Impact of FDI on manufacturing exports in Thailand

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Abstract

Thailand was one of the Asian economies with the fastest growth of manufacturing industry exports during the 1990s. The country produced and exported the largest value of the manufacturing industry among ASEAN countries. The Asian Financial Crisis in 1997 had an enormous impact on the economy of Thailand, but not much on manufacturing export. Thai manufacturing export continues to grow on average at 12% per year after the crisis. Various factors have been used to explain the growth of manufacturing export in Thailand such as productivity, exchange rate and tariff. FDI is also known as one of many factors that supported manufacturing export in Thailand. However, the growth of manufacturing export in Thailand has not been explained in the relation to FDI. Therefore, the objectives of this paper are to examine the impact of FDI on manufacturing export and to investigate whether FDI substitutes or complements manufacturing export from source countries to Thailand. The extended gravity model is the main model in this paper. The exchange rate and tariff are included in the model in order to find the impact of these factors on manufacturing export. The results show that FDI has a positive impact on manufacturing export from Thailand to other countries. In addition, FDI is complemented by manufacturing export from source countries to Thailand.

Keys words: Manufacturing export, Extended gravity model, Complimentary, Substitution

I. Introduction

Thailand experienced one of the fastest growths of manufacturing export among Asian economies during the 1990s. The country had an average growth rate of manufacturing export at approximately 20% per year. Thailand was a center of the manufacturing industry in ASEAN countries at that time. The country produced and exported the largest value of the manufacturing industry among ASEAN countries. The Asian Financial Crisis in 1997 had enormous impacts on the economy of Thailand, but not much on manufacturing export. The effect of the crisis in 1997 dropped the output of the manufacturing industry to the second largest among the ASEAN countries. However, the manufacturing export in Thailand continues to grow on average at 12% per year since the crisis.

Various factors have been used to explain the growth of manufacturing export in Thailand after the crisis such as productivity, exchange rate and tariff (Tumbunlertchai, 2009 and Jongwanich, 2010). FDI is also one of many factors that supported manufacturing export in Thailand. During the 1990s, the manufacturing export of Thailand mainly concentrated on labor intensive industry because the labor cost was relatively lower than partner countries. However, the labor intensive industries would no longer maintain their competitiveness in the long term. Therefore, the government of Thailand made an effort to promote the capital intensive industry by improving invest environment such as developing skilled of labor (training at domestic and foreign countries), investing in infrastructures (road, seaport, airport, and industrial zone), implementing investment promotion policies (tax holiday, import and export tariffs and grace period). After that, FDI from many counties set up in Thailand; as a result, FDI strengthened capital intensive industry and enhanced the manufacturing export of Thailand.

The significant growth of FDI in the manufacturing export in Thailand leads to question as follow; what are the impacts of FDI on manufacturing export of industry in Thailand; what is the relationship of FDI and manufacturing export from source countries to Thailand. In other words, it tests whether the relationship between FDI and manufacturing export is complementary or substitution. Thus, the objectives of this paper are twofold. The first objective of this paper is to examine the impacts of FDI on manufacturing export in Thailand. The second objective is to investigate the relationship of FDI and manufacturing export from

source country to Thailand. The study covers the period during 1999-2010 when FDI and manufacturing export was in the recovery period from the crisis in 1997. Furthermore, FDI and manufacturing export were in high growth periods.

II. Review of Literatures

There are many studies find that FDI impacts on the export of host countries (Kojima, 1982; Helpman, 1984; Helpman, Melitz, and Yeaple, 2003). Kojima (1982) clearly indicates that FDI has two directions of impacts on the export of a host country. In the first direction, FDI increases/decreases the export from the host country to source country. FDI increases the export from host country to source country when it has vertical investment. Vertical investment means foreign firms invest aboard to produce intermediate input that will be used in final production in their home country (Helpman, 1984). On the other hand, FDI reduces the export from the host to source country when they establish the full process of production in the host country. As a result, it is not necessary to re-import the intermediated product to the home country.

In the second direction, FDI increases/decreases the export from the host country to other countries. FDI increases the export from the host country to other countries when the source country invests in the host country as a production based. In other words, the host country is production platform for foreign investors due to the location advantage, low cost of factors, and availability natural resources. On the other hand, FDI decreases the export from the host to other countries when the export from the host country to source country crowds out the export from the host country to other countries.

Many empirical works of the impacts of FDI on the export are discussed at across countries and at the country level. Chaisrisawatsuk and Chaisrisawatsuk (2007) investigate the interaction of trade and FDI of 29 OECD and 6 ASEAN countries during 1980-2004. They apply the extended-gravity model to test the link between the trade and FDI. The result indicates that FDI increases the export from the host country to source country while it decreases the export from the host country to other countries. Liu, Wang and Wei (2001) apply the Granger causality test to analyze the relationship between trade and FDI in China during 1984-1998. The positive impacts of FDI on import and export suggest that FDI

compliments the trade of China. Xuan and Xing (2006) use the extended gravity model to analyze the impact of FDI on the export of Vietnam. The result clearly indicates that FDI has a positive impact on the export from Vietnam to source countries.

The discussions of the relationship of FDI and trade mainly concentrate on complimentary and substitution. The new trade theory emphasizes the role of horizontal investment and vertical investment. Makusen (1984) states that the motivation of horizontal investment is mainly based on market access and expansion. FDI in this situation is market seeking and therefore it substitutes for trade. Helpman (1984) provides another view of foreign investment. He suggests that the motivation of vertical investment is based on the difference of factor endowment. Thus, efficiency seeking FDI complements for trade.

The theory of intraindustry trade provides the view of substitution between FDI and trade. Krungman and Obstfeld (2005) indicate that the interindustry trade (cloth and food) reflects the comparative advantage while the intraindustry trade (cloth and cloth) reflects the economy of scale. If FDI seeks for economy of scale in the host country, FDI reduces trade or FDI substitutes for trade. Cheng and Kierzkowski (2001) argue that intraindustry trade can reflect both comparative advantage and economy of scale known as production fragmentation.[1] In this situation, FDI is complemented with trade. Makusen (2000) explains the role of multinational enterprises by showing that the vertical multinational enterprises dominate when countries are very different in relative factor endowment, and conversely horizontal multinational enterprises dominate when countries are similar in size and relative endowment and trade costs are moderate to high.

The empirical studies of complimentary and substitution of FDI and export are summarized here. Camarero and Tamarit (2003) study the impact of inbound and outbound FDI on trade of the manufacturing industry of 10 EU countries, Japan and the USA. The panel cointegration technique was applied in this paper. The general results indicate that there is a complementary relationship between FDI and trade in OECD countries. The result is consistent with Marjeed and Ahmad (2008) where they find that FDI increases the export of

[1]Multinational Enterprises (MNEs) produce low-end product, part and components, and other intermediate goods in the host country in order to import these products for final processing in their home country.

49 developing countries during 1970-2004. Pain and Wakelin (1998) identify the relationship of the export performance and inward and outward investment of 11 OECD countries. They apply the standard export demand model. The results indicate that eight out of eleven countries found inward FDI compliments the export while the inward FDI substitutes the export in Japan, Italy and Denmark.

In Thailand, the studies of impact of FDI on the export and the test of complimentary and substitution between FDI and trade are summarized as follows. Pupphavesa and Pussaransri (1994) study the relationship of FDI and export in Thailand. The Granger causality test indicates that FDI is Granger cause the export of Thailand. The relationship of FDI and the export is positive which means FDI enhances the export of Thailand. More recent work by Tumbunlertchai (2009) has supported the positive impact of FDI on export performance in Thailand. She used the firm-level data to analyze factors determining the export decision of three industries, textiles and clothes, foods, and electronics and electrical appliances. One significant factor for a firm's decision is FDI. The result indicates that foreign firms tend to export more and have better export performance than domestic firms. Johnson (2006), on the other hand, finds a negative impact of inflow FDI on the export of Thailand. Furthermore, the Granger causality test shows an independent relationship between the export and FDI.

Based on the previous literature, the impact of FDI on manufacturing export and the relationship of FDI and manufacturing export in Thailand are addressed in this paper. This research applies the extended gravity model since it includes important factors such the size of market, income and distance which affect manufacturing export. In addition, the extended gravity model allows adding other variables into the model. The exchange rate, tariff and FDI are included in the model in order to see the impact of these variables on the export of the manufacturing industry in Thailand.

## III. Methodology and data

3.1 Methodology

This paper applies the extended gravity model to analyze the impact of FDI to the export of the manufacturing industry in Thailand. Tinbergen (1962) introduced the gravity model to the international trade flow. Since then thousands of published articles and working papers follow his theory. The general form of the gravity model is expressed as follows:

$$F_{ij} = G \frac{M_i M_j}{D_{ij}}$$ (1)

where F_{ij} is trade flow from country i to country j, M_i and M_j are economic size of relevant country which are usually GDP, G is gravitational constant, and D_{ij} is distance from country i to country j. Recent literature (Prabir, 2006; Xuan and Xing, 2006; Chaisrisawatsuk and Chaisrisawatsuk, 2007) apply the extended gravity model by including factors such as macroeconomic factors, institution and investment policy in order to analyze the impact of these factors the trade flow. FDI is added into the gravity model to observe the impacts of FDI on manufacturing exports in Thailand.

Figure 1 Impact of FDI on export of Thailand to source countries
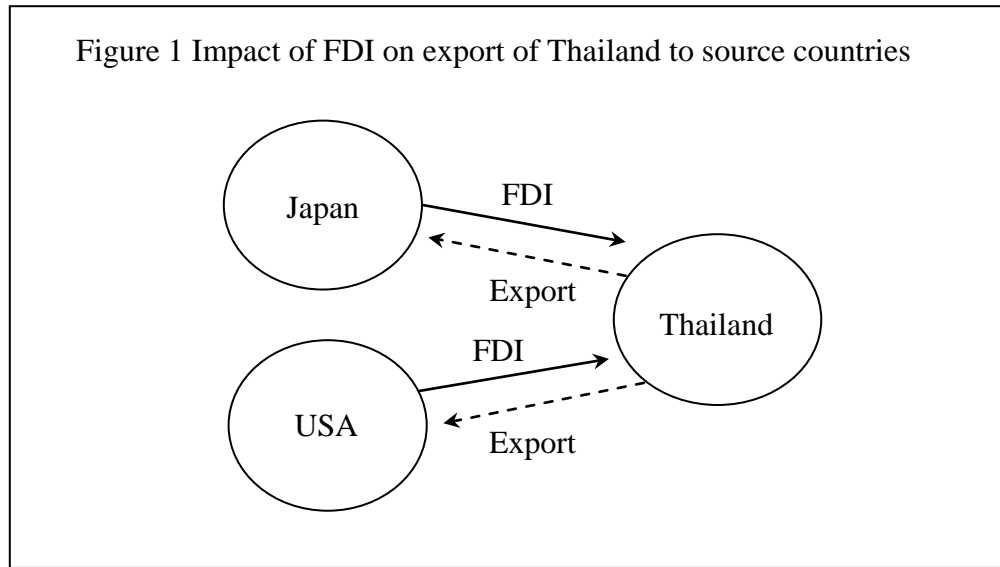
The impact of FDI on export of host country according to the concept of Kojima (1982) can be illustrated in figure 1. This situation, Japan and USA are source countries while Thailand is the host country of FDI. FDI impacts on the export of Thailand to Japan and USA. From this concept and the extended gravity, the impacts of FDI on manufacturing export from Thailand to source countries are formed in the following equation

$$EX_{ij,t} = f\left(GDP_{i,t}, GDP_{j,t}, DIS_{ij}, T_{ji,t}, EXCH_{ij,t}, FDI_{ji,t}, D_{gfc}\right)$$ (2)

where the subscripts i and j refer to Thailand and source country, respectively. The variables in equations (2) are defined as follows. $EX_{ij,t}$ is the value of manufacturing export from

Thailand to country j at time t deflated by export price. $GDP_{i,t}$ and $GDP_{j,t}$ are gross domestic product at constant price (base year = 2005) of Thailand and country j, respectively. DIS_{ij} is a distance from Thailand to country j. $T_{ji,t}$ is import tariff of the manufacturing industry that country j imposes on Thailand at time t. $EXCH_{ij}$ is a real bilateral exchange rate between country j and Thailand at time t. It is defined as

$$EXCH^i = \frac{FC^i}{HC} \times \frac{P}{P^i}$$

(3)

where FC^i is foreign currency; HC is home country currency (Thai Baht); P is home country's consumer price index, P^i is foreign country's consumer price index. $FDI_{ji,t}$ is foreign direct investment in the manufacturing industry from country j to Thailand. It is defined as the real value of FDI which has already operated. D_{gfc} is dummy variable for Global Financial Crisis in 2007 where it is 1 from 2007 to 2010 and 0 otherwise.

Figure 2 Impact of FDI on export of Thailand to source countries
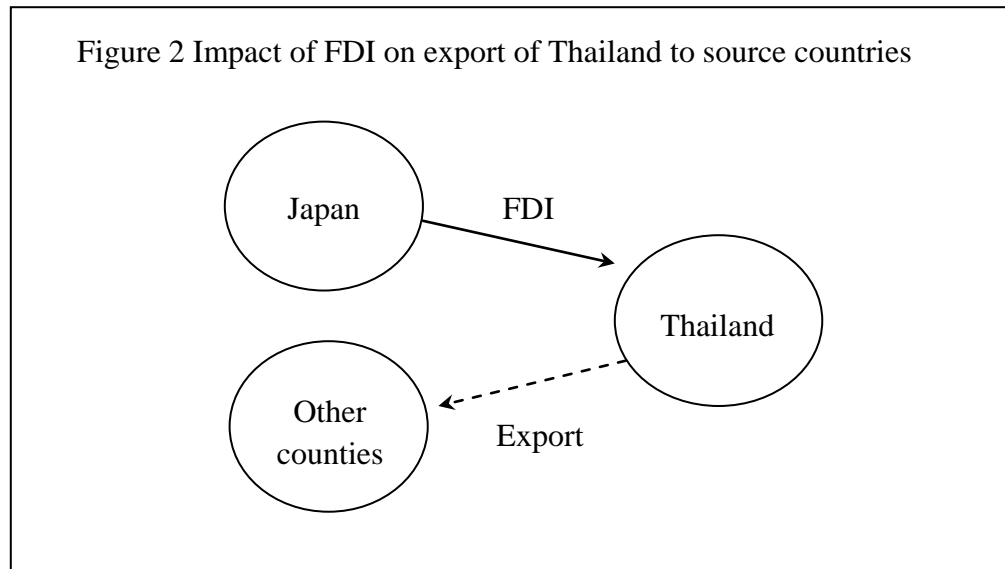
The second direction of the impact of FDI on the exports of Thailand is shown in figure 2. In this situation, Japan invests in Thailand in order to export to other countries. The impact of FDI on the export of the manufacturing industry from Thailand to other countries can be formed as the following equation

$$EX_{ioj,t} = f\left(GDP_{it}, GDP_{oj,t}, DIS_{ioj}, T_{oj,t}, REER_t, FDI_{ji,t}, D_{gfc}\right)$$

(4)

where $EX_{ioj,t}$ is the weighted average of real export of the manufacturing industry from country i to other countries except country j at time t. $GDP_{i,t}$ is GDP at constant price (base year = 2005) of Thailand at time t, $GDP_{oj,t}$ is the weighted average of GDP at constant price (base year = 2005) of other countries except country j at time t. DIS_{ioj} is the weighted average distance from country i to other countries except country j. $T_{oj,t}$ is the weighted average import tariff of other countries except country j at time t. $REER_t$ is the real effective exchange rate at time t. REER is calculated by using 22 countries currencies and weighted by the volume of trade. The weight is calculated by dividing trade of Thailand with country j on total trade of Thailand.

$$REER = \sum_{i=1}^{n} w^i \times \frac{FC^i}{HC} \times \frac{P}{P^i} \tag{5}$$

where $\sum_{i=1}^{n} w^i = 1$ and

$$w_i = \frac{EX^i + IM^i}{\sum_{i=1}^{n} EX^i + \sum_{i=1}^{n} IM^i} \tag{6}$$

where FC^i is foreign currency; HC is home country currency (Thai Baht); P home country's consumer price index, P^i is foreign country's consumer price index

Figure 3 Impact of FDI on export of Thailand to source countries
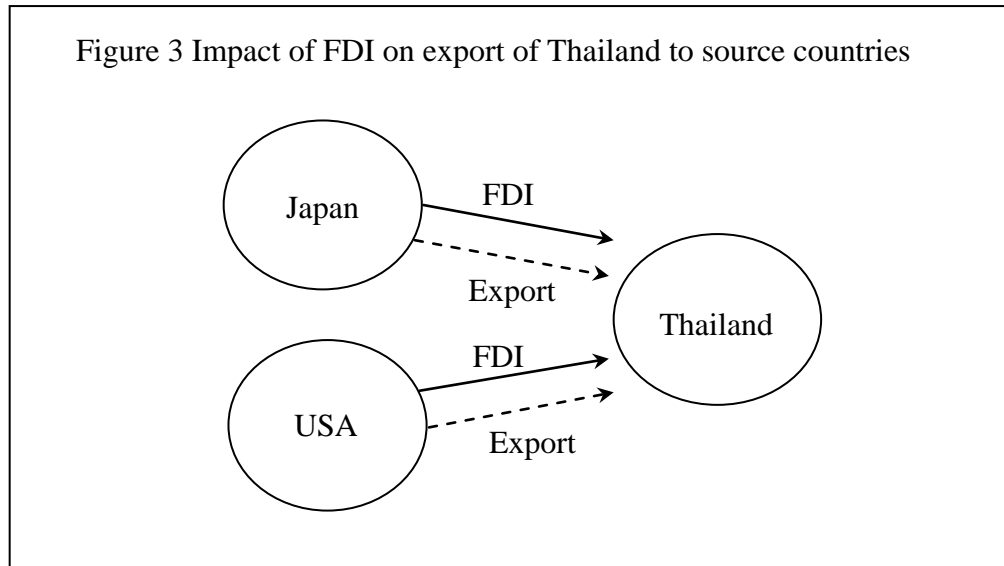
Figure 3 shows the direction of FDI and export of Japan and USA to Thailand. If FDI increase the export of Japan and USA to Thailand, the export is complimented by FDI. On the other hand, if FDI decreases the export of Japan and USA to Thailand, the export is substituted by FDI. The test of complimentary and substitution between the FDI and manufacturing export can be observed through the gravity model as in the functions as below

$$EX_{ji,t} = f\big(GDP_{i,t}, GDP_{j,t}, DIS_{ij}, T_{ij,t}, EXCH_{ij,t}, FDI_{ji,t}, D_{gfc}\big) \qquad (7)$$

$EX_{ji,t}$ is manufacturing export from country j to Thailand at time t or it is manufacturing import of Thailand from country j deflated by import price of manufacturing industry. $T_{ij,t}$ is import tariff of the manufacturing industry that Thailand imposes to country j; and the rest are defined as in equation (2).

3.2 Data sources

The impacts of FDI on the export of the manufacturing industry using the extended gravity model employed a panel data of 22 source countries over the period from 1999 to 2010. The manufacturing exports cover more than 90% of total export and include product groups from 15 to 37 under ISIC classification. In addition, FDI from these countries share around 92% of total investment in the manufacturing industry in Thailand.

Table 1. Summary of data sources

Variables	Data source
Export of the manufacturing industry	World Integrate Trade Solution website which is available at https://wits.worldbank.org/WITS/WITS/Restricted /Login. aspx
GDP of source and host country	World dataBank website which is available at http://databank.worldbank.org/ddp/home.do?Step=1&id=4
Tariff rate	World Integrate Trade Solution which is available at https://wits.worldbank.org/WITS/WITS/Restricted /Login.aspx
Distance	CEPII website which is available at http://www.cepii.fr/anglaisgraph/bdd/gravity.asp

| Exchange rate consumer price index | International Financial Statistic in 2011 (CD ROM) |
| FDI of the manufacturing industry | Board of Investment, Thailand |

V. Results

This section investigates the impact of FDI on the export of the manufacturing industry from Thailand to source countries. The study applies panel data of 22 source countries from 1999 to 2010. The statistics of variables are summarized in table 1 in the appendix. In the case of zero value of FDI, it was replaced by a small number (0.000001) in order to generate the natural logarithm of FDI. The cross-sectional time-series data or panel data can be estimated by using pooled OLS, fixed effect model (FE) and random effected (RE) model.

The decision on which models, FE or RE model, can be made by the Hausman test. The Hausman test is applied where the null hypothesis is preferred to RE model. The result suggests that the null hypothesis is rejected (see table A.2 in appendix A). Therefore, RE model is preferred. In addition, the gravity model includes a time invariant variable, i.e. distance; as a result, the fixed effect model is not appropriate. Then, the Breusch-Pagan Lagrange Multiplier (LM) test is applied in order to decide between RE model or pooled OLS. The null hypothesis of the LM test is that variance across entities is zero. In other words, there is no significant difference across units (countries). According the result of the LM test, the null hypothesis is rejected (p-value < 0.01) and concludes that there is a significant difference across the countries (see table A. 3 in the appendix A).

Table 2 Impacts of FDI on the manufacturing export to source countries

Variable	OLS	FE	RE
$lnGDP_{i,t}$	2.112***	2.333***	2.365***
	(0.255)	(0.252)	(0.191)
$lnGDP_{j,t}$	0.940***	1.000 **	0.918***
	(0.036)	(0.382)	(0.111)
$lnDIS_{ij}$	-1.552***		-1.565***
	(0.058)		(0.139)

$lnT_{ji,t}$	-8.922***	-3.915***	-4.434***
	(0.482)	(1.348)	(0.842)
$lnEXCH_{ij,t}$	-0.085***	-0.224	-0.125**
	(0.012)	(0.265)	(0.049)
$lnFDI_{ji,t}$	0.010*	0.000	0.000
	(0.006)	(0.003)	(0.003)
D_{gfc}	0.046	0.086***	0.080***
	(0.089)	(0.023)	(0.023)
Cons	-16.965***	-34.246***	-19.853***
	(3.051)	(3.939)	(2.430)
N	264	264	264
R-sq	0.840	0.891	0.890

Standard errors in parentheses

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

Table 2 shows results of the impact of FDI on the manufacturing export of Thailand to source countries using pooled OLS, FE, and RE. The coefficients of independent variables are slightly different among three models except the coefficient of tariff. According to the Hausman and the LM tests, the interpretation of coefficients is based on RE model. In general, the coefficient of independent variables provides the correct sign: the coefficients of GDP of host and source country are positively significant at the 1% level while the coefficients of distance, tariff, and exchange rate are negatively significant at the 1% level and the 5% level respectively.

The coefficient of the gravity model is interpreted as the elasticity. For example, the coefficient of GDP of source country is positively significant at the 1% level which indicates that 1% increase of GDP of country *j* increases manufacturing export from Thailand to country *j* by 2.365%. Interestingly, the impact of tariff on export is relatively high compared to the impact of other variables. The coefficient of tariff indicates that a 1% decrease of import tariff of country *j* increases the manufacturing export of Thailand by 4.498%. However, there is no significant impact of FDI on the manufacturing export from Thailand to source country.

Table 3 Impact of FDI on the manufacturing export from Thailand to other countries

Variable	OLS	FE	RE
$lnGDP_{i,t}$	1.921***	1.680***	1.826***
	(0.178)	(0.292)	(0.199)
$lnGDP_{oj,t}$	0.580***	0.759***	0.591***
	(0.032)	(0.157)	(0.041)
$lnDIS_{ioj}$	-1.064***		-1.160***
	(0.259)		(0.381)
$lnT_{joi,t}$	-3.684**	-6.968**	-4.798**
	(1.835)	(3.014)	(2.098)
$lnREER_{ij,t}$	-0.352*	-0.468**	-0.392**
	(0.182)	(0.184)	(0.179)
$lnFDI_{ji,t}$	0.001	0.003**	0.002*
	(0.001)	(0.001)	(0.001)
D_{gfc}	0.271***	0.289***	0.272***
	(0.037)	(0.038)	(0.035)
Cons	-13.261***	-22.285***	-11.392***
	(3.612)	(5.144)	(4.340)
N	264	264	264
R-sq	0.934	0.938	0.937

Standard errors in parentheses

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

The results of impact of FDI on the manufacturing export of Thailand to other countries are shown in table 3. The result of the Hausman and the LM test suggests that RE model is appropriate (see table A.4 and A.5 in the appendix A). In general, the independent variables provide correct signs: the coefficients of GDP and weighted average GDP of other countries except country j and FDI are positive while the coefficients of weighted average distance of other countries except country j, real effective exchange rate and average tariff of other countries except country j are negative. The coefficient of FDI has a positively significant at the 10% level.

Table 4 Impacts of FDI on the manufacturing import

Variable	OLS	FE	RE
$lnGDP_{i,t}$	1.835***	2.515***	2.673***
	(0.461)	(0.249)	(0.168)
$lnGDP_{j,t}$	0.899***	1.363**	1.139***
	(0.038)	(0.305)	(0.165)
$lnDIS_{ij}$	-1.377***		-1.835***
	(0.117)		(0.352)
$lnT_{ij,t}$	-5.659***	-0.034	-0.018
	(1.734)	(0.348)	(0.378)
$lnEXCH_{ij,t}$	-0.003	-0.162	-0.064
	(0.021)	(0.140)	(0.064)
$lnFDI_{ji,t}$	0.034***	0.007**	0.007**
	(0.006)	(0.003)	(0.003)
D_{gfc}	0.007	0.014	0.013
	(0.127)	(0.018)	(0.016)
Cons	-14.455***	-41.892***	-24.794***
	(5.286)	(2.526)	(3.669)
N	264	264	264
R-sq	0.754	0.911	0.909

Standard errors in parentheses

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

The results of impacts of FDI on the manufacturing import of Thailand are shown in table 4. The results of Hausman and LM test suggest that RE model is appropriated (see table A.6 and A.7 in the appendix A). In general, the coefficient of independent variables provides the correct sign: the coefficients GDP of host and source country while the coefficients of distance. However, there are no significant impacts of import tariff and bilateral exchange on the manufacturing import of Thailand. FDI has positive impacts on manufacturing import of Thailand.

V. Discussions

The coefficient of variables such as GDP of source country and Thailand and distance in models (2) and (4) are consistent with the previous studies of the gravity model; for example, Prabir (2006), Xuan and Xing (2006), Chaisrisawatsuk and Chaisirsawatsuk, (2007) in term of the relationship with export. The distance reflects the transportation costs; as a result, Thailand has more trade with closer countries than farther countries. Tariff has the strongest impact on manufacturing export among other independent variables because tariff rate has direct impact on the export and import price of the manufacturing products. This is the reason why the government of Thailand negotiates more free trade agreements with trading partners at the bilateral and multilateral levels.

Figure Tariff rate of five major trading partners
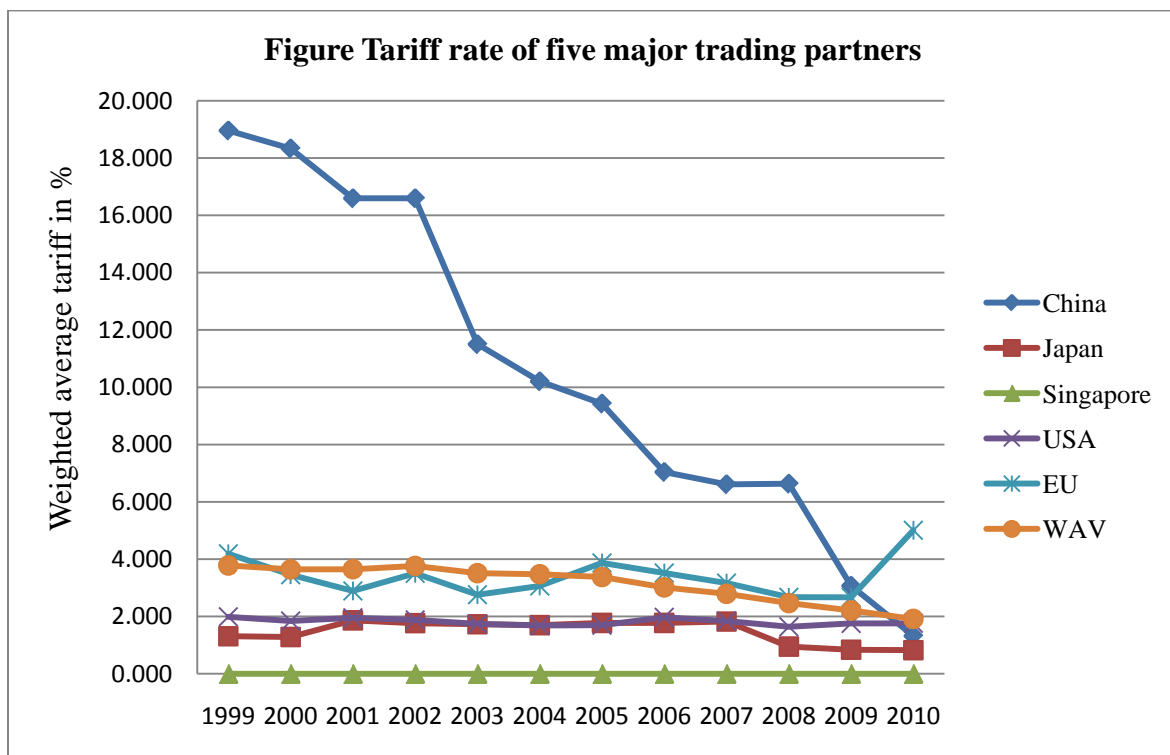
Figure 4 shows the weighted average import tariff rate of the manufacturing industry of five major trading countries and weighted average (WAV) import tariff of 22 countries impose on Thailand. In general, import tariff of trading partner countries with Thailand are significantly decreased from the result of trade negotiations and trade integrations. The trend of weighted average import tariff rate of 22 trading partner countries is slightly decreased overtime. The weighted average import tariff of China has dramatically reduced from nearly 20% in 1999 to about 2% in 2010; as a result, the share of trade between Thailand and China to total trade

moves from 5% in 1999 to 19% in 2010. The import tariff of China imposed on Thailand was significant reduced due to the ASEAN + China Free Trade Agreement (FTA) in 2002. This agreement implemented the Early Harvest Program in 2003 which means China had to reduce import tariff on Thailand to products code 01-08 (foods and vegetables) under the Harmonize System to 0% in 2003. In addition, 60% and 90% of import tariff of other products had to be reduced to 0% by 2007 and 2008, respectively. The trend of weighted average import tariff of Japan, the second largest trade partner with Thailand, also significant decreases due to the implementation of ASEAN + Japan FTA in 2008.

The manufacturing import of Thailand is not affected by the import tariff, since FDI has a number of benefits from investment promotion policies. Thailand Board of Investment (BOI) provides incentives to FDI under Investment Promotion Act in 1987 especially import duties as follow: exemption and reduction of import duties for machinery (section 28 and 29); reduction of import duties of raw or essential materials (section 30); exemption for all raw and essentials materials for use in production for export (section 36). According to the data of Thailand BOI, almost all FDI is registered with BOI, thus foreign firms can utilize the import duty exemption.

The real bilateral exchange rate and real effective exchange rate have negative impacts on the export from Thailand to source countries and to other countries. This result is consistent with Athukorala and Suphachalasai (2004) and Jongwanich (2010) in terms of relationship. They found a positive impact of the real effective exchange rate on the export of the manufacturing industry, but the real effective exchange rate in both studies is estimated in terms of Thai Baht per foreign currency. However, the real exchange rate has no impact on manufacturing import of Thailand.

The main focus of this paper is how FDI impacts manufacturing export of Thailand and the test of complimentary and substitution between FDI and manufacturing export from source country to Thailand. The study found the relationship of FDI and manufacturing export from Thailand to source country is positive, but it is statistically insignificant. The vertical investments or production fragmentation reduces the role in the manufacturing industry in the source countries. FDI can invest the completed process of production in Thailand or FDI can produce from raw material to final product by using local suppliers, intermediate good or raw

materials which are located in Thailand. In other words, the manufacturing industry in Thailand has strong backward and upward linkage. For example, there are 16 car makers and 7 motorcycles makers in the automotive industry. The support industry includes more than 690 companies in tier 1 and more than 1,700 companies in tier 2 and 3. This industry is strong enough to supply all necessary parts, from engine parts to interior and body parts. Therefore, cars and motorcycles are fully manufactured in Thailand (Thailand Board of Investment, n.d.).

FDI has a positive impact on manufacturing export from Thailand to other countries which indicates that FDI is invested in Thailand in order to utilize the factors of production. In other words, Thailand is production platform for foreign firms. The same products in their home countries are not competitive and therefore they need to diversify the production of location. This result is quite obvious since there are many sub-group industries under the manufacturing industry in Thailand which have strong comparative advantage. Similar results from Jongwanich (2010) found that FDI has a positive impact on the export of manufacturing in Thailand. Unlike the results of Pupphavesa and Pussaransri (1994) which found a positive impact of FDI on the export from Thailand to source country like Japan, USA and other countries.

The evidence is supported by FDI from Japan, since it has dominated FDI in Thailand from the late 1980s to the present. FDI from Japan covers 40-60% of total investment each year in the manufacturing sector (see table B.1 in appendix B). Dilios and Keeley (2001) conducted a survey of 400 Japanese manufacturing firms in Thailand in 1999. They found the primary attraction of Japanese firms to invest in Thailand was the low-cost of labor especially local blue-collar employees. However, during the early 2000s, FDI from Japan concentrated more on capital intensive manufacturing industries such as chemical and chemical products (24), radio, television and communication equipments (32) and motor vehicle, trailers and semi-trailers (34) under ISIC classification. These product groups have strong comparative advantage and their share of export to total export is around 30% of total export while FDI of these product groups shares about 40% of total FDI during 1999-2005 (see table B. 2 in appendix B).

Although FDI has impacts on manufacturing exports from Thailand to other countries, the degree of impact is small. This is quite natural since FDI is usually for establishing physical capital such as building structures and machinery and equipments and these factors are only a part of the production process (fixed asset). As a result, the impacts of FDI on the export go through the process of producing output and enhancing export of the host country. Therefore, the impact of FDI on the export of the manufacturing industry is smaller than the impact of tariff on the export of the manufacturing industry because tariff directly reflects to the export and import price of products.

The result of model (7) indicates that FDI complements manufacturing export from the source country to Thailand. In other words, FDI increase manufacturing imports of Thailand. The foreign investors not only invest but also bring some complicated machineries which are not produced in Thailand from their home countries to Thailand. Some parts and components cannot be produced in Thailand due to the lack of resources; therefore, foreign investors need to import these products from their home countries or other countries in order to assemble or produce in Thailand.

VI. Conclusions

The impacts of FDI and other variables on manufacturing exports in Thailand are investigated using the extended gravity model. Main variables such as GDP of host and source country and distance are consistent with the results of previous studies in term of relationship with export. The tariff has a strong impact on manufacturing exports but not on manufacturing import in Thailand. FDI has impact on the export from Thailand to other countries while there is no significant impact of FDI on the export from Thailand to source countries. The result also indicates that FDI complements manufacturing export from the source country to Thailand. It supports that foreign firms invest in Thailand to produce and export to other countries since many sub-groups under the manufacturing industry have comparative advantage. Although this analysis has provided evidences of the impact of FDI on manufacturing exports in Thailand, there are some constraints and limitations of data. The data of FDI and export of the manufacturing industry covers 57 sub-industries. The different characteristic, factors endowment, and FDI policy may provide diverse motivation of FDI and therefore different impacts of FDI on the export and import in each sub-industry. Thus,

further investigation should concentrate on potential sub-industries of the manufacturing industry in Thailand if there is sufficient data.

References

Athukorala, P. & Suphachalasai, S. (2004). Post-crisis export performance in Thailand. ASEAN Economic Bulletin, 21(1), 19-36.

Camarero, M. & Tamarit, C. (2003). Estimating exports and imports demand for manufactured goods: The role of FDI. Department of Economics, Jaume I University. Retrieved June 10, 2012, from http://www.uclm.es/profesorado/obajo/imagenes2/VIII%20Jornadas/pdf/51%20Camarero2.pdf

Chaisrisawatsuk, S. & Chaisrisawatsuk, W. (2007). Imports, export and foreign direct investment interactions and their effects. *Working Paper Series,* 45, Asia-Pacific Research and Training Network on Trade. Retrieved January 10, 2012, from http://www.unescap.org/tid/artnet/pub/wp4507.pdf

Cheng, L. K., & Kierzkowski, H. (Ed.). (2001). *Global production and trade in East Asia.* Boston: Kluwer Academics.

Dilios, A. & Keeley, T. D. (2001). Japanese foreign direct investment in Thailand: An empirical qualitative post-crisis analysis. *Journal of International Business and Economy,* 1(1), 91-118.

Helpman, E. (1984). A simple theory of international trade with multinational corporations. *Journal of Political Economy,* 92(3), 451-471.

Helpman, E., Melitz, M. J., & Yeaple S. R. (2003). Export versus FDI. *NBER Working Paper Series,* 9439, National Bureau of Economics Research.

Johnson, A. (2006). FDI and export: the case of high performing East Asian economies. *Electronic Working Paper Series,* 57, Centre of Excellent for studies in Science and Innovation.

Jongwanich, J. (2010). Determinants of export performance in East and Southeast Asia. *The World Economy,* 33(1), 22-41.

Kojima, K. (1982). A Macroeconomic Approach to Foreign Direct Investment, *Hitosubashi Journal of Economics,* 14(1), 1-21.

Krungman, P. R. & Obstfeld, M. (2005). *International economics: Theory and policy.* Boston: Pearson International.

Liu, X., Wang, C., & Wei, Y. (2001). Causal link between foreign direct investment and trade in China. *China Economic Reviews*, 12, 190-202.

Makusen, J. R. (1984). Multinational, multi-plant economies, and gain from trade. *Journal of International Economics,* 16, 205-226.

_____. (2000). Foreign direct investment and trade. *Policy Discussion Paper, No. 19,* Centre for International Economics Studies.

Marjeed, M. T., & Ahmad, E. (2008). Export and FDI in developing countries: Substitutes or compliments? *Pakistan Society of Development Economics*. Retrieved April 5, 2012, from http://www.pide.org.pk/psde23/pdf/Muhammad%20Tariq%20Majeed.pdf

Pain, N. & Wakelin, K. (1998). Export performance and the role of Foreign Direct Investment. *The Manchester School of Economic and Social Studies*, 66, 26-68.

Prabir, D. (2006). Why trade cost matter? *Working Paper Series, 7,* Asia-Pacific Research and Training Network on Trade. Retrieved January 10, 2012, from http://www.unescap.org/tid/artnet/pub/wp706.pdf

Pupphavesa, W. & Pussaransri, B. (1994).FDI in Thailand. *International Economics Relation Program*. TDRI, Bangkok.

Thailand Board of Investment. (n.d.). Automotive Industry in Thailand. Retrieved September 19, 2012, from http://www.boi.go.th/index.php?page=opp_automotive

Tinbergen, J. (1962).*Shaping the World Economy: Suggestion for an International Economic Policy.* New York, USA: Twenties Century Fund.

Tumbunlertchai, S. (2009). Foreign Direct Investment and Export Performance in Thailand (Unpublished BA dissertation), Wesleyan University, Connecticut, USA.

Xuan, M. T. & Xing, Y. (2006). Foreign direct investment and exports: the experience of Vietnam. *Economic Development & Policy Series*, EDP06-11.

Appendix A

Table A.1 Summary of variables statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
exji	264	3255.389	5657.447	44.432	44002.23
exij	264	4292.212	5799.572	128.537	34997.66
gdpj	264	1583768	2584070	91022.79	1.32e+07
gdpi	264	170434.1	25905.13	131279.5	210076.5
dist	264	6758.152	3781.915	1187.123	13943.4
tji	264	1.042	.05303	1	1.331
tij	264	1.162	.0494	1.027	1.257
fdi	264	114.035	375.57	0	4331.093
exioj	264	9651.035	4044.25	1910.558	18261.66
wgdpj	264	3712288	659460.8	1096860	4301252
wdist	264	6758.152	180.0912	6415.997	7023.438
reer	264	1.229042	.0937168	1.1014	1.3681
wtjoi	264	1.030191	.0065201	1.0139	1.03779

Table A.2 Hausman test (model 2)

	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	---- Coefficients ----			
lngdpi	2.3330	2.364847	-.0317692	.1065064
lngdpj	.9997	.9175972	.0821685	.1964526
lnexch	-.2240758	-.1251902	-.0988856	.1195807
lntji	-3.914714	-4.433631	.5189169	.5822234
lnfdi	.0000803	.000194	-.0001137	.0002424
crisis	.086471	.0797345	.0067365	.0053222

    b = consistent under Ho and Ha; obtained from xtreg
    B = inconsistent under Ha, efficient under Ho; obtained from xtreg
    Test: Ho: difference in coefficients not systematic
               chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =   6.01
             Prob>chi2 =   0.4221
             (V_b-V_B is not positive definite)

Table A.3 Breusch and Pagan LM test (model 2)

	Var	sd = sqrt(Var)

```
   lnexij |   1.590242        1.261048
        e |    .0411998         .2029774
        u |    .2703212         .5199242
---------+----------------------------
      Test:   Var(u) =    0
               chi2(1) =   905.69
          Prob > chi2 =   0.0000
```

Table A.4 Hausman test (model4)

```
---------+---------------------------------------------------------
                  ---- Coefficients ----
          |    (b)           (B)            (b-B)      sqrt(diag(V_b-V_B))
          |   fixed         random        Difference          S.E.
---------+---------------------------------------------------------
lngdpi   |   1.680049       1.82618       -.1461313         .2126268
lnwgdpj  |    .7590363       .59136         .1676764         .1512139
lntvioj  |  -6.968242      -4.797923      -2.170319         2.163826
lnreer   |   -.4684679      -.3919825      -.0764854         .0435566
lnfdi    |    .0033284       .0021538       .0011746         .0007093
crisis   |    .2892216       .2721645       .0170571         .0149487
------------------------------------------------------------------
```

  b = consistent under Ho and Ha; obtained from xtreg
  B = inconsistent under Ha, efficient under Ho; obtained from xtreg
  Test: Ho: difference in coefficients not systematic
      chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
         =   8.85
     Prob>chi2 =   0.1820
     (V_b-V_B is not positive definite)

Table A.5 Breusch and Pagan LM test (model 4)

```
  ---------+----------------------------
           |      Var       sd = sqrt(Var)
  ---------+----------------------------
  lnwexoj  |   .1868699       .4322845
        e  |   .0116248       .1078182
        u  |   .0008163       .0285712
  ---------+----------------------------
      Test:   Var(u) = 0
               chi2(1) = 4.58
          Prob > chi2 = 0.0324
```

Table A.6 Hausman test (model7)

```
---------+---------------------------------------------------------
                  ---- Coefficients ----
          |    (b)           (B)            (b-B)      sqrt(diag(V_b-V_B))
          |   fixed         random        Difference          S.E.
---------+---------------------------------------------------------
lngdpi   |   2.515247       2.672758      -.1575116         .0675244
lngdpj   |   1.363138       1.138957       .2241815         .0986076
lnexch   |   -.1623582      -.0639482      -.09841           .0974963
```

```
 lntij |   -.0336087     -.0180211          -.0155875                    .
 lnfdi |    .0074954      .0072809           .0002145                    .
crisis |    .0138163      .0127333           .001083                     .
-------------------------------------------------------------------------
      b = consistent under Ho and Ha; obtained from xtreg
      B = inconsistent under Ha, efficient under Ho; obtained from xtreg
    Test:  Ho:  difference in coefficients not systematic
                 chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                         =        5.10
              Prob>chi2 =      0.5305
              (V_b-V_B is not positive definite)
```

Table A.7 Breusch and Pagan LM test (model 7)
```
 ---------+----------------------------
          |      Var      sd = sqrt(Var)
 ---------+----------------------------
   lnexji |   2.033409       1.425977
        e |    .0337302       .1836579
        u |    .3625069       .6020855
 ---------+----------------------------
      Test:   Var(u) =   0
               chi2(1) =   1017.66
           Prob > chi2 =   0.0000
```

Table B.1 Share of FDI in manufacturing industry by countries

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Australia	7.49%	0.72%	0.10%	0.03%	0.00%	0.12%	0.00%	0.02%	1.32%	0.03%	0.43%	0.60%
Austria	0.49%	0.00%	0.57%	0.00%	0.27%	0.06%	0.00%	0.08%	0.24%	0.95%	0.82%	0.26%
Belgium	0.07%	0.56%	0.00%	0.18%	0.10%	0.00%	4.85%	0.03%	0.04%	0.25%	7.13%	0.55%
Canada	0.00%	1.43%	0.18%	0.04%	0.00%	0.00%	3.26%	0.99%	0.02%	0.00%	0.15%	0.00%
Denmark	0.00%	0.09%	0.71%	0.14%	0.00%	0.00%	0.24%	0.17%	0.00%	0.00%	0.00%	0.14%
France	0.03%	0.53%	0.52%	0.10%	0.01%	13.69%	0.31%	3.32%	0.04%	0.11%	0.23%	0.13%
Germany	1.78%	0.55%	2.97%	0.95%	0.79%	0.92%	0.63%	2.69%	2.66%	0.03%	0.70%	0.47%
Hong Kong	1.59%	0.69%	0.63%	0.70%	1.05%	1.97%	1.04%	1.10%	3.25%	0.16%	1.00%	0.48%
India	1.04%	0.06%	0.05%	0.04%	0.00%	5.05%	0.00%	0.02%	0.39%	0.00%	2.02%	0.39%
Indonesia	0.00%	0.00%	0.14%	0.00%	0.52%	0.00%	0.00%	0.12%	0.54%	0.00%	0.00%	0.00%
Italy	0.00%	0.01%	0.01%	0.09%	0.51%	1.82%	0.57%	0.06%	0.00%	0.43%	0.12%	0.05%
Japan	67.90%	54.25%	38.38%	39.30%	64.01%	43.84%	47.23%	47.73%	44.76%	39.93%	48.25%	66.25%
Malaysia	1.24%	0.48%	0.43%	1.58%	8.29%	4.51%	0.28%	1.54%	0.55%	1.15%	1.52%	2.37%
Netherland	0.25%	1.53%	6.20%	27.44%	2.39%	0.83%	0.80%	2.91%	5.89%	6.50%	6.80%	1.13%
China	5.40%	0.66%	0.55%	0.67%	0.01%	3.84%	2.14%	4.21%	0.00%	0.51%	2.79%	0.54%
Korea	3.41%	1.14%	0.30%	1.12%	0.57%	0.32%	1.61%	1.13%	2.37%	0.62%	2.44%	1.03%
Singapore	1.34%	4.66%	3.89%	3.21%	9.92%	2.19%	2.24%	2.34%	9.78%	9.91%	5.59%	7.87%
Switzerland	0.00%	1.35%	2.33%	0.62%	0.15%	1.36%	11.00%	1.23%	1.33%	0.60%	0.80%	1.22%
Sweden	0.00%	0.21%	0.00%	0.35%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%	0.00%	0.04%
Taiwan	2.54%	8.90%	4.39%	4.34%	2.96%	7.12%	4.53%	2.40%	3.39%	2.54%	2.64%	3.47%
USA	3.57%	13.05%	32.42%	15.98%	4.07%	6.11%	3.15%	3.96%	10.69%	19.92%	6.71%	6.61%
UK	0.49%	0.59%	1.34%	0.15%	1.39%	2.05%	9.81%	0.00%	0.43%	9.75%	2.22%	0.96%
Others	1.38%	8.53%	3.88%	2.99%	3.00%	4.22%	6.29%	23.95%	12.31%	6.53%	7.64%	5.44%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table B. 2 FDI by industry for three major investors in Thailand 1999-2005   (Million USD)

ISIC	Description	Japan	USA	EU	Others	Total
15	Foods and beverages	316.87	101.24	50.30	285.86	754.27
16	Tobacco products	-	-	-	-	-
17	Textiles	103.28	253.43	61.44	206.50	624.65
18	Wearing apparel; Dressing and dyeing of fur	23.25	10.28	3.68	62.23	99.44
19	Tanning and dressing of leather; Luggage; Handbags; Saddlery and Harness and Footwear	1.36	0.12	22.94	28.14	52.56
20	Wood and wood products; Cork; Except furniture; Article of straws and plaiting materials	17.19	-	1.19	31.56	49.94
21	Paper and paper products	20.31	14.26	4.83	228.42	267.82
22	Publishing; Printing and reproduction of recorded media	9.40	2.98	-	21.12	33.50
23	Coke oven products, Refined petroleum products and nuclear fuel	37.67	37.67	1.43	-	76.77
24	Chemicals and chemical products	1,347.28	535.08	1,069.05	501.96	3,453.37
25	Rubber and plastics products	780.97	130.99	192.34	568.05	1,672.35
26	Other non-metallic mineral products	245.19	58.87	74.84	145.61	524.51
27	Basic metals	104.00	0.87	0.70	333.74	439.31
28	Fabricated metal products; Except machinery and equipments	915.42	4.67	49.77	472.63	1,442.49
29	Machinery and Equipment n.e.c.	2,320.81	154.57	169.02	653.10	3,297.50
30	Office, accounting and computing machinery	-	-	-	-	-
31	Electrical machinery and apparatus n.e.c.	139.51	75.97	41.46	68.48	325.42
32	Radio; Television; Communication equipment and Apparatus	3,124.75	2,198.73	796.55	2,647.14	8,767.17
33	Medical; Precision and optical instruments; Watches and clocks	89.26	0.07	45.56	13.46	148.35
34	Motor vehicles, Trailers and semi-trailers	2,828.98	46.85	39.56	270.56	3,185.95
35	Other transport equipment	-	-	7.88	15.06	22.94
36	Furniture; Manufacturing n.e.c.	32.44	17.46	40.70	219.73	310.33
37	Recycling	0.95	-	-	7.75	8.70
	Total	12,458.89	3,644.11	2,673.24	6,781.10	25,557.34

Note: FDI base on approval and appointment
Source: Statistics of FDI in ASEAN, 2006