ASEAN market, does not appear to be significant, which might be caused by the recent shifting of Japanese investments towards other developing regions of Southeast Asian due to the rise of overall production cost in some of the ASEAN economies, and the shifting of investments between the manufacturing industries from natural resources towards more machinery-based industries.

We can argue that over the las few decades this positive relationship we appreciate between Japan´s trade and FDI, for most of its major manufacturing industries, has shown a beneficial impact over the Japanese economy. However, this has come with some drawbacks, especially for the small domestic manufacturing firms, as major multinationals do not necessarily need to rely on them, shifting production towards foreign markets, taking advantage of their low production costs and additionally gaining experience by serving abroad. However, in recent years new challenges have arisen, not only due to the increase of production cost in certain developing nations which has forced many multinationals to reconsider their manufacturing strategies by shifting production towards other emerging economies. But also, due to the logistic challenges caused by the recent pandemic of 2020. This recent supply chain disruption has caused many Japanese multinationals to reconsider their manufacturing and investment strategy, as many has started shifting their production back into their home economy in order to avoid possible disruptions due to lockdowns, which has forced many affiliates to close temporarily, and also avoid the global shipping container shortage. Even though the production cost in Japan is considerably higher, the overall cost is still smaller considering the circumstances. We can argue that over the next few years, we might start to appreciate major changes in the Japanese outward FDI structure. As mentioned, over the past decades we already started appreciating a shift of manufacturing FDI towards the non-manufacturing sector. However, with challenges such as this supply chain disruption caused by the pandemic, new changes are expected, especially in those industries where production can continue in their home economy.

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Appendix

Summary of dataset, 2005-2019.

Variable	Source	Unit of Measure	Observations	Mean	Std. Deviation
Real Total Exports	UN Comtrade	Million USD	90	11.47	0.48
Real Total Imports	UN Comtrade	Million USD	90	10.84	0.45
Real OFDI	Bank of Japan	Million USD	90	9.19	0.70
SimGDP	World Bank	Million USD	90	-2.04	0.46
SumGDP	World Bank	Million USD	90	17.66	0.06
DifGDP	World Bank	Million USD	90	17.50	0.05
DifGDPpc	World Bank	Million USD	90	-1.31	0.27
Real Exchange Rate	IMF Ex.Rate	Direct quote	90	8.41	0.23
Distance	CEP II	Km	90	18.66	28.65
Island	World Atlas	Dummy	90	0.5	0.50

Table 1: Countries and Free Trade Agreements (FTA) establishment

Country	Year
Indonesia	2008
Malaysia	2006
Philippines	2008
Singapore	2002
Thailand	2007
Vietnam	2009

Source: Ministry of Foreign Affairs of Japan (MOFA)

Table 2: Manufacturing outward FDI distribution (%) per industry, 2005 and 2019

	Singapore		Thailand		Indonesia	
	OFDI		OFDI		OFDI	
Industries	2005	2019	2005	2019	2005	2019
Food	53,60	31,03	3,69	3,40	2,29	5,81
Textile	0,17	0,04	2,56	2,27	0,30	0,44
Chemicals and Pharmaceuticals	1,44	4,34	11,13	15,73	26,41	22,92
General Machinery	2,06	0,27	5,85	20,23	12,87	7,83
Glass and Ceramics	12,46	1,93	3,49	2,08	7,71	0,36
Electronic Machinery	10,06	6,75	11,63	20,84	2,30	7,84
Transportation Equipment	15,29	41,82	42,52	3,74	31,27	44,87
Precision Machinery	2,05	4,82	1,40	2,84	2,07	0,01
Rubber and Leather	1,41	7,96	0,96	3,29	8,23	1,72
Iron and Steal	1,46	1,04	16,75	25,58	6,56	8,19

	Malaysia		Philippines		Vietnam	
	OFDI		OFDI		OFDI	
Industries	2005	2019	2005	2019	2005	2019
Food	20,29	6,90	43,38	22,95	1,18	10,30
Textile	14,04	0,20	0,05	0,01	5,22	4,13
Chemicals and Pharmaceuticals	6,30	15,97	1,94	2,64	10,07	14,85
General Machinery	12,26	6,39	5,45	1,75	8,79	11,04
Glass and Ceramics	1,25	16,47	1,60	0,27	0,37	5,86
Electronic Machinery	11,49	21,39	18,45	31,69	21,57	19,54
Transportation Equipment	17,76	25,08	5,68	11,56	37,10	22,41
Precision Machinery	6,87	3,59	7,67	1,04	6,23	2,17
Rubber and Leather	0,01	2,47	5,28	5,00	2,19	0,08
Iron and Steal	9,74	1,53	10,49	23,09	7,28	9,63

Source: Bank of Japan, Balance of Payments Related Statistics