Exchange Rate, FDI Outflow and Trade Linkage: Evidence of Seven US' Sub-Sectors in Manufacturing Industry

Master Thesis

Author: Dandy Satriatama (444728ds)

Supervisor: prof. dr. J.M.A. Viaene

Second Assessor: dr. A. Erbahar

Date: 31 August 2017

Master of Economics and Business

Specialization in International Economics

Erasmus School of Economics

Erasmus University Rotterdam

Abstract

Previous literatures have come to a mixed result on how FDI flows affect both export and import. A possibility of endogeneity problem might arise that made this relationship is quite difficult to conclude, let alone using aggregate data may arise aggregate bias. Using US FDI outflow 2-digit ISIC Revision.3 as industry code and 6-digit trade data obtained from UNCOMTRADE, this thesis tries to reveal relationship between US FDI outflow and trade across seven sub sectors in manufacturing industry in the US. It is found that, indeed, the relationship of US FDI outflow and trade vary across these sub-sectors. It is reported that there are three sub-sectors that US FDI outflow complements both export and import, there two sub sectors that US FDI outflow affects differently to each export and imports. Lastly, there are two sub sectors that US FDI outflow affects negatively on both export and import, making the relationship is substitute.

Further, this thesis also tries to find linkage of exchange rate on trade and FDI in different sub sectors, since exchange rate is a mutual determinant factor in these two indicators. It is found that almost in all sub sectors, exchange rate gives both direct effect and indirect effect (through FDI) on trade. Moreover, the effect of exchange rate on FDI outflow confirms our proposed hypothesis only in Metal and Machinery manufacturing that appreciation in US dollar leading the US investors to increase direct investment abroad since US dollar dominates other currency, however, only Machinery manufacturing is found statistically significant.

Acknowledgment

This thesis is written in part fulfillment of requirement for Master of Economics and Business specialization in International Economics at Erasmus University of Rotterdam. Firstly, I would like to utilize this opportunity to thank God for all the blessings, health and knowledge for the journey in the past year during my days in this university up to the completion of this thesis. Secondly, I would like to show my gratitude toward Prof. dr. J.M.A. Viaene as my supervisor for his abundant help, direction and encouragement towards me during the whole process of thesis writing. Also, I would like to thank the scholarship institution, Indonesia Endowment Fund for Education (LPDP) to give me opportunity to pursue my dream for obtaining master degree at one of the best schools of economics in the world. This is absolutely one of the best experiences I have ever had in my life. Lastly, to all of my Indonesian and International friends, I thank you to who always believe in that I can get through all of the hardness while staying here. It has been one truly life-changing moment for me in a year.

Rotterdam, 31 August 2017

Dandy Satriatama

Contents

1. Introduction

Foreign Direct Investment (FDI) and trade are two of main indicators of the sign of countries enter globalization era. When a country involves in these activities, it indicates that a country is filled with many multinational firms which can stimulate a country's economic growth (WTO, 1996).[1] For instance, one of the reasons of doing trade is to enhance domestic product competitiveness by letting foreign goods into home country; it is either coming in terms of intermediate goods for a production or of imported final goods for fulfilling domestic needs. As such, firms will think of strategies how to benefit from this situation or to keep being in the market; one of the ways is by serving the foreign market through abroad production thus it invests to create subsidiary abroad, or we call it as direct investment.

Take an example for United States (US) as the most powerful economy in the world where many foreign affiliates operate in there and many US multinational companies to invest abroad. These facts result in US as top source of FDI outflow and top host countries for FDI inflows in the world (UNCTAD, 2017). FDI is said to be a way to increase efficiency of firms' which to obtain lower price of production input can be achieved in abroad, in case it is developed country where production inputs are expensive, so it obtains from less developed country, or to held a production stage in poor countries where production cost can be reduced—or resource-seeking strategy (Franco et al., 2008). Additionally, if firms have subsidiary abroad means that they want to either serve foreign market in other countries or want to manufacture the products in abroad and bring it back to home countries so they can get a lower price of final product compared as if it produces in home countries. That said, international trade and its direct investment plays simultaneously in international economic activity. This kind of trade is also called affiliates sales among multinational corporation (MNC) where it takes one third of global trade (WTO, 1996)[2].

The number of foreign affiliates sales and the decision of direct investment and international trade, as explained, are based on production cost which can lead to lower or higher price of traded goods. One of the factors that can affect that is exchange rate. Foreign country's currency movement is

[1] Retrieved from WTO's article which is available at: https://www.wto.org/english/news_e/pres96_e/pr057_e.htm
[2] *Ibid*.

something to be aware of by exporter and importer firms and also by investors who are willing to build subsidiaries in other countries or host countries.

In relation thereto, this thesis tries to look at the linkage of FDI and trade of US. The FDI values used here is US FDI outflow to host countries. Previous study by Pantulu and Poon (2003) argued that outward FDI and trade flow relationship is more complex to conclude since that according to the type of industry, country, and period of time. Therefore, we will look at the relationship based on different sub-sectors in manufacturing industry (the type of sub-sectors will be further discussed in section 3).

This thesis will try to reveal relationship between FDI outflow and trade, also try to link these two variables to exchange rate since they have mutual affecting variables of exchange rate (Goldberg and Klein, 1998). The exchange rate used in this thesis is a real exchange rate, which considers the foreign country's prices relative to domestic prices (US) using consumer price as the proxy, hence real exchange rate used in this thesis represents destination/host countries' currency. The analysis of these variables varies across manufacturing industry's sub sectors since we disaggregate the data into 2-digit industry level using concordance table from WITS which transform the 6-digit HS code of export and import into 2 digit codes of ISIC Revision.3. This selection process done by matching the data for FDI outflow and trade and results in 7 sub-sectors in industry manufacturing (see part 3 of this thesis to see the details of the sub-sectors). The regression process in this thesis uses 2SLS estimation since there is a problem of endogeneity in FDI when it is included as one of the factors affecting the trade. As such, we performed first stage regression to generate fitted value of FDI ($\widehat{FDI}$) by using instrumental variable of one of the indicators in political stability index. The choice of the indicator will be based on the significance of it in affecting FDI in the first stage regression.

After that, we allow $\widehat{FDI}$ to enter the initial regression in order to find the linkage of FDI and trade with a more convincing magnitude of a coefficient. Besides, we also add control variables, for instance, GDP, GDP per capita, and trade openness, to control for economic size and openness of countries selected to globalization. Our empirical results convince previous studies that relationship between FDI and trade varies across industries. For instance, in transport equipment manufacturing, US FDI outflow complements US exports to other countries, while it replaces US import from other countries. Further, the direct and indirect effect of exchange rate is not always

found on export and import in all sub sectors manufacturing industry. Meanwhile, the effect of exchange rate on FDI outflow depends on its strategy of the business in each sub sector. Our result found that exchange rate is negatively affecting US FDI outflow, indicating that the FDI may have a strategy of market-oriented where exchange rate may not be the strongest factors affecting US FDI outflow. It is somehow contrast with our proposed hypothesis, which also found in Brouwer et al. (2008) that it negatively affects FDI, thus it does not support hysteresis hypothesis.

The remainder of this thesis is arranged as follows: section 2 outlines some previous literatures about the relationship of FDI flows and trade in across countries and across industries. In this section, also features hypotheses being tested in this thesis based on these previous studies. Section 3 discusses about the methodology and data used. Then it is followed by result analysis of relationship between FDI and trade varies across seven sub sectors in manufacturing industry. Section 5 provides summary to conclude empirical results in this thesis, and also discusses the policy relevant.

2. Related Theoretical and Literature Review

International trade between countries has occurred due to the factor abundance that results a country has comparative advantage in one goods relative to other country; this is known as Heckscher-Ohlin (H-O) model (Bilas and Bosnjak, 2015). The assumption made for this condition is 2x2x2 (two countries, two goods and two factors) with same preference for technology between countries. The country who trade in this setting has one factor that is relatively more abundant in producing goods A and the other country in producing goods B. For instance, goods A is capital-abundant and B is labor-abundant, more specified of factor used for its production between countries, more trade will be created. However, it is not that country who produces capital-abundant goods does not have labor endowment at all, but relative to a country who produce labor-abundant goods, labor price in capital-abundant country is more expensive. Thus, it is beneficial to import labor-intensive goods; it is mirror image for the factor price of capital in this setting. If the difference of factor endowment prices becomes larger this will create more trade as well. Furthermore, it is known that firms are the ones who actually trade (not countries) although, firms who exports are relatively rare (e.g. in one country only 10-15 percent of total firms do export). In the U.S., out of 55 million firms only 4 percent engaged in exporting; this is relatively small due to U.S. status as one of biggest exporter in the world (Bernard et al., 2007).

In relation thereto, the decision for multinational firms to serve foreign market depends on their own effectiveness of production activity. Theory related about this setting is called heterogeneity of firms which states that firms who are most productive will have a chance to serve foreign market either through export or affiliate's sales (FDI). The rest of the firms which are the least productive will leave the market and those who are less productive can serve only the domestic market due to expensive additional cost to enter foreign market which they cannot afford. The most productive firms have the option to serve foreign market by either exporting or FDI. The reduction in trade barriers (e.g. trade cost) induces these firms to opt to serve foreign market by exporting rather than through FDI. This substitution pattern is proven in most of the research indicating that FDI can dominate export or the way around. However, there is also a complementary pattern where an increase in FDI induces export which the export products is in the form of intermediate goods needing to be assembled in affiliates abroad, hence this implicates an increase in FDI (Head and Ries, 2004).

Although in this thesis I will not try to reveal such pattern in firm-level, but the theory about the relationship is used and explained here is only meant to link the framework on how multinational firms get to choose export over affiliate activity (FDI) or the other way around.

Moreover, there is a linkage of exchange rate to FDI and export that will help to explain a little further about the relationship of these two. The linkages are *direct* and *indirect* effect. The effect of exchange rate on FDI which is through relative wage, relative wealth channel and imperfect capital market which result in an increase of attractiveness of a location for receiving the FDI from source country (Goldberg, 2006). The above effects of exchange rate indirectly affect the export only through the FDI. On the other hand, exchange rate affects export directly through its price level of goods traded (Goldberg and Klein, 1998).

The following sub-sections explain more about the relationship the linkage of exchange rate, FDI and trade according to number of empirical studies.

2.1. FDI and Trade: Substitution Effect

Bilateral trade occurs only if there is a difference between countries as it is stated in Heckscher-Ohlin (H-O) model. It is Mundell (1957) who was first to derive this neo-classical trade theory but improve it with the use of assumption of factor movement; he relaxes factor immobility assumption which becomes factors are mobile to other country at no cost. He argues that an increase in trade barriers leads to factor movements and on the other hand, an increase in factors restrictions which makes factors are no longer mobile and this stimulates trade activity (Brouwer et al., 2008).

Bowen et al. (2012) documented this finding in their book by stating that equilibrium condition is where factor immobility stimulates trade due to equalization of factor prices between countries who trade to each other. As such, when factors are mobile, trade cannot take place because it is more beneficial to produce themselves. This substitution effect of FDI on trade suggests that an increase in FDI leads to a decrease in trade.

The supporting empirical literature is Goldberg and Klein's (1998) which found a substitution relationship of U.S. outward investment to Southeast Asia and its trade to these regions where indicating an increase in each 10 percent of FDI reduces 3 percent of trade. Furthermore, at product level substitution effect of FDI on trade was found by Head and Ries (2001) which use data from

number of Japanese exporting companies. Several firms in Japanese automotive industry prefer to invest their capital abroad by setting up a plant outside Japan for assembly due to cheaper cost rather than serving foreign market by exporting to other countries. This pattern is found in big player in automotive industry because cost is cheaper when parent firms hand over the assembly stage for final product to their plant abroad which then they pass it on again to independent supplier which make the whole process even cheaper.

Moreover, Helpman et al. (2004) investigate the relationship using U.S. exports and affiliates sales of a set of panel data across 38 countries at firm level that covers 52 manufacturing sectors. They used trade barriers, economies of scale and within-firm dispersion of firm size to expose the relationship of FDI and trade. They found firms prefer to take participation of serving in the foreign market by building a new plant abroad rather than exporting products outside the country when trade restrictions are higher and the economies of scale are lower. Furthermore, they also found that heterogeneity plays role in affecting the form of foreign trade and investment in a way that induces the size of firm dispersion and eventually affects the ratio of export to affiliates sales. The effect of this substitution relationship can also be seen in the paper of Gopinath et al. (1999) for U.S. firms in food processing industry.

Based on discussion on previous studies above, we expect that FDI outflow can have negative relationship with export and import, which indicates FDI outflow substitutes export and import, hence the proposed hypotheses for this matter is as follows:

$H1_a$: US FDI outflow affects trade (export and import) negatively and significantly

2.2. FDI and Trade: Complementary Effect

In contrast, there is a complementary relationship between of FDI and trade that suggests an increase in FDI induces more trade. This condition can be explained as fragmentation in the production stage where parent companies hand over affiliates in their plants abroad to conduct production stage for several parts that may be cheaper when accomplished abroad (i.e. fragmentation) and then export it back to the country where the parent is at, hence an increase in investment induces more export activity. It is Markusen (1983) who comes up with an argument of complementary relationship between FDI and trade. As such, when factors immobility assumption is relaxed it leads to perfect mobility of the factors used intensively in production of export goods.

Most studies have indeed concluded positive correlation between FDI and trade, but Lipsey and Weiss (1981) is the first who attempted complementary relationship through empirical study. They examined U.S. export and 13 other exporting countries to 44 destination countries across 14 manufacturing industries. They found a robust and consistent result for U.S. manufacturing affiliate's sales positively correlates to U.S. export in less developed countries.

In relation to fragmentation, Bouras and Raggad (2015) stated that firms can minimalize production cost by reallocating the labor-intensive production process to other countries where labor cost is cheaper and capital-intensive production process to more industrialized countries. As such, parent companies perform vertical FDI abroad as their affiliates specialize in the value chain and all the production is only meant for export. In their empirical result, they found complementary relationship between FDI and trade using disaggregated data for both manufacturing and non-manufacturing sectors across 10 countries; this result rejects Mundell's substitution finding. Moreover, Aizenman and Noy (2005) studied about the inflow vertical FDI to developing countries increases their international trade since developed countries likely to fragment their production stage to developing countries where price of factor of production is relatively cheaper.

Brouwer et al. (2008) used an empirical finding of the relationship between FDI and trade to answer the effect the extension of new member of European Monetary Union (EMU) by ten countries that currently entered EU in 2004. They found that the effect of EMU for 10 new member of EU results in positive impact on the amount of investment they received and on trade activity. The positive trend of their trade also comes from higher FDI stocks they received. Another paper uncovering complementary relationship of FDI and trade is Vavilov (2005) which the result is two-fold that inward FDI positively correlates with export while outward FDI positively correlates with import in both CEE and CIS member countries.

Based on discussion on previous studies above, we can expect that FDI outflow can have positive relationship with export and import, which indicates that FDI outflow complements export and import, hence the proposed hypotheses for this matter is as follows:

$H1_b$: US FDI outflow affects US trade (export and import) positively and significantly

2.3. Linkage of Exchange Rate on Trade and FDI

The effect of currency movement on both FDI and trade can be explained by two channels that consist of *direct* and *indirect* (Goldberg and Klein, 1998); (i) direct effect of exchange rate on trade is through price level. This effect indicates that appreciation (depreciation) of currency makes the price of good higher (lower) and the good is less (more) interested to buyers. Meanwhile (ii) indirect effect comes from stimulating the FDI. In this case, exchange rate affects FDI in a way that it disturbs the decision of investor to invest the money since exchange rate affects price of intermediate inputs of the production used by affiliates. As such, exchange rate only affects trade through FDI.

This view is empirically proven by Brouwer et al. (2008) where they found that the correlation of FDI and trade is positive and significant, thus the euro currency gives impacts on trade through two channels: (i) direct effect that can be viewed as the benefit of having common currency of European Union (EU) area, while the other channel which is (ii) indirect effect comes from stimulating effects on its FDI, also a similar finding found by Pham and Nguyen (2013) and Goldberg and Klein (1998). The interest thing from paper Goldberg and Klein is that they take a point of view from developing countries' side instead of U.S. and Japan's side (the home countries). For instance, when there is an increase in exchange rate index means that an appreciation of developing countries' currency with respect to either Japan or U.S., because they construct the real effective exchange rate (RER) index as price index of developing countries relative to price index of either U.S. or Japan.

2.3.1. Exchange Rate on Trade

Many studies conducted that construct a model to reveal relationship between exchange rate and trade. There are many ways to measure exchange rate variable, but most studies use exchange rate measurement as units of domestic currency relative to units of bilateral partner country's currency (Brouwer et al., 2008). The hypothesis that comes with this measurement is that an increase in exchange rate index means a depreciation in domestic currency relative to foreign currency and lead to increase in trade. As such, we expect a positive (negative) relationship between exchange rate index and export (import).

Alemu and Jin-sang (2014) examined the effect of currency depreciation on trade in selected Asian economies. At first, they found no significant effect when featuring whole sample of the countries,

then they figured out that there are number of countries that have low and unstable economies such as Pakistan, Bangladesh, Sri Lanka, Vietnam and Philippines. With sub sample of countries, the result varies from previous as exchange rate gives strong and positive effect on trade whereas that currency depreciation contributes to the increase in trade balance (export minus import). Bahmani-Oskooee (2012) examined the impact of Indonesian Rupiah's depreciation on its bilateral *in-payments* and *out-payments* between Indonesia and its trade partners in the short and long run. They found that a depreciation of rupiah has short-run effect on Indonesia's export and import with the trading partners and also has positive correlation where a 1 percent of rupiah depreciation increases Indonesia's trade balance by 2 percent. Supporting their previous paper, Bahmani-Oskooee and Harvey (2014) also published a paper examining the trade activity between Indonesia and U.S., where in this paper they take the U.S. point of view. As such, a depreciation of U.S. dollar of 1 percent could improve 1.8 percent U.S. trade balance respect to its trading activity with Indonesia, such relationship cannot be found in all the industries between these countries in both short-run and long-run period.

Benassy-Quere and Lanreche-Revil (2003) examined the effect of exchange rate on trade in Asia region to see the benefit of having China in the region where they used the volatility of exchange rate instead of index level; the effect of it to export is significantly negative. The data used covers 11 Asian countries as exporter and the other 23 countries as importer from 1984 to 2001 and is assessed with gravity equation. Despite of using a volatility, Kharroubi (2011) argued that real exchange rate level gives more sensitive effect to trade balance. He found that there are number of countries that can benefit from having its currency depreciating and one of them is U.S with a fact that U.S. has a high Intra-Industry Trade (IIT). Same result also can be seen in other papers (Yuen-Ling et al., 2008).

To propose hypotheses about this, we define exchange rate as number of other countries' currency per US dollar. Besides, based on discussion of previous studies above, we can expect that exchange rate affects export negatively which an appreciation in US dollar leads to a decrease in US export to other countries, while it affects import positively that an appreciation in US dollar leads to an increase in US import from other countries. As such, we formulate hypotheses as follows:

> *$H2_a$: Exchange rate depreciation (appreciation of the US dollar) affects US export to foreign country negatively and significantly*

$H2_b$: Exchange rate depreciation (appreciation of the US dollar) affects US import positively and significantly

2.3.2. Exchange Rate on FDI

The movement of countries' currency is spread out to affect FDI. It was Froot and Stein (1991) that was first pointed out that a depreciation of a currency is one of the strongest determinant of direct investment. There are two reasons for this relationship (Klein and Rosengren, 1992): (i) exchange rate varies relative wealth across countries and (ii) exchange rate affects relative cost of production. Firstly, exchange rate affects relative wealth in which that a currency movement of domestic country favors foreign investor to hold that domestic country's asset. For instance, a depreciation of a U.S. dollar makes assets valued in dollar cheaper to foreigners hence it gives incentive for investor to take control of that assets. Secondly, exchange rate affects cost of production relatively, especially wage of labor, where a appreciation of a country's currency strongly relates to the cost of production in which increases the price of labor. As such, since the purpose of FDI is that capital-abundant countries seek for other countries with labor-abundant which represents relatively cheaper labor. These two cases point out that a depreciation in exchange rates lead to an increase in direct investment.

The decision of having FDI outflow to the rest of the world is mixed among many determinants that causes this. One of them is exchange rate in which affects FDI in the following way: (1) influence the total amount of the investment and (2) the allocation of the investment outside domestic country where the candidate countries should have a lower currency rate than domestics. (Goldberg, 2006). Blonigen (1997) found the effect of exchange rate to acquisition of foreign asset for Japanese FDI in the U.S. using 3-digit SIC industries from 1975-1992 which the result is that a depreciation of U.S. dollar strongly correlates with the inward FDI from Japanese in the U.S. The regression tells that in 10 percent of US dollar depreciation induces 18 to 32 percent of manufacturing of Japanese R&D.

For the hypothesis creation matter, the same as $H2_a$ and $H2_b$, we define exchange rate as number of other currency per US dollar. Besides, based on discussion of previous studies above, we can expect that exchange rate affects US FDI outflow positively, which indicates an appreciation in US dollar leads to an increase in US FDI outflow. Then, we formulate the proposed hypothesis as follows:

H3: Exchange rate depreciation (appreciation of the US dollar) affects US FDI outflow positively and significantly

2.4. FDI, Trade and Endogeneity

Many researches have come to reveal the linkage of FDI and trade in a way that FDI can affect international trade of a country. However, this relationship may arise a problem of endogeneity, particularly to reverse causality. As such, current researches have come to realization that endogeneity problem cannot be ignored because it can cause a biased estimated coefficient in which result in untrusted magnitude of the coefficient (Makki and Somwaru, 2004). Previous studies handle this problem by applying the approach of dynamics estimation with General Method of Moment (GMM) where they use lagged values of independent and dependent variables or even they do not take into account such problem. Goldberg and Klein (1998) seemed to choose not to pick this topic where they only use simple OLS approach and lagged values of their independent variables. Different from previous studies, Walsh and Yu (2010) chose to tackle endogeneity problem using instruments of lagged values of dependent variables and independent variables in the equation and apply GMM based on Arellano-Bond methodology (also see Chen and Wu, 2017). Using lagged variables as instrument can be effective instead of choosing poor-quality instruments (Clemens et al., 2004).

Moreover, the following is an example of using instrument variables that are not lagged variables of its independent variables. It is Esiyok (2015) who studied the relationship by employing instrument variables such as index of corruption, law and order and also bilateral investment treaties between Turkey and the other countries, in order to solve endogeneity problem that could produce a biased OLS estimator.

2.4.1 FDI and Political Stability

The quality of government is in fact affecting the maturity of a country to perform better in the view of international investors. La Porta, et al. (1999) studied about the quality of government across countries and concluding that larger countries that has a good government perform better in economic. In order to decide to invest the capital out of the country, the investors must take into account several considerations of the destination countries. For instance, political risk affects the inflow of foreign capital asset (Lucas, 1990). The considerations generally are put as FDI determinants; and one of them is institutional determinants, such as political stability and doing

business index. In relation thereto, Kim (2010) proved the literature from these two papers that political factors can be determining factor for FDI flows. He found that if countries with higher political stability have higher outward FDI, but interestingly, countries with low democracy level and higher level of corruption of government attract more inward FDI. This is also supported by Walsh and Yu (2010) who studied the use of qualitative measure using legal and judiciary variables. They concluded that these institutional variables have a positive impact on FDI stock flows to host countries where greater indexes induce an increase in FDI flows.

Table 2.1 Literature Matrix of Previous Studies

Author	Research Question	Variables	Method	Sample	Outcome
Lipsey and Weiss (1981)	What is the relationship of FDI and export in manufacturing industries?	Dependent variable: Export independent variable: FDI controls: Distance, market size, dummy variable for EEC membership	n/a	Using export data of 4-digit across 14 industries in US and 13 exporting countries; 1970	The U.S. manufacturing affiliates sales is positively correlated to export of U.S as it is the same as foreign manufacturing affiliates induces foreign exports. While U.S. affiliate manufacturing is negatively related to foreign exports and it is the same for the other way around.
Lucas (1990)	Why rich countries do not invest in poor countries?	n/a	theoretical analysis	n/a	Political risk can be limiting capital inflows in terms that foreign investor concern about the decision of the hosting country's policies whether to attract more capital inflows or focus on human capital
Froot and Stein (1991)	What is the impact of exchange rate on FDI in imperfect capital market?	Dependent variable: exchange rate Independent variable: various forms of FDI	panel regression	Across industries in the U.S; 1973-1987	Exchange rate is found to be pervasive due to its relationship with different forms of FDI across countries and industries under market imperfection.
Klein and Rosengren (1992)	What is the relationship of Exchange rate and FDI in the U.S.?	Dependent variable: inward FDI (outlays, total and M&A); Independent variable: exchange rate, real wage rate, wealth data (using stock data).	panel regression using fixed effect	Across 7 industrial countries; 1979-1991	The linkage exchange rate and FDI does not support real wage effect but only real wealth in the U.S.
Blonigen (1997)	What is the relationship of exchange rate of hosting countries to the number of affiliate from home country?	Dependent variable: the number of Japanese affiliates in the U.S. across 3-digit SIC industry independent variable: real exchange rate of USD/Yen. Controls: Japan real GDP growth, domestic acquisition, industry value-added share, Japan stock market, U.S. protection, time trend.	panel regression using random effect	Japanese acquisition in the U.S. across 3-digit SIC industries; 1975-1992	The result shows a high correlation during the period of a lower currency of dollar rate induces Japanese FDI to the U.S. which likely more involve firm-specific assets.
Goldberg and Klein (1998)	1. How is exchange rate affecting trade? There are direct channel and indirect channel through direct	*Direct investment regression* Dependent variables: foreign direct investment from US and Japan Independent variables: bilateral	panel regression using gravity model and they use lagged values	Across countries including: Japan and US ASEAN: Indonesia,	Effects of real depreciation of the exchange rate of Southeast Asian with respect to Chinese Yen are as follows: 1. Increase FDI to these countries from Japan

Author	Research Question	Variables	Method	Sample	Outcome
	investment 2. What is the relationship between trade and direct investment?	real exchange rate controls: GDP of home and partner countries, and interaction variables of dummy variable for Latin American countries and real exchange rate of Japan and US *Trade regression* Dependent variable: trade (export and import). Independent variables: Real exchange rate of US and Japan, FDI of US (if dependent variable is trade of US), and vice versa. controls: GDP from the source and destination		Malaysia, Philippines, Thailand; 1979-1995	2. Decrease FDI to these countries from US FDI from japan to Southeast Asian increases imports from Japan. This also increases exports from these countries to japan and US. FDI from Japan to Latin America increases export of these countries to US.
Gopinath et al. (1999)	What is the relationship of FDI and export in the U.S. food processing industry?	Dependent variable: Foreign affiliate's sales, export, affiliate employment, FDI demand. Independent variables: price of export, wage, interest rate, agricultural price, GNP per capita, producer stability equivalent (PSE), exchange rate	Time series cross-section regression in SAS software and also use econometric packages such as LIMDEP to account for 2SLS.	U.S. FDI abroad in food processing industry across 10 high-income countries; 1984-1994	The result shows a small effect of substitution between foreign affiliate sales and exports, also FDI is proven to be protection-jumping for food processing industry.
Head and Ries (2001)	How is the relationship between FDI and export across 932 Japanese manufacturing firms over 25 years?	Dependent variable: export Independent variable: investment in distribution investment in manufacturing firm characteristics comprises: size, capital intensity, labor productivity, and wages. Dummy variable	panel regression using fixed effect	932 manufacturing firms in Japan; 1966 - 1990	The result shows that of 932 manufacturing firms, the relationship between FDI and export is mostly complimentary. Moreover, note that most of large automobile companies such as Toyota, Nissan and Honda shows substitution relationship between foreign direct investment and exports.

Author	Research Question	Variables	Method	Sample	Outcome
		Controls: exchange rate, regulatory environment affecting overseas investment.			
Pantulu and Poon (2003)	What is the nature of FDI and trade looking at evidence from US and Japan?	Dependent variable: export of goods and services value independent variable: FDI flow from i to j country, FDI stocks, spatial affinities links between i and j instrument variables: income per capita	panel data analysis using gravity model	Across 32 countries for US and 29 countries for Japan; 1996 - 1999	1. Trade creation occur in East Asian countries and in industrialized countries (Europe). 2. Trade with Canada arising with US investment 3. Trading Malaysia and Thailand is not too beneficial for US investment. 4. It is difficult to summarize between Japanese or US investment that is more superior to one another because both equally have positive relationship to trade hence the result noted that FDI from both Japan and US are more complementary than substitute.
Benassy-Quere and Lanreche (2003)	What is the effect of China's exchange rate to Asian's countries and outside-countries' export using gravity equation?	Dependent variable: export independent variable: Volatility and RER controls: GDP, Distance, Dummy for Asian country (ASIA) and non-Asian countries (1-ASIA), dummy variables such as for trade agreement; for common language; for common border	panel regression using fixed effect	11 Asian countries as exporter and 23 other countries as importer; 1984-2001	1. Exchange rate volatility show different impact to different area of export. It is insignificant in explaining within-Asia export while significant in explaining export to outside Asia. 2. The relationship of volatility and export is negative where indicates that higher nominal exchange rate volatility reduces volume of exports. 3. real exchange rate and export share a positive relationship as in the rise in the value of RER (depreciation) increases volume of export from country i to country j.
Makki and Somwaru (2004)	What is the of direct investment and trade in affecting economic growth acceleration;	Dependent variable: economic growth Independent variables: FDI and	Seemingly Unrelated Regression (SUR) and Three Stage Least Square (TSLS) approach	Across 66 developing countries of the last three decades-	The result indicates that FDI and trade interaction gives a strong and positive relation to economic growth. Also, from control variable that represent

Author	Research Question	Variables	Method	Sample	Outcome
	what is the interaction among FDI, trade and economic growth?	trade controls: human capital, domestic capital investment, GDP, inflation, tax on income, state consumption.		-1971-1980, 1981-1990, 1991-2000	macroeconomic variables, we can obtain the result where stable macroeconomic policies and institutional stability are important determining factor for economic growth driven by FDI for a country.
Helpman et al. (2004)	To what extent does heterogeneity of firm play role in firms' decision for serving abroad and its relationship when engaging in FDI?	Dependent variable: FDI and Export independent variables: Freight, tariff, export, controls: capital (book value net pf depreciation) per worker, squared form of capital per worker variable and 4-digit industry fixed effect.	panel regression using random effect	across 52 manufacturing sectors in 38 countries	1. Firms are distinguished into categories according to its productivity. The least production firms will leave the market because if they stay they cannot afford to pay such cost; low-productivity firm remains stay in the market to serve domestic; the remaining firms serve both domestic and abroad. Especially firms with foreign market target will choose to serve by exporting or invest in the foreign market. 2. Firms who export will increase relative to investing money in foreign market when trade barriers are lower or the economies of scale is higher.
Vavilov (2005)	what is the relationship of foreign direct investment and international trade?	dependent variable: export and import independent variable: GDP exchange rate FDI inflow and outflow distance (in Russia model) FDI stock time lags for FDI	Gravity Model, investment flows and stocks are lagged 1 and 2 years to indicate timing effects, also they use lagged period panel regression using random effect	Across countries of Central & Eastern Europe (CEE) and Commonwealth of Independent States (CIS); 1993-2003	1. In CEE countries and non-energy producers and exporters of CIS, FDI increases trade volume. (*Inward* FDI positively correlated to export, outward FDI positively correlated to import). 2. FDI-trade relationship across oil & gas exporters of ex-USSR and major world petroleum exporters is similar across these country groups which is positive between outward FDI and export while negative between inward FDI and import. 3. Both inward and outward FDI are complementary to Russian export while is insignificant to its import due to

Author	Research Question	Variables	Method	Sample	Outcome
					differences in FDI inflows across industries.
Aizenman and Noy (2005)	The relationship between FDI and trade (investigate the two-way feedbacks), also possibly the relationship is bi-directional	Dependent variable is FDI openness index, FDI inflow/outflow independent variables: trade openness which divided into two sub categories: trade in goods and services controls: macroeconomic variables: host countries' GDP per capita, domestic interest rate spread, weighted average of growth, government budget surplus, inflation, interest rate, government consumption. Political indicator: degree of democratic rule and corruption index.	Panel regression using fixed effect using decomposition of causality to check granger causes in linear feedback between FDI and trade.	Across 81 countries;1982-1998	1. The relationship between FDI and trade is positively significant and stronger in developing countries data hence it is vertical FDI depicted here. 2. Ignoring the comparable between two causalities and thus is insufficient to our main interest. What they do is only capturing the percentage of overall linear feedback where FDI openness to trade openness have much feedback than the other way around.
Goldberg (2006)	What is the effect of currency volatility on FDI?	n/a	Theoretical analysis	n/a	currency volatility affects the FDI in terms of internationalization of its productivity activity without worsening the economic condition and also can influence FDI through several channels such as relative wage level, relative wealth and imperfect capital market.
Bernard et al. (2007)	To what extend does exporting firms differ from firm that only serve domestic market?	Dependent variable: export premia, share of exporting/importing firm, share of export/import value, number of exported/imported products	Panel regression with gravity model using fixed effect. Also using theoretical analysis	Across manufacturing industries in the US; 1997 and 2000	Firms who export are more skill and capital-intensive, more produce more variety of products and pay higher wages to its skilled-labor. Furthermore, one noted that these differences exists even before the exporting starts.

Author	Research Question	Variables	Method	Sample	Outcome
		Independent variable: GDP, distance, employment, shipments, valued-added per worker, TFP, capital per worker, skill per worker,			Moreover, reduction in trade cost benefits those firms who trade in any given sector. Lastly with respect to vertical differentiation, U.S. remains consistent with its comparative advantage and compete more in capital intensive country also leave the competition with low-wage countries and these differences in factor abundance lead to more trade.
Brouwer et al. (2008)	What is the impact of EMU for 10 new EU members? Considering the trade and FDI effect	Dependent variables: log of nominal bilateral export from country i to j in US$ logarithm form of nominal outward FDI stock of country i in j independent variables: time-varying binary variables: binary variable that captures the potential benefits of EMU ln volatility, interaction term "TBxLn volatility"; XR change, XR depreciation, XR appreciation; lnGDPi, ln GDPj; Ln distance, contiguity, language;	Panel regression with gravity equation using fixed effect	unbalanced panel data using bilateral trade across 29 countries; 1990 - 2004	The enlargement of EMU to the 10 new members gives positive effect to the amount of FDI they receive. Furthermore, FDI and trade relationship is complimentary (or positive) which means that trade effect arises from higher FDI stocks.
Yuen-Ling et al. (2008)	what is the relationship of real exchange rate and trade balance looking at evidence in Malaysia	Dependent variable: Trade balance independent variable: Real exchange rate controls: GDP (level, growth, lagged values), trade balance growth, real exchange rate growth	Time series; Unit root tests, Co-integration, Engle-Granger Test and Vector Error Correction Model (VECM)	Malaysia; 1955-2006	The result implicates that depreciation of the ringgit value leads to improved trade balance. Furthermore, the result from the VECM shows no evidence of J-curve effect which there is downward movement of trade balance in the short term suggested by J-curve.
Walsh and Yu (2010)	1. What is the determinant of three	Dependent variables: FDI inflows as a share of nominal GDP.	Generalized Method of Moments (GMM)	Across 27 advanced and	FDI (primary) is found to be no strong correlation with macroeconomic,

Author	Research Question	Variables	Method	Sample	Outcome
	types of FDI (primary, secondary and terriary) 2. What differentiates factors that attract FDI in rich and emerging countries with respect to institutional and development indicators?	Independent variables: 1. macroeconomic variables such as: openness, multilateral real exchange rate, 3-year average inflation, stock of FDI, real GDP growth, GDP per capita, 2. institutional and qualitative variables: labor market flexibility, infrastructure quality, judicial independence, legal system efficiency, financial depth and school enrollment (primary, secondary and tertiary levels).	dynamic estimator using Arellano-Bond methodology.	emerging market countries from 1985 - 2008.	development, or institutional condition; when using cluster the effect is found to be important, also larger stocks attracts greater additional FDI inflows. By distinguishing secondary and tertiary we can see the importance of the different linkages to macroeconomic and institutional indicators. Furthermore, FDI in services are more affected by macroeconomic indicators than FDI in manufacturing. Lastly. FDI (tertiary) are higher in more growing economies.
Kim (2010)	What is the relationship of political stability and FDI?	Dependent variable: FDI (inflows, outflows, performance). Independent variables: variety of political stability index. Controls: GDP, exchange rate, corporate tax, capital account closeness.	Pooled OLS, GLS estimation, and random effect estimation of panel data	Across 28 countries; 1990-2002	Countries with more political stability attracts more capital flows to invest in countries with unstable political condition. Furthermore, countries with higher level of corruption and lower democracy attract more FDI inflows.
Kharroubi (2011)	What is the relationship of real currency value and trade balance respect to its level of IIT and ICE?	Dependent variable: Trade balance independent variables: the growth rate of domestic absorption, real effective exchange rate (REER), interaction terms between REER and import content of export (ICE), and REER and intra-industry trade (IIT).	Panel regression using fixed effect	Across 20 OECD countries; 1985-2008	The result indicates that countries with high IIT and low ICE index benefits from exchange rate depreciation which generates improved trade balance. On the other hands, countries with low IIT and high ICE should not expect a depreciation in exchange rate.
Bahmani-Ooskee (2012)	How is the relationship of the effect of exchange rate on inpayment and	Dependent variable: export and import values Independent variables: Real exchange rate	Time series; Akaike information criterion (for optimum lags) and error correction model	Indonesia's 13 main trading partner; 1973-2011	1. The relationship of exchange rate and export is positive and is negative relating to import; this supports the theory. 2. The impact of exchange rate on inpayment and outpayment in Indonesia

Author	Research Question	Variables	Method	Sample	Outcome
	outpayment in the long-period of trade?	Controls: trading partners' income			is a short-run period with majority of its trading partner while is long-run term with only half of the trading partners.
Pham and Nguyen (2013)	The possible linkage of foreign direct investment, real exchange rate and trade.	FDI regression: Dependent variable: FDI Independent variable: exchange rate, export, lag-1 export, GDP, lag-1 GDP, dummy variable for Asian crisis Export regression: dependent variable: Export independent variable: exchange rate, FDI, lag-1 FDI, GDP, lag-1 GDP, dummy variable for Asian crisis	Pedroni panel co-integration 1. Unit root test 2. Heterogeneous panel co-integration for the long run co-integration 3. Fixed effect model	Using panel cross section of Vietnam as home country and ten partner countries such as japan, US, France, Thailand, Singapore, Australia, Malaysia, Hong Kong, Taiwan and Korea; 1990-2007	1. Major result: a. real depreciation of Dong increases FDI and export of Vietnam. b. it is a complementary relation between FDI and export c. economic growth plays a role in attracting FDI into Vietnam 2. Second result: the impact of exchange rate on both FDI and export supports two ways through direct effect on the price level and indirect effect through FDI is found statistically.
Alemu and Jin-sang (2014)	What is the impact of currency depreciation on export?	Dependent variable: trade balance Independent variables: exchange rate Controls: GDP per capita, inflation, lending interest rate, population size, degree of openness, physical infrastructure.	Panel regression using random effect and feasible generalized least square (FGLS)	Across 14 countries in Asia; 1990-2012	The result tells no evidence of improved trade balance due to depreciation in their currency. This was because there are changes in primary trade commodity that made export was not in response of lower currency rate.
Bahmani-Ooskee and Harvey (2014)	To what extent does the insignificance of exchange rate of Indonesia's rupiah relative to dollar rate explain Indonesia's *inpayment* and *outpayment* with US?	Dependent variable: U.S. export and import value Independent variable: real exchange rate controls: Indonesia's income	time series; akaike information criterion (for optimum lags) and error correction model	Across 108 US exporting industries and 32 US importing industries	Indonesia's rupiahs relative to US Dollar shows a short run significant effect on both inpayment and outpayments. While in the long run, only about 31 industries for the inpayments and only about 17 industries for outpayments that significantly affected. Furthermore, the exchange rate induces an improvement of trade balance by 1.8

Author	Research Question	Variables	Method	Sample	Outcome
					percent (0.54% for the inpayment and 1.3% for the outpayment)
Esiyok (2015)	Does inward foreign direct investment increase imports to turkey? An instrumental variable approach	Dependent variable: Turkey's import Independent variable: sum of GDP home country and Turkey similarity index of GDP per-capita trade cost real exchange rate custom union dummy	Two methods are used 1. use lagged FDI 2. Use 2SLS there is argument that use lagged variables does not ensure causality, hence 2SLS is necessary to account for potential bias. Author use two instruments for endogenous FDI which are: 1. corruption, law and order indexes 2. ratified bilateral investment treaties for investment liberalization	across 19 countries; 1982-2007	After controlling for real exchange rate, custom union effects and trade costs, the result is that FDI is significant positively and induces trade which suggests complimentary relationship.
Bouras and Raggad (2015)	How is the effect of direct investment on export.	There are three models where they differentiate FDI into three parts: Dependent variable: FDI total, FDI manufacturing and FDI non-manufacturing. Independent variable: Total export, export manufacturing, export non-manufacturing, inflation rate. all the variable using natural logarithm form	Panel data analysis using random effect	Across manufacturing and non-manufacturing sectors relative to 10 developing and non-developing countries;	1. The effect of export to FDI is positive for total data. Meaning that export induces FDI grow larger, thus the relationship is complementary. However, the inflation effect as control is insignificant. 2. For the manufacturing sector, FDI and export also have positive relationship while the inflation is negative and all significant. 3. For the non-manufacturing sector, the relationship between export and FDI is also positive although the coefficient is

Author	Research Question	Variables	Method	Sample	Outcome
					less compared to total and manufacturing.
Bilas and Bosnjak (2015)	The empirical evidence of international trade between Croatia and EU members	Dependent variable: ratio of import to export of Croatia to EU Independent variables: share of skilled labor in EU compared to share of skilled labor in Croatia, share of low educated labor in EU to low educated labor in Croatia, ratio of share capital to labor in EU and in Croatia.	Panel regression	Across Croatia and other EU member according to industrial code of NACE 2007; 1995-2011	Croatia benefits from trading with capital-abundant country since it has abundant factor in labor endowment. Government of Croatia may create policy to increase investment hence it may lead to Croatia take advantage of capital mobility.
Chen and Wu (2017)	What is the effect of FDI and trade in China's urbanization?	Dependent variable: urbanization rate Independent variables: FDI and export Controls: GDP, fixed asset investment, per capita GDP, total population.	Dynamic panel regression and instrument variable for endogeneity problems	262 prefecture cities in China; 2004-2013	On average FDI and export play a significant role in China's urbanization. However, FDI gives a positive impact on coastal area since it offers a great attraction for labor-intensive FDI and also over the past decade, technology has been emerging in this area. Furthermore, export gives a positive impact on urbanization in both coastal and inland region.

3. Data and Methodology

3.1. Data

The data used for the estimation is describe in this sub-part. The purpose of this thesis is to reveal the relationship between outflow FDI and trade—either with export or import, we retrieve the FDI dataset from Bureau Economic Analysis (BEA) of United States' government because we can find FDI data that is disaggregated (2-digit level) into different sub sectors. The industry that we picked in this thesis is manufacturing industry which consists seven different sub-sectors as follows: (1) food, (2) chemical, (3) metal, (4) machinery, (5) computer & electronic, (6) electrical and, (7) transport equipment. The FDI data obtained from BEA includes negative values (inflow) which decreases the values of FDI abroad while positive values (outflow) increases it. For the purpose of this thesis, we then take natural logarithm for this FDI data and the negative values are eliminated as the logarithm process only proceeds the positive values. As a result, we only have positive values of US FDI (outflow).

Furthermore, the data for trade—export and import is retrieved from International Trade statistics from United Nation COMTRADE (UNCOMTRADE) where we search for trade data by product, thus the use of disaggregated data based on Harmonized System (HS) code is needed. Firstly, we obtain export and import data based on the 1996 version of HS code for 6-digit commodities, then we use the product concordance table of World Integrated Trade Solution (WITS)[3] to match HS code with ISIC Revision.3 of two-digit industry. The purpose of using this concordance procedure is to find the codes that match our FDI data since such dataset is in 2-digit code while the trade data is in 6-digits code as explained earlier. Lastly, after identifying the codes using concordance table we have found the disaggregated level of data that is suitable for this thesis as follows[4]:

15	Food products and beverages manufacturing
24	Chemicals and chemical products manufacturing
27	Basic metal manufacturing
28	Fabricated metal products, except machinery manufacturing
29	Machinery and equipment, n.e.c manufacturing
30	Office, accounting and computing machinery manfuacturing
31	Electrical machinery and apparatus n.e.c manufacturing

[3] World Integrated Trade Solution, (http://wits.worldbank.org/product_concordance.html).
[4] Classifications Registry. *United Nations Statistics Division.* (https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2)

32	Radio, television and communication equipment manufacturing
34	Motor vehicles, trailers and semi-trailers manufacturing
35	Other transport equipment manufacturing

Moreover, based on the list above, code 15, 24, 29, and 32, separately, stands for their own code, while we have to take sum of the rest of data because they jointly fall under the same category. For instance, the ISIC code of 27 and 28 falls under metal manufacturing category, code of 30 and 32 falls under computer & electronic manufacturing category, and code of 34 and 35 falls under transport equipment manufacturing category.

Furthermore, we also obtain data for exchange rate index. The type of exchange rate we use in this thesis is real exchange rate because we want to measure the real movement of currencies that is allowing for inflation, which uses consumer price index as its proxy. As such the calculation for real exchange rate is as follows[5]:

$$Real\ exchange\ rate = nominal\ exchange\ rate\ x\ \frac{CPI\ of\ foreign\ country}{CPI\ of\ domestic\ country}$$

where nominal exchange rate denotes for local currency unit of other countries relative to US dollar or simply it is the price of other currency per 1 US dollar. Foreign country here is US and domestic country is the host/destination countries where US FDI outflow and trade goes to. The index obtained from the calculation above results as real exchange rate that belongs to those destination countries. The nominal exchange rate and consumer price index dataset are retrieved from International Monetary Fund (IMF) and World Bank database, although for some countries the data are not available in datasets. As such, we utilize several of sources such as the Bureau of Statistics[6,7] website for each country, etc.[8]

Moreover, we also include political stability index[9] for the instrument variable used in the first stage regression. This dataset is retrieved from World Government Index (WGI) from World Bank database. Additionally, other explanatory variables where we assume to be control variables are included to estimate the equations for this thesis such as, Gross Domestic Product (GDP), GDP per capita or total GDP per country relative to total population of its country,

[5] Bank of International Settlements (BIS) methodology, (http://www.bis.org/ifc/events/6ifcconf/takats_pres.pdf)
[6] Taiwanese Bureau of Statistics (https://eng.stat.gov.tw/ct.asp?xItem=37408&CtNode=5347&mp=5)
[7] Venezuela's Bureau of Statistics (http://www.ine.gob.ve)
[8] Canadian Forex Website (http://www.canadianforex.ca/forex-tools/historical-rate-tools/historical-exchange-rates)
[9] Political stability index consists six different indices such as voice accountability, stability and no-violence, government effectiveness, regulator quality, rule of law, and control of corruption. The choice for instrument variable made from this list depends on how it affects the endogenous variable; we look at its p-value to tell the significance, then we pick the one with highly significance.

Openness defines the sum of export and import as a share of total GDP. These data can be obtained from World Bank database.

Overall, the data we obtained is a set of data panel that covers 18 years period which spans from 1998 to 2015 and consists of 60 countries.[10] Basically, the number of observations amounts to 1080 data (balanced), however due to missing values in FDI which is caused by non-disclosure values of US FDI outflow to some countries, thus unbalanced data. The number of observation for each regression may vary in different dependent variable (the use of data of US FDI outflow in different sub-sectors in manufacturing industry).

Table 3.1 shows the variables' description along with how the variables are constructed. All the variables used except political stability indices are deflated using GDP deflator to make it real values. The real values show that there is role of inflation rate which since 1998-2015 (as the period of the data in this thesis) there must be the effect of how prices level affects the trade and FDI decision. Further, in table 3.2 shows the descriptive statistics of all variables used in this thesis. Zero values for export and import belongs to Taiwan, UNCOMTRADE does not disclose the data Taiwanese export and import of commodities. All variables used will be transformed into natural logarithm, therefore the coefficient between x and y in a regression equation will be an elasticity of independent affecting dependent variables, thus using percentage changes in the interpretation.

[10] Table of list of countries will be featured in Appendix A. These countries amount to 60 countries only due to data availability.

Table 3.1 Description of Variables

Variables name	Description	Construction	Source
FDI_t	Financial transaction of US direct investment abroad where positive values increases investment abroad while negative values decreases it. The values are expressed in US dollars	Deflate the nominal values of FDI per sub-sector using GDP Deflator index (base year: 2010)	Bureau of Economic Analaysis (BEA) - US Department of Commerce (www.bea.gov)
$\widehat{FDI}_t$	Fitted value of the FDI_t from first stage regression	Doing first regression as a first step in the 2SLS regression. Then take a predicted value of the regression.	Author's calculation
$Export_t$	Value of merchandise trade (only goods--services not included) of US exported to other countries; expressed in US dollars.	Deflate the nominal export value using US GDP Deflator index (base year: 2010).	United Nations Comtrade Database
$Import_t$	Value of merchandise trade (only goods--services not included) of US imported from other countries; expressed in US dollars.	Deflate the nominal import value using US GDP Deflator index (base year: 2010).	United Nations Comtrade Database
RER_t	Real exchange rate index - a product of other country's nominal exchange rate per US dollar and ratio of foreign (US) price relative to domestic price.	Adjusting nominal exchange rate with foreign (US dollar) and domestic currency (other countries' currency).	International Monetary Fund and World Bank
RER_{t-1}	Lagged values of the described RER_t	Generate the lagged value in Stata.	Author's calculation
GDP_t	Gross Domestic Product of other countries relative to GDP deflator.	Deflate the nominal GDP using US GDP deflator (base year: 2010)	World Bank Database
GDP_{t-1}	Lagged values of the described GDP_t	Generate the lagged value in Stata.	Author's calculation
GDP Per $capita_t$	Gross Domestic Product (GDP_t) of other countries divided by its population.	Divide real GDP with total population	World Bank Database
GDP $Percapita_{t-1}$	Lagged values of the described GDP $Percapita_t$	Generate the lagged value in Stata.	Author's calculation
$Openness_t$	the ratio of country's total trade, the sum of exports plus imports, to the country's gross domestic product.	(Exports + Imports)/(Gross Domestic Product). Deflate it with GDP Deflator (base year: 2010).	World Bank Database
$Openness_{t-1}$	Lagged values of the described $Openness_t$	Generate the lagged value in Stata.	World Bank Database
Political Stability $index_t$	An index from World Government Indicator that describes political conditions of countries	-	World Government Indicator of World Bank
Political Stability $index_{t-1}$	Lagged values of the described Political Stability $Index_t$	Generate the lagged value in Stata.	Author's calculation

Table 3.2 Descriptive Statistics

Variables	Observation	Mean	Standard Deviation	Minimum value	Maximum value
FDI (food manufacturing)	621	913767.2	3990283	-7212252	8.11E+07
FDI (chemical manufacturing)	878	2001710	6806348	-4.33E+07	6.18E+07
FDI (metal manufacturing)	581	491191.7	2220788	-1.69E+07	1.79E+07
FDI (machinery and equipment manufacturing)	675	900242.1	2864159	-1.08E+07	3.55E+07
FDI (computer and electronic manufacturing)	641	1914132	6437438	-1.85E+07	5.33E+07
FDI (electrical manufacturing)	809	225263.4	1309522	-9885893	1.35E+07
FDI (transportation equipment)	521	597552.2	4238320	-2.83E+07	5.51E+07
Export (food manufacturing)	1,062	7973080	2.33E+07	0	2.79E+08
Export (chemical manufacturing)	1,062	2.39E+07	4.39E+07	0	2.93E+08
Export (metal manufacturing)	1,062	1.13E+07	3.55E+07	0	3.69E+08
Export (machinery manufacturing)	1,062	2.07E+07	5.02E+07	0	4.93E+08
Export (computer and electronic manufacturing)	1,062	2.14E+07	4.16E+07	0	3.25E+08
Export (electrical manufacturing)	1,062	7037753	1.99E+07	0	1.82E+08
Export (transportation equipment manufacturing)	1,062	2.49E+07	7.44E+07	0	6.64E+08
Import (food manufacturing)	1,062	1.00E+07	1.97E+07	0	1.64E+08
Import (chemical manufacturing)	1,062	2.41E+07	4.68E+07	0	3.04E+08
Import (metal manufacturing)	1,036	1.76E+07	4.03E+07	52.82919	3.18E+08
Import (machinery manufacturing)	1,062	2.29E+07	5.69E+07	0	4.58E+08
Import (computer and electronic manufacturing)	1,057	3.98E+07	1.42E+08	580.7959	1.50E+09
Import (electrical manufacturing)	1,062	1.22E+07	3.92E+07	0	3.29E+08
Import (transportation equipment manufacturing)	1,018	4.56E+07	1.36E+08	72.42314	8.48E+08
Real exchange rate	1,062	326.6062	1654.679	0.4836694	21251.75
Gross Domestic Product (GDP)	1,078	1.31E+10	5.09E+10	3.83E+07	5.24E+11
GDP Per capita	1,078	528.603	2266.476	4.787745	23487.17
Trade openness	1,058	102.8774	132.7984	0.000018	1958.73
Political Stability Index					
Voice and accountability	958	0.558786	0.8645964	-1.862976	1.826381
Political stability and absence of violence	960	0.2109822	0.9197923	-2.3857	1.663373
Government effectiveness	960	0.7611627	0.9178952	-1.228671	2.431312
Regulatory quality	960	0.7326874	0.840525	-1.857714	2.262884
Rule of Law	960	0.592093	1.008236	-1.990581	2.120458
Control of corruption	960	0.6422003	1.097113	-1.380633	2.58558

Notes: (1) FDI values are in US dollar; (2) the export and import values are in US dollar; (3) real exchange rate values are in domestic currency unit per US dollar; (4) GDP and GDP per capita values are in the US dollar; (5) trade openness values are share of net trade respective to GD; (6) political stability index values are index ranged from -2.5 to 2.5; (7) all the variables are transformed into natural logarithm form in this thesis.

3.2. Methodology

3.2.1. Benchmark Equations and Variables

As explained, the purpose of this thesis is to reveal the relationship of FDI outflow and trade across sub-sectors in industry manufacturing, thus the equations used are as follows:

$$ln(Export_t) = \alpha + \beta_1 ln(FDI_t) + \beta_2 ln(RER_t) + \beta_3 ln(RER_{t-1}) + \beta_4 ln(X_t) + \beta_5 ln(X_{t-1}) + CountryFE + YearFE + \varepsilon_t \quad (3.1)$$

$$ln(Import_t) = \alpha + \beta_1 ln(FDI_t) + \beta_2 ln(RER_t) + \beta_3 ln(RER_{t-1}) + \beta_4 ln(X_t) + \beta_5 ln(X_{t-1}) + CountryFE + YearFE + \varepsilon_t \quad (3.2)$$

$$ln(FDI)_t = \alpha + \beta_1 ln(RERt) + \beta_2 ln(RERt\text{-}1) + \beta_3 ln(Xt) + \beta_4 ln(X_{t-1}) + CountryFE + YearFE + v_t \quad (3.3)$$

the above model is benchmark regression where in this thesis is used to reveal the relationship between FDI outflow and trade, also to see the linkage from exchange rate either it gives direct or indirect effect on trade. The use of lower subscript "t" denotes current time of the data, however attached also in the two models above is the subscript of "t-1" which denotes lagged values of the data. Besides, all variables are changed into logarithm form so that the interpretation is an elasticity and to synchronize the data since the units vary from one to another variable, as we can from the descriptive statistic table (see table 4.1).

We use two different dependent variables to distinguish trade into export and import where, as explained earlier, we obtain from UNCOMTRADE using 1996-version HS code 6 digit of only commodities—service goods are excluded. The reporting country of these export and import data is US and the destinations are 60 countries chosen due to data available. The main variables of the two models are FDI and RER where FDI denotes for US FDI outflow to these 60 countries and RER denotes for destination countries' currencies, respectively. However, FDI variable used in this benchmark model arises endogeneity problem which will result in estimation bias (later will be discussed in the part 3.3.2 below). Further, letter "X" denotes for control variables that consist of GDP, GDP per capita and trade openness where this thesis follows Goldberg and Klein (1998) to include these variables. The regression features country fixed effect where we take account for individual country's characteristics that are not in the equation, and also year fixed effect where there could be events in certain period affecting the dependent variable that needs to be controlled.

3.2.2. Endogeneity Problem and Instrument Variable (IV) Approach

Furthermore, the FDI used as explanatory variable in the above models are often arising endogeneity problem where at least it results in three problems of estimations which are: (1)

omitted variable bias, (2) measurement error, and (3) simultaneity or reverse causality. A variable is said to be endogenous because there are some factors correlated to the variable but they are not put in the regression and fall under the error terms, this makes the coefficient of the main variable is not consistent in explaining the correlation to dependent variable, hence creating a biased estimation.

The main problem when revealing relationship between FDI and trade using equation (1) and (2) is not that FDI causing export and import, but may be reversed—or it is called *reverse causality*. As such, we can assume that FDI may be an endogenous variable and we have to tackle this problem using Instrument Variable (IV). The choice of IV is also an important matter that it should not correlate with the error terms and only affect dependent variable (export and import) through FDI outflow. In order to estimate the model with a solution for the endogeneity problem, this thesis will use Two Stage Least Stage (TSLS/2SLS) estimate where there will be two stages of regression. The first stage regression will be done to get a fitted value of endogenous variable (FDI outflow) which later will be included within the regression in the initial equation (1) and (2) for second stage regression.

- Initial equation:

$$ln(Export_t) = \alpha + \beta_1 ln(FDI_t) + \beta_2 ln(RER_t) + \beta_3 ln(RER_{t-1}) + \beta_4 ln(X_t) + \beta_5 ln(X_{t-1}) + CountryFE + YearFE + \varepsilon_t \quad (3.3)$$

where FDI_t is still endogenous variable, we then use first stage of regression to get predicted values of FDI using exogenous variable as its independent variables in this first stage regression.

- First stage:

$$ln(\widehat{FDI}_t) = \alpha + \beta_1 ln(PoliticalIndex_t) + \beta_2 ln(PoliticalIndex_{t-1}) + \beta_3 ln(RERt) + \beta_4 ln(RER_{t-1}) + \beta_5 ln(Xt) + \beta_6 ln(X_{t-1}) + CountryFE + YearFE + v_t \quad (3.4)$$

- Second stage:

$$ln(Export_t) = \alpha + \beta_1 ln(\widehat{FDI}_t) + \beta_2 ln(RER_t) + \beta_3 ln(RER_{t-1}) + \beta_4 ln(X_t) + \beta_5 ln(X_{t-1}) + CountryFE + YearFE + \varepsilon_t \quad (3.5)$$

In the first stage regression, we include not only the chosen instrument variable but also all exogenous variables in it to find a consistent coefficient due to the correct standard error, hence we include other explanatory variable that we think to be exogenous but can correlate in terms

of creating a predicted/fitted value of FDI outflow.[11] Then, we regress the fitted value as the variable of interest in the second stage regression using. Additionally, a weak instrument might result in a biased coefficient of predicted values of the so-called endogenous variable because it results in an incorrect standard error, therefore we use F-test value to check if the instrument is strong. As such, if the F-statistics is high, thus strong IV. In the next part, we will discuss the result from the regression procedures that have been discussed in this part.

[11] Article of Vince Wiggins from StataCorp, retrieved from: (http://www.stata.com/support/faqs/statistics/instrumental-variables-regression/). The article uses reference from Baltagi (2011).

4. Result Analysis

This part presents the result of several regression in order to answer the relationship between trade (export and import) and FDI outflow and the linkage of exchange rate on these two variables. In the first part, there will be a result analysis from trade regression starting from export model and then import model which there will be an explanation of each relationship with FDI outflow across manufacturing industries in the US, also the linkage of exchange rate to import and export. Later on, the second part, there will be a result analysis of the FDI model from different sub-sectors manufacturing industry.

The empirical result from export regression model is depicted in several tables where we can see the relationship between FDI and export of US across manufacturing industries. However, previous literatures have proven that in order to crack the relationship between these two is by firstly solving the endogeneity problem that might arise. The endogeneity problem arises when coefficient resulting from the regression gives a biased value because there is omitted variables that correlate to FDI are not included when determining the relationship between export and FDI. We pick the variable that correlates to FDI but not correlate to export and hence we use Political Stability Index. Further, in order to solve the endogeneity problem, we use the Two Stage Least Square (2SLS) analysis by doing first stage regression of the correlation of Political Stability Index on FDI, then we take the predicted value of the first stage regression and use fitted value from the first stage regression in the second stage regression.

Below is the table 4.1 of all the first stage regressions for all sub-sectors in manufacturing industry. We can see that the use of indicator in the political stability index in all sub sectors vary which in the first stage regression, the control of corruption indicator is used the most in all the first stage regression, while the other indicators being used as well are government effectiveness and regulatory quality. These indicators show that foreign investor concerns about these indicators and how the quality of government matter when it comes to decision of foreign investor to outflow the money in the host countries. This result also is in line with the work of La Porta et al. (1990).

Table 4.1 First Stage Regression for All Sub-Sectors (1)

VARIABLES	FDI1	VARIABLES	FDI2	VARIABLES	FDI3	VARIABLES	FDI4
Political stability index$_{t-1}$	0.224**	Political stability index$_{t-1}$	0.191**	Political stability index$_{t}$	-0.401**	Political stability index$_{t-1}$	-0.155*
	(0.094)		(0.082)		(0.182)		(0.08)
Real exchange rate$_{t}$	1.019	Real exchange rate $_{t}$	0.688	Real exchange rate$_{t}$	0.35	Real exchange rate $_{t-1}$	-0.089
	(0.712)		(0.498)		(1.327)		(0.102)
GDP$_{t-1}$	-0.200*	GDP$_{t-1}$	0.086	GDP$_{t-1}$	0.148	GDP$_{t-1}$	-0.020
	(0.102)		(0.093)		(0.288)		(0.115)
Openness$_{t}$	-0.548	Openness$_{t}$	0.124	Openness$_{t}$	-3.120***	Openness$_{t}$	-0.254
	(0.684)		(0.433)		(1.029)		(0.798)
GDP Percapita$_{t}$	1.650***	GDP Percapita$_{t}$	1.109**	GDP Percapita$_{t}$	-0.071	GDP Percapita$_{t}$	0.25
	(0.59)		-0.457		(1.544)		(0.792)
Constant	9.55**	Constant	4.12	Constant	22.24	Constant	3.292
	(4.43)		(5.13)		(11.61)		(7.029)
Observations	306	Observations	452	Observations	263	Observations	291
R-squared (within)	0.126	R-squared (within)	0.112	R-squared (within)	0.156	R-squared (within)	0.205
F-stat	6.52	F-stat	5.23	F-stat	4.61	F-stat	9.27
Prob>F	0.000	Prob>F	0.000	Prob>F	0.000	Prob>F	0.000
Country Fixed Effect	**YES**	Country Fixed Effect	**YES**	Country Fixed Effect	**YES**	Country Fixed Effect	**YES**
Year Fixed Effect	**YES**	Year Fixed Effect	**YES**	Year Fixed Effect	**YES**	Year Fixed Effect	**YES**

Notes: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

- For FDI1 (food manufacturing), the political stability index chosen is government effectiveness.
- For FDI2 (chemical manufacturing), the political stability index chosen is regulation quality.
- For FDI3 (metal manufacturing), the political stability index chosen is control of corruption.
- For FDI4 (machinery manufacturing), the political stability index chosen is control of corruption.

Table 4.2 First Stage Regression for All Sub-Sectors (2)

VARIABLES	FDI5	VARIABLES	FDI6	VARIABLES	FDI7
Political stability index$_{t-1}$	0.379***	Political stability index$_{t}$	1.228***	Political stability index$_{t-1}$	0.430**
	(0.125)		-0.398		-0.194
Real exchange rate $_{t}$	-0.787	Real exchange rate $_{t}$	-3.292**	Real exchange rate $_{t}$	(1.287)
	(0.725)		-1.295		-1.508
GDP $_{t-1}$	0.323	GDP$_{t-1}$	0.125	GDP $_{t-1}$	0.095
	(0.479)		(0.255)		(0.096)
Openness $_{t}$	3.072***	Openness$_{t}$	1.299	Openness $_{t}$	-0.339
	(0.653)		(0.976)		(0.883)
GDP Percapita $_{t}$	1.332	GDP Percapita$_{t}$	2.157*	GDP Percapita $_{t}$	-0.287
	(0.963)		(1.250)		(1.205)
Constant	-18.9	Constant	23.08*	Constant	6.762
	(11.340)		(13.510)		(11.480)
Observations	314	Observations	224	Observations	218
R-squared (within)	0.208	R-squared (within)	0.296	R-squared (within)	0.342
F-stat	6.20	F-stat	6.28	F-stat	25.30
Prob>F	0.000	Prob>F	0.000	Prob>F	0.000
Country Fixed Effect	**YES**	Country Fixed Effect	**YES**	Country Fixed Effect	**YES**
Year Fixed Effect	**YES**	Year Fixed Effect	**YES**	Year Fixed Effect	**YES**

Notes: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

- For FDI5 (computer and electronic manufacturing), the political stability index chosen is government effectiveness.
- For FDI6 (electrical manufacturing), the political stability index chosen is control of corruption.
- For FDI7 (transport equipment manufacturing), the political stability index chosen is control of corruption.

4.1. US FDI Outflow and US Trade (Export and Import) Regression

4.1.1. US FDI Outflow and US Export and Import in Food Manufacturing Industry

The complementary relationship obtained from positive sign from the predicted FDI coefficient, which tells that an increase in U.S. FDI outflow in food manufacturing industry increases U.S. export in food manufacturing product to the destination countries. The coefficient itself tells us if there is a 1 percent increase in US FDI outflow abroad the export will go up by 0.1 percent, approximately, however it is insignificant thus the complementary relationship is not confirmed.

Further, the effect of exchange rate on export appears to be significant where we include or exclude predicted FDI. This is where exchange rate has two effects as the aforementioned in the earlier part of this thesis; direct and indirect effect. The indirect effect is seen in the model regression where we include both predicted FDI and real exchange rate into the same regression model, hence exchange rate is said to affect export through the FDI since we also include real exchange rate variable in the FDI model in the first stage regression. While, the direct effect is

seen from the model where we exclude predicted FDI from the model; meaning that exchange rate affects export directly through its price level. The sign for this coefficient is negative, this is in line with the proposed hypothesis where a decline in real exchange rate index of a host country defines a depreciation in US' currency, then this causes US exported goods to be more competitive in foreign market, besides the depreciation of US dollar leads to lower price of the export goods, thus export of U.S. in food product to the destination country increases.

Table 4.3 Export regression (in food manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.062		0.0721
	(0.100)		(0.093)
Real exchange $rate_t$		-0.653***	-0.698***
		(0.119)	(0.115)
GDP_{t-1}	0.195**	0.220***	0.174**
	(0.085)	(0.062)	(0.075)
Openness $_{t-1}$	0.576***	0.484***	0.480***
	(0.115)	(0.070)	(0.113)
GDP Percapita $_{t-1}$	-0.012	-0.059	-0.041
	(0.113)	(0.071)	(0.101)
Constant	6.920***	9.405***	9.156***
	(2.225)	(1.402)	(2.020)
Observations	590	885	590
R-squared (within)	0.228	0.376	0.315
F-stat Prob>F	8.52 0.000	27.87 0.000	19.8 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1

On the import model, we find a substitution relationship as we can see in the table 3. The coefficient of predicted US FDI outflow is however insignificant in affecting US import which the negative sign tells that in which a complementary relationship also occurs for US FDI outflow and import of US. Markusen and Venables (1998) argues that positive relationship of US FDI outflow and import happens because there may be a case of subsidiary activity where parent company extradite their production activity abroad then they will import the final good back to fulfill domestic consumers' needs. However, since the result we found here is negative relationship, the more increase US FDI outflow is, the lower US import this product from host countries, it can be said that US FDI outflow is meant to serve foreign market, not domestic market.

Further, exchange rate gives two effects as well in import model although a negative effect of exchange rate obtained on import model is contrast with the proposed hypothesis, where the effect should be positive; a rise in exchange rate index defines an appreciation in US dollar, making the US import should be increasing since an appreciation in US dollar makes purchasing power of US importer higher in buying import goods from other countries.

Table 4.4 Import regression (in food manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	-0.028		-0.022
	(0.095)		(0.082)
Real exchange $rate_t$		-0.330**	-0.373***
		(0.141)	(0.109)
GDP_{t-1}	0.092	0.151**	0.081
	(0.092)	(0.065)	(0.086)
Openness $_{t-1}$	0.274***	0.192*	0.223**
	(0.093)	(0.111)	(0.091)
GDP Percapita $_{t-1}$	0.055	-0.002	0.039
	(0.145)	(0.075)	(0.139)
Constant	11.70***	11.41***	12.89***
	(2.064)	(1.469)	(1.807)
Observations	589	884	589
R-squared (within)	0.072	0.102	0.103
F-stat Prob>F	4.08 0.006	4.79 0.002	5.88 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1

4.1.2. US FDI Outflow and U.S. Export and Import in Chemical Manufacturing Industry

In the table 5 we can see the regression model that depicts the relationship between US FDI outflow and US export in the chemical manufacturing industry. The result is the same as in the regression model for the food manufacturing industry, we use predicted FDI values from first stage regression in second stage regression in order uncover relationship between FDI and trade so we can avoid the endogeneity problem. This regression also results in a complimentary relationship between US FDI outflow and US export in chemical manufacturing industry. The coefficient tells when there is 1 percent increase in US FDI outflow in chemical manufacturing industry, US export chemical processed products increases by 0.2 percent, approximately. The significance is also at 1 percent level. Next, we see the link of exchange rate in export model for this industry. The exchange rate also gives both direct and indirect effects on export as seen in the table 5 column 1 where we include both real exchange rate index and FDI together in one model and in column 2 where we exclude the FDI variable, respectively. The exchange

rate gives a negative contribution directly, through export price, to export volume meaning that a decline in exchange rate index by 1 percent (appreciation in host country's currency or depreciation in US' currency) leads to 0.5 percent higher of US export, approximately. This occurs because the depreciation of US dollar makes the US' export goods price is cheaper and thus many countries will prefer to use US goods thus leads to an increase of US export goods.

Table 4.5 Export regression (in chemical manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.192**		0.190**
	(0.079)		(0.074)
Real exchange $rate_t$		-0.443***	-0.518***
		(0.127)	(0.075)
GDP_{t-1}	0.110	0.184***	0.096
	(0.076)	(0.060)	(0.071)
Openness $_{t-1}$	0.547***	0.489***	0.472***
	(0.095)	(0.064)	(0.096)
GDP Percapita $_{t-1}$	0.125	0.005	0.110
	(0.097)	(0.056)	(0.082)
Constant	7.822***	10.71***	9.549***
	(1.836)	(1.367)	(1.787)
Observations	577	836	577
R-squared (within)	0.306	0.413	0.361
F-stat Prob>F	11.53 0.000	35.34 0.000	26.7 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

The relationship is also complimentary between US FDI outflow and US import in this industry as depicted in the table 4.6 below. US FDI flow positively correlates to import where the coefficient tells that an increase by 1 percent in US FDI outflow leads to approximately 0.4 percent of its import. Similarly, exchange rate affects import also in two ways, both in direct through its price of import and indirect way through FDI, although the sign is different as proposed; it shows a negative sign where it should be positive.

Table 4.6 Import regression (in chemical manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.360**		0.356**
	(0.140)		(0.139)
Real exchange $rate_t$		-0.444**	-0.821***
		(0.215)	(0.133)
GDP_{t-1}	0.062	0.143*	0.039
	(0.066)	(0.073)	(0.057)
Openness $_{t-1}$	0.376***	0.344***	0.258***
	(0.094)	(0.087)	(0.086)
GDP Percapita $_{t-1}$	0.035	0.000	0.013
	(0.123)	(0.078)	(0.102)
Constant	7.232***	11.44***	9.970***
	(1.828)	(1.725)	(1.932)
Observations	577	836	577
R-squared (within)	0.105	0.115	0.179
F-stat Prob>F	7.98 0.000	10.71 0.000	28.85 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

4.1.3. US FDI Outflow and U.S. Export and Import in Metal Manufacturing Industry

As mentioned in earlier part of this thesis, we have discussed how the relationship between FDI and trade is not clear and it is based on disaggregated level of data. We disaggregate level of FDI and trade into seven categories of manufacturing industries, therefore we may find different relationship in different industries. In this part, we look at such relationship in metal manufacturing industry data and we found the relationship to be substitute between US FDI outflow and US export of product in this industry. In the table 4.7 below, we can find a negative and highly significant coefficient of predicted FDI amounting to -0.324 in column 3 (considered as best combination model) meaning that a 1 percent increase in US FDI outflow results in decreasing US export of product in metal manufacturing industry by 0.3 percent, approximately. Additionally, such relationship is also found in US FDI and import with negative sign where a 1 percent increase in US FDI outflow will decrease US export by 0.2 percent, more or less. Remain the same as earlier result for two previous manufacturing industries that the link of exchange rate on trade is present in both export and import regression in direct and indirect effect. The sign of exchange rate for export model confirms the proposed hypothesis which real exchange rate affects export negatively as a rise in real exchange rate index means an appreciation in US dollar making the price of US export increases and the US export product is less competitive, thus a lower export volume. Meanwhile, exchange rate in the import model is contrast with the proposed hypothesis, it shows a negative effect.

Table 4.7 Export regression (in metal manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	-0.325***		-0.324***
	(0.056)		(0.047)
Real exchange $rate_t$		-0.557***	-1.035***
		(0.141)	(0.159)
GDP_{t-1}	0.238***	0.247***	0.211***
	(0.079)	(0.071)	(0.069)
Openness $_{t-1}$	0.466***	0.641***	0.376***
	(0.103)	(0.077)	(0.102)
GDP Percapita $_{t-1}$	0.043	0.026	0.006
	(0.063)	(0.066)	(0.060)
Constant	11.23***	7.692***	14.23***
	(1.974)	(1.623)	(1.908)
Observations	573	880	573
R-squared (within)	0.386	0.43	0.462
F-stat Prob>F	21.45 0.000	32.99 0.000	43.67 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

Table 4.8 Import regression (in metal manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	-0.197***		-0.196***
	(0.060)		-0.586*
Real exchange $rate_t$		-0.576**	-0.29
		(0.238)	(0.065)
GDP_{t-1}	0.006	0.107	-0.009
	(0.070)	(0.069)	(0.065)
Openness $_{t-1}$	0.0858	0.323***	0.0344
	(0.099)	(0.118)	(0.115)
GDP Percapita $_{t-1}$	0.041	-0.051	0.021
	(0.063)	(0.072)	(0.061)
Constant	16.79***	12.84***	18.48***
	(1.703)	(1.596)	(2.038)
Observations	567	867	567
R-squared (within)	0.07	0.148	0.13
F-stat Prob>F	4.87 0.0022	8.03 0.0000	9.36 0.0000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

4.1.4. US FDI Outflow and U.S. Export and Import in Machinery Manufacturing Industry

In machinery manufacturing industry, the relationship between export and import is a complementary although the result shows confusion where in table 4.9 column 1 the coefficient is found to be positive and significant, but in column 3 when I include exchange rate in the model, the coefficient of FDI becomes insignificant, however the sign remains positive which means there is indeed a confirmation of complementary relationship even though it is

insignificant. However, in the import model, FDI variable shows high significance of the coefficient that defines complementary relationship is strongly found here (see table 4.10); the magnitude of the coefficient is even higher for the import as an increase in US FDI outflow by 1 percent will increase the import by 0.3 to 0.4 percent. Similarly, with other previous industries, the exchange rate gives impact on trade in direct and indirect effect. As discussed, the indirect effect of exchange rate is through FDI where exchange rate can affect the price of factor endowment in host country, the direct effect on the other hand, channels to export through its price level, which in this result depicted in table 11 column 2—where we exclude FDI variable out of model, the exchange rate contributes a negative and significant changes to export.

Table 4.9 Export regression (in machinery manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.155**		0.0167
	(0.068)		(0.051)
Real exchange $rate_t$		-0.294**	-0.810***
		(0.135)	(0.152)
GDP_{t-1}	0.073	0.160***	0.055
	(0.062)	(0.047)	(0.059)
Openness $_{t-1}$	0.382***	0.361***	0.343***
	(0.084)	(0.064)	(0.083)
GDP Percapita $_{t-1}$	-0.005	0.002	-0.088
	(0.112)	(0.045)	(0.116)
Constant	10.47***	11.44***	14.70***
	(1.437)	(1.193)	(1.438)
Observations	445	864	444
R-squared (within)	0.273	0.31	0.358
F-stat Prob>F	7.35 0.000	18.03 0.000	12.79 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

The interpretation will be that a decline in exchange rate index means an appreciation in destination country's currency or a depreciation in US currency leading to US export price is lower and US export goods becomes more competitive in the market, thus US export in machinery increases; a 1 percent increase in exchange rate index lower US export by 0.3 percent (see column 2 in table 4.9). It goes the same as import model where we found a negative and significant effect of exchange rate on import, however, it does not confirm our proposed hypothesis. The table 4.10 column 2 presents the result for import model.

Table 4.10 Import regression (in machinery manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.377***		0.311***
	(0.107)		(0.104)
Real exchange $rate_t$		-0.438**	-0.385*
		(0.168)	(0.222)
GDP_{t-1}	-0.064	0.113	-0.072
	(0.153)	(0.092)	(0.152)
Openness $_{t-1}$	0.247	0.332***	0.228
	(0.172)	(0.115)	(0.170)
GDP Percapita $_{t-1}$	-0.088	0.009	-0.128
	(0.195)	(0.086)	(0.200)
Constant	10.82***	11.15***	12.84***
	(2.756)	(2.008)	(2.614)
Observations	445	864	444
R-squared (within)	0.143	0.114	0.15
F-stat Prob>F	4.76 0.000	7.3 0.000	3.81 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

4.1.5. US FDI Outflow and U.S. Export and Import in Computer and Electronic Manufacturing Industry

The relationship of US FDI outflow and US export in computer and electronic manufacturing industry is shown to be complementary shown by a positive and significant coefficient in the table 4.11 below column 1 and 3. The complete model of combination lies in column 3 where we also include real exchange rate variable. The coefficient tells an increase by 1 percent in FDI outflow leads to an increase US export by approximately 0.3 percent in this industry. The same complementary relationship also occurs to import, where shown in table 4.12 column 1 and 3 as well, with a positive coefficient amounting to more or less 0.25 percent indicating that a 1 percent increase in FDI outflow increases import by 0.25 percent. Those coefficients both in export and import model gets a 1 percent level of significance. However, the effect of exchange rate on trade is not found in this industry as we can see in the table 4.11 and 4.12 for export and import model, respectively, especially in column 2 where we exclude FDI variable that leaves only RER as main variable there.

Table 4.11 Export regression (in computer and electronic manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.306***		0.310***
	(0.062)		(0.066)
Real exchange $rate_t$		-0.0864	0.108
		(0.105)	(0.126)
GDP_{t-1}	-0.169**	-0.00347	-0.167**
	(0.079)	(0.049)	(0.078)
Openness $_{t-1}$	-0.287	0.00634	-0.277
	(0.192)	(0.095)	(0.189)
GDP Percapita $_{t-1}$	-0.205***	-0.117***	-0.205***
	(0.073)	(0.033)	(0.072)
Constant	17.56***	16.29***	17.21***
	(1.831)	(1.367)	(1.764)
Observations	528	838	528
R-squared (within)	0.079	0.009	0.079
F-stat Prob>F	7.65 0.000	4.18 0.005	10.81 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

Table 4.12 Import regression (in computer and electronic manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.252***		0.257***
	(0.063)		(0.065)
Real exchange $rate_t$		-0.0905	0.129
		(0.141)	(0.200)
GDP_{t-1}	-0.089	0.123	-0.087
	(0.093)	(0.083)	(0.094)
Openness $_{t-1}$	-0.203	0.189	-0.191
	(0.126)	(0.165)	(0.125)
GDP Percapita $_{t-1}$	-0.109	-0.036	-0.108
	(0.122)	(0.066)	(0.122)
Constant	14.26***	10.18***	13.84***
	(1.997)	(2.314)	(2.143)
Observations	532	842	532
R-squared (within)	0.07	0.045	0.071
F-stat Prob>F	4.02 0.004	3.58 0.000	4.48 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

4.1.6. US FDI Outflow and U.S. Export and Import in Electrical Manufacturing Industry

Another substitute relationship occurs between US FDI outflow and export of goods in the electrical manufacturing industry. In table 4.13 we can see such relationship depicted with a negative and significant coefficient of predicted FDI value which amounts to -0.109 in column 1 and -0.116 in column 3, respectively. This tells that US FDI outflow abroad substitutes export activity; with such coefficient value, we can tell that an increase in FDI outflow by 1 percent

lowers the export of goods by approximately 0.11 to 0.12 percent in this industry. The substitute relationship also occurs in import side as seen in table 4.14 where we can see that an increase in FDI outflow will lower US import of goods by around 0.12 to 0.13 percent in this industry. Note that, the significance of the coefficients is stronger in import side than in export side where it obtains 10 percent level of significances in export model and 1 percent level of significance in import model, respectively.

Table 4.13 Export regression (in electrical manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	-0.109*		-0.116*
	(0.063)		(0.063)
Real exchange $rate_t$		-0.283	-0.489**
		(0.190)	(0.225)
GDP_{t-1}	0.115	0.143***	0.099
	(0.091)	(0.051)	(0.086)
Openness $_{t-1}$	0.447***	0.426***	0.396**
	(0.157)	(0.084)	(0.172)
GDP Percapita $_{t-1}$	-0.120	-0.0987*	-0.139
	(0.113)	(0.057)	(0.105)
Constant	11.86***	10.64***	13.51***
	(1.962)	(1.219)	(2.053)
Observations	465	885	465
R-squared (within)	0.05	0.057	0.057
F-stat Prob>F	6.59 0.000	7.48 0.000	2.73 0.043
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1.

Further, the direct and indirect effect of exchange rate only happens to affect import while it is only indirect effect on export. The indirect effect, as discussed earlier, affects trade through FDI which in table 4.13 and 4.14, it is depicted that when we still include FDI in the model combination, we can look that real exchange rate variable is significant in import model, while it affects import indirectly through FDI with 10 percent level of significance, also it is found significant in export model for an indirect effect result with higher level of significance of 5 percent. Further, still in the same table (table 4.13 and 4.14), especially in column 2, where we exclude predicted FDI from the model, the real exchange rate is insignificant in export model, although the sign is in line with our proposed hypothesis which real exchange rate should affect export negatively as in depreciation in other countries' currencies or appreciation in US currency leads to a lower US export. However, as in other industries, although the coefficient is significant, the sign of real exchange rate is not in line with proposed hypothesis where it should positively affect import.

Table 4.14. Import regression (in electrical manufacturing industry)

VARIABLES	(1)	(2)	(3)
FDI_t	-0.121***		-0.131***
	(0.038)		(0.037)
Real exchange $rate_t$		-0.481***	-0.663*
		(0.158)	(0.376)
GDP_{t-1}	-0.019	0.0775	-0.040
	(0.185)	(0.108)	(0.181)
Openness $_{t-1}$	0.212	0.361***	0.143
	(0.207)	(0.103)	(0.202)
GDP Percapita $_{t-1}$	0.096	-0.023	0.070
	(0.130)	(0.092)	(0.127)
Constant	14.25***	11.44***	16.47***
	(3.669)	(2.396)	(3.962)
Observations	465	884	465
R-squared (within)	0.06	0.091	0.083
F-stat	2.82	6.37	3.11
Prob>F	0.038	0.000	0.018
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1

4.1.7. US FDI Outflow and U.S. Export and Import in Transportation Equipment Manufacturing Industry

In contrast with previous results in other industries explained in this thesis, in transport equipment manufacturing industry we find the opposite relationship between FDI outflow-export and FDI outflow-import. In table 4.15 column 1 and 3 below, we can find that FDI outflow correlates positively to export of goods in transport equipment manufacturing with high significance (1 percent level of significance). The coefficient tells if US FDI outflow increases by 1 percent, it leads to increase in export of goods by 0.46 percent which describes complementary. However, in the import model, the increase in FDI outflow by 1 percent decreases export of goods by approximately 0.3 percent in this industry (see table 4.16) which describes a substitute relationship. Further, the effect of exchange rate also differs in export and import for transportation equipment manufacturing industry. In the table 4.15 column 2, the significance of real exchange rate is not significant when we exclude predicted FDI, this tells us that exchange rate does not affect export in direct way through its price level.

Table 4.15 Export regression (in in transportation equipment industry)

VARIABLES	(1)	(2)	(3)
FDI_t	0.470***		0.505***
	(0.091)		(0.090)
Real exchange $rate_t$		0.00666	-0.741*
		(0.176)	(0.369)
GDP_{t-1}	-0.117	-0.0235	-0.140
	(0.084)	(0.061)	(0.094)
Openness $_{t-1}$	0.313*	0.000726	0.277
	(0.167)	(0.112)	(0.175)
GDP Percapita $_{t-1}$	-0.218	-0.121*	-0.311
	(0.177)	(0.071)	(0.200)
Constant	12.39***	16.52***	14.49***
	(1.798)	(1.546)	(2.246)
Observations	453	869	453
R-squared (within)	0.201	0.009	0.213
F-stat Prob>F	7.72 0.000	15.64 0.000	7.97 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1

Further, the exchange rate only affects export indirectly through FDI which is depicted in table 4.15 column 3 above when we include predicted FDI variable however the correlation is weak since we get the significant coefficient only at 10 percent level. On the other hand, exchange rate only affects import directly where can be seen in column 2 in the table 4.16 below that the magnitude of the coefficient of exchange rate is -0.44 and significant at 10 percent level, while the indirect effect channel is not found in import model (see column 3), although (again) the same as other result for exchange rate in affecting import in other sub-sectors that exchange rate is affecting negatively on import where it should be positive—this is not in line with proposed hypothesis.

Table 4.16 Import regression (in in transportation equipment industry)

VARIABLES	(1)	(2)	(3)
FDI_t	-0.244***		-0.226***
	(0.053)		(0.055)
Real exchange $rate_t$		-0.439*	-0.368
		(0.234)	(0.424)
GDP_{t-1}	-0.065	0.172*	-0.076
	(0.094)	(0.089)	(0.090)
Openness $_{t-1}$	0.242	0.206	0.227
	(0.151)	(0.191)	(0.148)
GDP Percapita $_{t-1}$	0.038	-0.020	-0.009
	(0.149)	(0.115)	(0.141)
Constant	17.68***	10.19***	18.72***
	(2.509)	(2.248)	(2.519)
Observations	443	843	443
R-squared (within)	0.129	0.054	0.134
F-stat Prob>F	8.03 0.000	3.76 0.000	6.95 0.000
Country Fixed Effect	**YES**	**YES**	**YES**
Year Fixed Effect	**YES**	**YES**	**YES**

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1

Overall, we find the result where relationship between FDI outflow and trade is mixed, as we can see in the discussion above, all the result from different sub-sectors in manufacturing do not conclude one clear relationship, thus as expected, it varies across sub-sectors. Further, all the effects of exchange rate on export confirms our proposed hypothesis that there is a negative correlation between exchange rate and export. It results in US exporting firm gets the wealth effect as if there is a depreciation in US exchange rate against other country's currency; the price of goods export abroad is cheaper and thus it makes the US export goods become more competitive in the foreign market, thus foreign buyer will prefer to buy US export goods compared to foreign goods. Meanwhile, the effect of exchange rate on import does not confirm the proposed hypothesis; our finding shows that across sub sectors there is a negative correlation of exchange rate and import. It can be explained by the following two factors: (1) abundant use of US dollar as invoice for imports by foreign seller, this makes the import price charged by foreign seller to US buyer does not change significantly when foreign currency appreciates, because the goods is labelled in US dollar anyway, therefore, it may be the reason why US dollar depreciation (fall in exchange rate index) leads to more import, (2) second factor according to the author is that US is a very competitive and big market for foreign trader, and in any case if the foreign currency appreciates (US dollar depreciates), instead passing the effect of exchange rate movements on to US consumer, the foreign sellers prefer to reduce their

margin profit in order to gain more share in US market thus, depreciation of US dollar still leads to more import (Goldberg and Dillon, 2007).

4.2. US FDI Outflow Regression

After obtaining the answer for the link of exchange rate on trade, we now move on to the effect of exchange rate on US FDI outflow in different sub sectors in manufacturing industry. The FDI variable used in this regression is not predicted values as used in trade regression, it is only a natural logarithm form of FDI outflow. The real exchange rate used here is the same as used in trade regression which is a number of other currency per US dollar. The effects of exchange rate on FDI can be seen from the channel of the price of factor endowment which either encourages or discourages investor to invest the business abroad. However, it shows that the effect of exchange rate differs across industries as well, since it may depend on the strategy of the investment. There are two strategies in this matter whether *cost-oriented* or *market-oriented*. Investors with cost-oriented strategy intend to choose host country with lower currency than their currency (US dollar) or, in other words, they will increase the amount of investment abroad when there is a depreciation in host country's currency. This is because a depreciation in other country's currency can lower the production cost of the affiliates' production abroad, thus it encourages US investor to outflow more of FDI money to these countries. On the other hand, for investor with market-oriented strategy, they intend to choose host country with higher currency than home currency; market-oriented investment seek for bigger market to sell their product in other country by setting up subsidiary abroad, having an appreciation of host country's currency gives advantage to these investors to gain more as leading to higher revenues of US FDI, thus it stimulates US FDI outflow (Campa, 1993).

Table 4.17 below shows us the effect of exchange rate on US FDI outflow. Out of seven sub-sectors in manufacturing industry, there are five of them showing that real exchange rate affects US FDI outflow negatively and significant. This can explain according to the discussion above that Food, Chemical, Fabricated Metal, Computers, Electrical Equipment and Transportation Equipment sectors in manufacturing industry are *market-oriented* FDI. There are two sub sectors showing that there is a positive effect of exchange rate on FDI outflow, which is Primary & Fabricated Metals and Machinery manufacturing making these two categorized as *cost-oriented* FDI, however it is only in Machinery manufacturing that is significant. The result confirms our proposed hypothesis which statistically tells that 1 percent of US appreciation leads to 0.16 percent positive impacts of FDI outflow from US to host countries. The

dominance of US dollars over other currency stimulates *cost-oriented* US FDI activity in host country as they look for market with lower cost of production because appreciation of dollar can make price of factor of production cheaper in the host country hence, they benefit from the exchange rate movement in this matter (Chen et al., 2006).

Table 4.17 The Effect of real Exchange Rate on US FDI Outflow

Independent Variables	Various of US FDI Outflow as Dependent Variable						
	Food	Chemicals	Primary and fabricated metals	Machinery	Computers and electronic products	Electrical equipment, appliances, and components	Transportation equipment
Real Exchange Rate	-0.202**	-0.723**	0.35	0.157**	-1.672**	-3.617***	-0.338*
	(0.088)	(0.328)	(1.327)	(0.075)	(0.810)	(1.265)	(0.191)
GDP	-0.176	0.334**	0.148	0.133	0.128	-2.358*	0.209
	(0.133)	(0.146)	(0.288)	(0.100)	(0.392)	(1.184)	(0.212)
GDP Per capita	-0.155	0.462	-0.0712	-0.689	2.237**	-1.069	-0.107
	(0.297)	(0.279)	(1.544)	(0.824)	(0.851)	(0.860)	(0.342)
Openness	-0.257	-0.0449	-3.120***	1.593**	0.211	0.0832	-0.0647
	(0.272)	(0.150)	(1.029)	(0.701)	(0.780)	(0.251)	(0.338)
Political Stability Index	0.315***	0.067	-0.401**	-0.061	0.177	1.166***	0.046
	(0.090)	(0.074)	(0.182)	(0.083)	(0.159)	(0.400)	(0.116)
Constant	19.73***	5.694	22.24*	3.929	5.545	74.49**	11.01***
	(2.901)	(3.933)	(11.610)	(6.115)	(9.342)	(28.740)	(3.715)
Observations	306	440	263	293	313	224	251
R-squared (within)	0.108	0.097	0.157	0.188	0.128	0.302	0.34
F-stat Prob>F	6.85 0.000	4.73 0.000	4.61 0.000	15.08 0.000	5.71 0.000	5.69 0.000	19.16 0.000
Country Fixed Effect	YES	YES	YES	YES	YES	YES	YES
Time Fixed Effect	YES	YES	YES	YES	YES	YES	YES

Note: Robust standard errors are displayed in parentheses, the levels of significance are *** p<0.01, ** p<0.05, * p<0.1. All the variables have been transformed to natural logarithm (including dependent variable) and lagged values (excluding dependent variable and exchange rate). The choices of political stability indicator are the same as the ones used in the table 4.1 and 4.2.

5. Conclusion

5.1. Summary

The fact that U.S becomes a powerful and advantageous market for foreign investor is a challenge for its domestic market competitiveness, because it can be affected with cheaper product from outside of US through importing, or through goods produced by foreign affiliates operated in US. However, the position of U.S remains being top source of FDI into developing countries indicates that U.S is looking for foreign market where it can produce their products with cheaper production cost. The link for FDI and trade cannot be explained aggregately because it can be easily masked by aggregate bias, hence this thesis tries to uncover relationship between FDI outflow and trade using 2-digit ISIC industry code, especially in manufacturing industry.

Table 5.1 Summary of Results

Dependent variables	Independent variable	Expected sign	Realized sign	Remarks
Relationship between FDI and trade				
Export and Import	FDI (food manufacturing)	+ (complementary) and - (substitute)	+ (for export) - (for import)	FDI outflow and export relationship is substitutes. FDI outflow and import relationship is complementary. (*both are insignificant*)
	FDI (chemical manufacturing)		+	FDI outflow and both export and import relationship is complementary.
	FDI (metal manufacturing)		-	FDI outflow and both export and import relationship is substitutes.
	FDI (machinery manufacturing)		+	FDI outflow and both export and import relationship is complementary. (*the import model is insignificant*)
	FDI (computer and electronic manufacturing)		+	FDI outflow and both export and import relationship is complementary
	FDI (electrical manufacturing)		-	FDI outflow and both export and import relationship is substitutes.
	FDI (transportation equipment manufacturing)		+ (for export) - (for import)	FDI outflow and export relationship is complementary. FDI outflow and import relationship is substitutes.
Effect of exchange rate on export				

Dependent variables	Independent variable	Expected sign	Realized sign	Remarks
Export (food manufacturing)	Exchange rate	-	-	Our result confirms the hypothesis where if US dollar appreciates, the US export will decrease. Exchange rate gives both direct and indirect effect in food, chemical and machinery sub-sectors.
Export (chemical manufacturing)		-	-	
Export (metal manufacturing)		-	-	
Export (machinery manufacturing)		-	-	It only gives direct effect in metal sub-sector.
Export (computer and electronic manufacturing)		-	-	our result confirms the hypothesis where if US dollar appreciates, the US export will decrease. *(insignificant result)*
Export (electrical manufacturing)		-	-	Our result confirms the hypothesis where if US dollar appreciates the US export will decrease. Exchange rate only gives indirect effect on export in this sub-sector.
Export (transportation equipment manufacturing)		-	-	our result confirms the hypothesis where if US dollar appreciates, the US export will decrease. It only gives indirect effect on export.
Effect of exchange rate on import				
Import (food manufacturing)	Exchange rate	+	-	Our result does not support hypothesis which if US dollar appreciates, the US import decreases. The correct hypothesis should be positive relationship.
Import (chemical manufacturing)		+	-	
Import (metal manufacturing)		+	-	
Import (machinery manufacturing)		+	-	
Import (computer and electronic manufacturing)		+	+	Our result does support hypothesis where if US dollar appreciates, the import increases. (*insignificant result*)
Import (electrical manufacturing)		+	-	Our result does not support hypothesis which if US dollar appreciates, the US import decreases. The correct hypothesis should be positive relationship.
Import (transportation equipment manufacturing)		+	-	
Effect of exchange rate on FDI				
FDI (food manufacturing)	Exchange rate	+	-	Our result does not support hypotheses which if US appreciates, US FDI outflow increases, however the result
FDI (chemical manufacturing)		+	-	

Dependent variables	Independent variable	Expected sign	Realized sign	Remarks
				shows decreases in FDI outflow.
FDI (metal manufacturing)		+	+	Our result confirms hypothesis that exchange rate should positively correlate with FDI outflow which if US dollar appreciates the FDI outflow increases. (*insignificant result*)
FDI (machinery manufacturing)		+	+	Our result confirms our hypothesis where if US dollar appreciates, US FD outflow to host country increases.
FDI (computer and electronic manufacturing)		+	-	Our result does not support hypotheses where if US appreciates, US FDI outflow does not increase, otherwise it decreases, except for machinery manufacturing that shows positive correlation of exchange rate on FDI.
FDI (electrical manufacturing)		+	-	
FDI (transportation equipment manufacturing)		+	-	

Note: The insignificant result will be noted within the table, and the ones without means significant result.

The result of this thesis found that relationship between FDI outflow and trade vary across sub-sectors within manufacturing industry. Section 4 shows the analysis of how the relationship varies across sub sector industries; out of seven, the finding in five sub sectors (food, chemical, machinery, computer & electronic and transport equipment) tells that FDI complements trade, except in food and transport equipment manufacturing, it is only for export model. This indicates that there is a subsidiary strategy where US affiliates abroad; in order to produce goods, obtain the intermediate materials from US market (for example, they have conducted research and development about their products as if they want to continue maintaining their good quality, they have to use inputs only from home country, which is US), thus an increase in US FDI outflow increases US export of such products in these sub sectors manufacturing industry. For the import side, it can be explained as those products is assembled abroad using intermediate inputs from US market, will be shipped back to US; this indicates an increase in FDI outflow increases US import of these products.

Moreover, the substitution relationship between FDI outflow and trade is found in metal and electrical manufacturing (for both export and import), additionally, in food and transportation equipment, it is only for import model. This indicates that in these two sub sectors, US FDI is

used as the strategy of international trade, called *tariff jumping*; it is a strategy of home (US) multinational firms to avoid the tariff applied in goods exported to destination country (Hwang and Mai, 2002). Also, it confirms to what Mundell's (1957) finding that if there is an increase in trade restrictions (it causes a decline in demand for export) it allows FDI to increase, thus we expect a negative sign, or in other words, an increase in US FDI outflow substitutes US export. Lastly, in transportation equipment manufacturing industry, we found complimentary relationship on export side and substitute relationship on import side.

Furthermore, the linkage of exchange rate on trade also varies across sub-sectors in industry manufacturing. Both direct and indirect effect of exchange rate are not found in all sub-sectors. For instance, in metal and transportation equipment manufacturing, the exchange rate only affect import directly which is only through price level, while in electrical and transport equipment manufacturing, exchange rate only affect export indirectly which is through FDI. Other than these particular cases in two sub sectors, we found that exchange rate affects trade directly and indirectly on both export and import in other sub sectors.

In contrast, exchange rate affects FDI negatively in most sub sectors, which indicates that FDI is market-oriented because a depreciation in US dollar increases US FDI outflow, indicating that US investors can benefit from this because they can get higher revenues from their affiliates activity in host country due to an appreciation in host country's currency.

5.2 Policy Relevant

As founded in many previous literatures, the relationship of US FDI outflow and trade from the result in this thesis is mostly complementary, especially for four sub sectors out of seven sub sectors in manufacturing industry. To make US multinational firms benefit from this, US government should compose a complementary trade policies (Goh et al., 2013). As such, the trade policy should be to maintain indigenous' firm capacity so that US inputs can be functioned by American affiliates abroad. Additionally, US government needs to improve the business environment in domestic in terms of political stability and great infrastructure to support the investment activities either for US multinational firms in domestic or for foreign affiliates operate in the US. Hence, US remains to be top source of FDI outflow abroad and top host country for inflow FDI. Lastly, it is found that exchange rate in most regression affects trade both in direct and indirect way, it is a signal for the US to maintain exchange rate in a good volatility, hence export can increase and US can have net trade in more years ahead. Also, it is beneficial for US dollar if the value is stable since most countries prefer to use US dollar for their trading activity instead of their own currency.

References

Aizenman, J., Noy, I. (2006). 'FDI and Trade: Two Way Linkage?'. *The Quarterly Review of Economics and Finance*, Vol 46, pp 317-337.

Alemu, A.M. and Jin-sang, L. (2014). 'Examining the Effects of Currency Depreciation on Trade Balance in Selected Asian Economies'. *International Journal of Global Business*, Vol 7(1), pp. 59-76.

Bahmani-Oskooee, M. (2012). 'How Responsive are Indonesia's Bilateral Inpayments and Outpayments to Real Depreciation of Rupiah?' *Studies in Economics and Finance, Emerald Group Publishing*, Vol. 29(2), pp 133-143.

Bahmani-Oskooee, M. and Harvey, H. (2014). 'US--Indonesia Trade at Commodity Level and the Role of the Exchange Rate'. *Applied Economics, Taylor & Francis Journals*, Vol. 46(18), pp. 2154-2166.

Baltagi, B.H. (2011). 'Econometric (Fifth Edition)'. Leipzig: Springer Science & Business Media.

Elod, T. (2012). 'Real Effective Exchange Rates-The BIS methodology'. *Bank for International Settlements*. Available at: http://www.bis.org/ifc/events/6ifcconf/takats_pres.pdf. Retrieved at 11 August 2017.

Benassy-Quere, A. and Lanreche-Revil, A. (2003). 'Trade Linkages and Exhange Rates in Asia: The Role of China.' *Working Paper*. Retrieved from CEPII Institute website: (http://www.cepii.fr/PDF_PUB/wp/2003/wp2003-21.pdf).

Bernard, A.B., Jensen, B.J., Redding, S.J. and Schott, P.K. (2007). 'Firms in International Trade.' *Journal of Economic Perspectives*, Vol 21(3), pp. 105-130.

Bilas, V. and Bosnjak, M. (2015). 'Empirical Evidence on Heckscher-Ohlin Trade Theorem: The Case of International Trade Between Croatia and the Rest of the European Union Member States'. *Journal of Economics and Business,* Vol 3(1), pp. 103-124.

Blonigen, B. (1997). 'Firm-Specific Assets and the Link between Exchange Rates and Foreign Direct Investment.' *American Economic Review,* Vol. 87(3), pp. 447-465.

Bouras, H. and Raggad, B. (2015). 'Foreign Direct Investment and Exports: Complementarity or Substitutability An Empirical Investigation.' *International Journal of Economics and Financial Issues*, Vol. 5(4), pp. 933-941.

Bouwen, H.P., Hollander, A. and Viaene, J.M. (2012). 'Applied International Trade (Second Edition).' New York: Palgrave Macmillan.

Brouwer, J., Paap, R. and Viaene, J.-M. (2008). 'Trade and FDI Effects of EMU Enlargement.' *Journal of International Money and Finance*, Vol 27(2), pp. 188- 208.

Bureau of Economic Analysis. (n.d.). 'U.S. Direct Investment Abroad: Balance of Payments and Direct Investment Position Data.' Available at: https://www.bea.gov/international/di1usdbal.htm. Retrieved at 11 July 2017.

Campa, J.M. (1993). 'Entry by Foreign Firms in the United States Under Exchange Rate Uncertainty.' *Review of Economics and Statistics*, Vol. 75, pp. 614-622.

Canadian Foreign Exchange Rate. (n.d.). 'Historical Exchange Rates.' Available at: http://www.canadianforex.ca/forex-tools/historical-rate-tools/historical-exchange-rates. Retrieved at 28 July 2017.

Chen, C. and Wu, Y. (2017). 'Impact of Foreign Direct Investment and Export on Urbanization: Evidence from China.' *China and World Economy,* Vol. 25(1), pp. 71-89.

Chen, K.M., Rau, H. and Lin, C. (2006). 'The Impact of Exchange Rate Movements on Foreign Direct Investment: Market Oriented vs Cost-Oriented'. *The Developing Economics,* Vol. 44(3), pp. 269-287.

Esiyok, B. (2015). 'Does Inward Foreign Direct Investment Increase Imports to Turkey? An Instrumental Variable Approach'. *CEA Journal of Economics,* pp. 23-35.

Franco, C., Rentocchini, F. and Marzetti, G.V., (2010). 'Why do Firms Invest Abroad? An Analysis of the Motives Underlying Foreign Direct Investments.' *Journal of International Business Law*, Vol. 9(1-2), pp. 42–65.

Froot, K.A. and Stein, J.C. (1991). 'Exchange Rates and Foreign Direct Investment: An Imperfect Capital Markets Approach'. *Quarterly Journal of Economic,* Vol. 106(4), pp.1191-1217.

Goh, S.K., Wong, K.N. and Tham, S.Y. (2013). 'Trade Linkages of Inward and Outward FDI: Evidence from Malaysia.' *Economic Modelling,* Vol. 35, pp. 224-230.

Goldberg, L.S. (2006). 'Exchange Rates and Foreign Direct Investment'. *Princeton Encyclopedia of the World Economy*.

Goldberg, L.S. and Dillon, E.W. (2007). "Why a Dollar Depreciation May Not Close the U.S. Trade Deficit." *Federal Reserve Bank of New York Current Issues in Economics and Finance*, Vol. 13(5).

Goldberg, L.S. and Klein, W. (1998). 'Foreign Direct Investment, Trade, and Real Exchange Rate Linkages in Developing Countries. In R. Glick (ed.) *Managing Capital Flows and Exchange Rates: Lessons from the Pacific Basin*. Cambridge: Cambridge University Press, pp 73-100.

Gopinath, M., Pick, D. and Vasavada, U. (1999). 'The Economics of Foreign Direct Investment and Trade with an Application to the US Food Processing Industry'. *American Journal of Agricultural Economics*, Vol 81(2), pp. 442-452.

Head, K. and Ries, J. (2001). 'Overseas Investment and Firm Exports'. *Review of International Economics*, Vol 9, pp. 108–122.

Head, K. and Ries, J. (2004). 'Exporting and FDI as Alternative Strategies.' *Oxford Review of Economic Policy,* Vol. 20(3), pp. 409-423.

Helpman, E., Melitz, M.J. and Yeaple, S.R. (2004). 'Export Versus FDI with Heterogeneous Firms.' *American Economic Review*, Vol 94(1), pp. 300-316.

Hwang, H. and Mai, C. (2002). 'The Tariff-Jumping Argument and Location Theory.' *Review of International Economics*, Vol. 10(2), pp. 361-368.

Instituto Nacional de Estadistica Republic Bolivariana de Venezuela. (n.d). 'Economics, National Accounts.' Available at: http://www.ine.gov.ve/index.php?option=com_content&view=category&id=100&Itemid=59. Retrieved at 28 July 2017.

International Monetary Fund. (n.d). 'International Financial Statistics.' Available at: http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1409151240976. Retrieved at 30 July 2017.

Kharroubi, E. (2011). 'The Trade Balance and the Real Exchange Rate'. *BIS Quarterly Review. Retrieved from (*SSRN: https://ssrn.com/abstract=1953321).

Kim, H. (2010). 'Political Stability and Foreign Direct Investment.' *International Journal of Economics and Finance,* Vol. 2(3), pp. 60-71.

Klein, M. and Rosengren, E. (1992). 'The Real Exchange Rate and Foreign Direct Investment in the United States: relative wealth vs. relative wage effects'. *Working Paper Series No. 4192.* Retrieved from National Bureau of Economic Research website: (http://www.nber.org/papers/w4192.pdf).

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. (1999). 'The Quality of Government.' *Journal of Law, Economics and Organization*, Vol. 15(1), pp. 222-279.

Lipsey, R. E. and Weiss, M. Y. (1981). 'Foreign Production and Exports in Manufacturing Industries'. *Review of Economics and Statistics*, Vol 63(4), pp. 488- 94.

Lucas, R.E.Jr. (1990). 'Why Doesn't Capital Flow from Rich to Poor Countries?' *The American Economic Review,* Vol. 80(2), pp. 92-96.

Makki, S.S. and Somwaru, A. (2004). 'Impact of Foreign Direct Investment and Trade on Economic Growth: Evidence from Developing Countries'. *American Journal of Agricultural Economics*, Vol. 86(3), pp. 795-801.

Markusen, J. (1983). 'Factor Movements and Commodity Trade as Complements'. *Journal of International Economics*, Vol 14(3-4), pp. 341-356.

Markusen, J.R. and Venables, A.J. (1998). 'Multinational Firms and the New Trade Theory.' *Journal of International Economic*, Vol. 46, pp. 183-203.

Mundell, R. (1957). 'International Trade and Factor Mobility'. *American Economic Review*, Vol 47(3), pp. 321-335.

National Statistical Republic of China (Taiwan). (n.d.). 'Statistical Tables.' Available at: https://eng.stat.gov.tw/ct.asp?xItem=37408&CtNode=5347&mp=5. Retrieved at 28 July 2017.

Pantulu, J. and Poon, J.P.H. (2003). 'Foreign Direct Investment and International Trade: Evidence from the US and Japan.' *Journal of Economic Geography*, Vol. 3(3), pp. 241-259.

Pham, T. H. H. and Nguyen, T.D. (2013). 'Foreign Direct Investment, Export and Real Exchange Rate Linkages inVietnam: Evidence from A Co-Integration Approach'. *Journal of Southeast Asian Economies*, Vol. 30(3), pp. 250-262.

United Nations Conference on Trade and Development. (2017). 'World Investment Report 2017.' Available at: http://unctad.org/en/PublicationsLibrary/wir2017_en.pdf. Retrieved at 18 August 2017.

United Nations Statistics Division. (n.d). 'ISIC Rev.3'. Available at: https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2. Retrieved at 3 August 2017.

Vavilov, S, (2005). 'Foreign Direct Investment in Transition Economies: Evidence from Energy Industry'. Available at SSRN: (https://ssrn.com/abstract=676391).

Walsh, J.P. and Yu, J. (2010). 'Determinants of Foreign Direct Investment: A Sectoral and Institutional Approach'. *IMF Working Paper No. 187.* Retrieved from International Monetary Fund website: (https://www.imf.org/external/pubs/ft/wp/2010/wp10187.pdf).

Wiggins, V. (n.d.). 'Two-Stage Least-Squares Regression'. *StataCorp.* Available at: https://www.stata.com/support/faqs/statistics/instrumental-variables-regression/. Retrieved at 10 August 2017

World Bank. (n.d.). 'World Development Indicators.' Available at: http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators. Retrieved at 28 July 2017.

World Bank. (n.d.). 'World Government Indicators'. Available at: http://info.worldbank.org/governance/wgi/#home. Retrieved at 30 July 2017.

World Integrated Trade Solution (WITS). (n.d.). 'Product Concordance'. Available at: http://wits.worldbank.org/product_concordance.html. Retrieved at 3 August 2017.

World Trade Organization. (1996). 'Trade and Foreign Direct Investment'. *1996 Press Release.* Available at: *https://www.wto.org/english/news_e/pres96_e/pr057_e.htm.* Retrieved at 19 August 2017.

Wu, C. and Yu, C. (2017). 'Impact of Foreign Direct Investment and Export on Urbanization: Evidence from China'. *China & World Economy,* Vol. 25(1), pp. 71-89.

Yuen-Ling, N., Wai-Mun, H., and Geoi-Mei, T. (2008). 'Real Exchange Rate and Trade Balance Relationship: An Empirical Study on Malaysia'. *International Journal of Business and Management*, Vol. 3(8), pp. 130-137.

Appendix A

List of Countries as Destination

Argentina	Italy
Australia	Jamaica
Austria	Japan
Bahama	Korea, Republic of
Barbados	Luxembourg
Belgium	Malaysia
Bermuda	Mexico
Brazil	Netherlands
Canada	New Zealand
Chile	Nigeria
China	Norway
Colombia	Panama
Costa Rica	Peru
Czech Republic	Philippines
Denmark	Poland
Dominican Republic	Portugal
Ecuador	Russia
Egypt	Saudi Arabia
Finland	Singapore
France	South Africa
Germany	Spain
Greece	Sweden
Guatemala	Switzerland
Honduras	Taiwan
Hong Kong	Thailand
Hungary	Trinidad and Tobago
India	Turkey
Indonesia	United Arab Emirates
Ireland	United Kingdom
Israel	Venezuela