The Relationship between Manufacture Foreign Direct Investment in Indonesia and Indonesia's Bilateral Intra Industry Trade with Japan, China, and ASEAN-9

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ABSTRACT

In the globalization era, many countries try to engage more in the international trade to be part of global networks. International trade is believed can be triggered by enlarging country's production of scale. Foreign investment is expected to be one of ways to improve it. Thus, developing countries, such as Indonesia, try to attract more FDI inflow. Intra industry trade (IIT) is a form of international trade measuring export and import in the same categorize of industry. High degree of IIT means a country has strong integration with partner's country. This study tries to examine the relationship between manufacturing FDI in Indonesia and bilateral IIT between Indonesia and each Japan, China, and ASEAN-9, especially in the industry level. The result shows that not all FDI in all industries have positive and significant relationship with intra industry trade. For example, FDI in paper-based goods, and printing industry has positive association and statistically significant with IIT between Indonesia and Japan as well as Indonesia and China. Moreover, FDI in metal, except machinery, and equipment has positive and statistically significant with IIT between Indonesia with both China and ASEAN-9. The relationship of FDI and intra industry trade differs across location and industries.

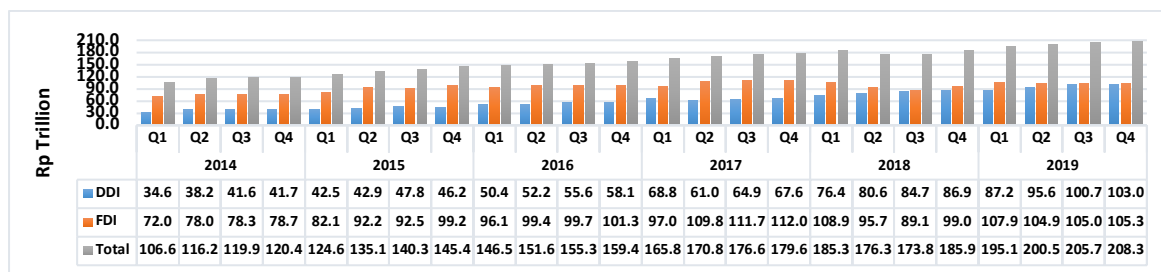**Keywords**: Foreign direct investment, intra industry trade

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Introduction

In the global economy implementation, multinational enterprises (MNEs) try to expand their production in order to compete globally through investing abroad. While developed countries focus on enlarging their business, developing countries attempt to attract foreign direct investment (FDI) and participate in international trade. Host country, such as developing country, can obtain financial capital, knowledge, and technology from FDI (Halaszovich and Kinra, 2018). The trade among countries also happen when there is production fragmentation. The production process of final products of MNEs is separated into two or more stages which each of them may be processed in different location as a result from an international fragmentation of production (Fung *et al.*, 2013). Indonesia as a developing country becomes one of major recipients of FDI. Investment in Indonesia is still dominated by foreign investment, even though in the recent year the share of domestic investment starts to follow the share of foreign investment.

Figure 1. The Investment Trend in Indonesia in 2014-2019 (Quarterly)

		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
			2014				2015				2016				2017				2018				2019		
DDI		34.6	38.2	41.6	41.7	42.5	42.9	47.8	46.2	50.4	52.2	55.6	58.1	68.8	61.0	64.9	67.6	76.4	80.6	84.7	86.9	87.2	95.6	100.7	103.0
FDI		72.0	78.0	78.3	78.7	82.1	92.2	92.5	99.2	96.1	99.4	99.7	101.3	97.0	109.8	111.7	112.0	108.9	95.7	89.1	99.0	107.9	104.9	105.0	105.3
Total		106.6	116.2	119.9	120.4	124.6	135.1	140.3	145.4	146.5	151.6	155.3	159.4	165.8	170.8	176.6	179.6	185.3	176.3	173.8	185.9	195.1	200.5	205.7	208.3

Source: Indonesia Investment Coordinating Board, 2019

One of the international trade forms is intra industry trade. It measures both export as well as import of goods and services in the same categorize of industry. The concept of international trade is usually implemented in the trading partners which has similar characteristic, such as industrialized countries (Xing, 2007). Intra industry trade is important since it can bring a country to be part of global economy. It can create a diversification product so that a country can compete in the global or international market. Furthermore, intra industry trade also shows the linkage of international producers (global supply chain) which make use of capital as a home country and abundant labor in a host country.

The purpose of this paper is to evaluate the relationship between FDI and Indonesia's bilateral intra industry trade in manufacturing sector. This study wants to elaborate more the relationship of FDI and intra industry trade in the industry level. We will include 12 industries in manufacture sector. In order to match the data of export and import as well as FDI, we will categorize industry in the ISIC Rev. 3 for export and import which has similar categorize of industry with ISIC Rev. 4 for FDI. The method used here is panel data method which has been implemented in the similar topic in the research by Xing (2007) and Fung *et al.* (2013).

Some studies (Xing (2007), Kandogan (2003), Yoshida (2013), and Burange, Thakur, and Kelkar (2017)) evaluate the relationship of FDI and intra industry trade. The difference between this study and the former one is that this study attempts to capture what specific industry in Indonesia, particularly in manufacture sector, which will have association with bilateral intra industry trade. Especially, this study wants to show the bilateral intra industry trade between Indonesia and each Japan, China and ASEAN-9. Those three countries are chosen since the FDI in Indonesia are majority from Japan, China, and some countries in ASEAN.

The result shows that FDI in some industries have positive association with intra industry trade. Those industries are mainly from FDI in the labor intensive and resource-intensive manufactures. The FDI of specific industry which has relationship with intra industry trade is different between Indonesia and each Japan, China, and ASEAN-9.

This study is arranged into four sections. The first section is introduction which captures the background information, motivation, and aims of doing this research. The second section will discuss more about the theory and previous studies done by other researches to give more information especially for the method that researches use and the economic theory. The third section will give explanation about the data, method, and empirical results. The results include three parts which will explain each relation between Indonesia and three trading partners. The last section describes about conclusion.

The theoretical literature

Intra industry trade measures to what extent both exports and imports on goods or services of a country in the same industry. Krugman, Obstfeld, and Melitz (2012) stated that the concept of intra industry trade is mainly the two side exchanges in similar goods. A country usually will have a high degree of IIT when the trade partners have nearly similar economic scale. Economic scale can represent a demand of a country so that if both countries have the same demand structure, it believes that the countries will engage more in IIT. In the study by Xing (2007) described that a country with similar trading partners tend to have intra industry trade, for example between industrialized countries. Furthermore, Sawyer, Sprinkle, and Tochkov (2010), Razvan and Camelia (2015), and Fukao, Ishido, and Ito (2003) explain that a country tend to have an intra industry trade when a country has similar endowment factors with its trade partners, while if a country has different of endowment with its partners, a country will involve more in an inter industry trade.

Basically, intra industry trade can be classified into two, based on the quality of products, namely horizontal and vertical intra industry trade. If a product has different quality, then we can say that the intra industry trade is vertical. Meanwhile, a horizontal one is when there is nearly the same quality of product. Sawyer, Sprinkle, and Tochkov (2010) states that vertical intra industry trade has product's differentiation, it can be different in price and quality. Horizontal intra industry trade usually happens between countries with similar income per capita, for example between developed countries (Razvan and Camelia, 2015). Thus, the products they exchange has similar quality. However, they also add that vertical intra industry trade is usually between countries with different income. As we know vertical one has differentiation products, so the products have different quality. For instance, Indonesia exports casual t-shirt to China as well as imports wool jacket from China. Since it is in the same categorize of industry, textile industry, then it is included in intra industry trade.

Intra industry trade is important for country. Intra industry trade will create integration between countries. The more countries participate in the intra industry trade, the more countries potentially have high economic of scale since countries will be part of global value chain. The raising of trade activities in export and import which is represented in the raising of intra industry trade means that countries have improvement on variety of products, economic of scales and technology (Xing, 2007). Moreover, as the countries are integrated more in the global value chain, the trade pattern will also change. Schmitt and Yu (2001) mentioned that there is positive association between economies of scale and intra industry trade. A sector which has high economies of scale tend to have a higher share of intra industry trade.

There are several factors which influence intra industry trade. Some factors which will potentially affect the value of intra industry trade are FDI share, GDP, trade balance, trade barriers, and real exchange rate, geographical distance, and relative size of country. Many studies have been conducted to identify the factors which determine intra industry trade. Sawyer, Sprinkle, and Tochkov evaluates determinants of intra industry trade in Asia. They claimed that spending on research and development and export in manufacture products are mainly determinants of intra industry trade in Asia. The openness of trade and trade agreement also can encourage trade among countries. Another study by Razvan and Camelia (2015) states that previous intra industry trade and economic growth have positive influence on intra industry trade. The different of endowments also has relationship to the low share of intra industry trade.

FDI is believed to be dominant factor that influence intra industry trade. Fung *et.al.* (2013) mentions that the increasing volume of foreign investment is linked with the raising share of intra industry trade. Foreign direct investment is one of the ways of multinational enterprises (MNEs) enhances their market scale abroad. The companies which are located in the more developed country tend to expand their production to the developing countries. Developing countries usually has abundant natural resources and affordable labor. Thus, the production cost will be lower. Sun (2001) states that the international division in labor and factor production mobility, such as technology and management, can happen when foreign investment is involved. FDI inflow can help to improve the availability of capital, technology, and productivity of labor. This condition also could help host country has variety of products in which they could not produce before (Xing, 2007). A research by Fukao, Ishido, and Ito (2003) also find that foreign direct investment has strong association with vertical intra industry trade.

In general, foreign investment is mainly export oriented since companies want to compete in global market. As stated by Fung *et.al.* (2013), the increasing volume of FDI will create the diversity products as well as increase the quantity of products, and eventually it will also increase the volume or value of intra industry trade since the value or volume of export increases as well. Moreover, they also explain that the existence of intra industry trade is usually correlated with the foreign investment which has fragmentation of production. The multinational companies make production fragmentation in different locations. For example, a host country as the destination of multinational companies' investment will increase its import in the parts and components. After that, a host country will produce finished or final products and then exports their products to other countries. A host country may export back the final products to the home or source country.

There are several studies related to foreign direct investment and intra industry trade. Most of them are using panel data analysis. However, the studies were mainly estimating foreign investment in aggregate and not in the industry level. Xing (2007) explains that foreign investment plays essential role on raising of intra industry trade especially between China and Japan, even though in the case of China and US, the result cannot prove this statement. Sun (2001), Rahmaddi and Ichihashi (2013), and Fung *et al.* (2013) also states FDI can promote export performance.

Some studies found that FDI from certain countries do not have association with trade. Probably this result occurred when we use aggregate data. Since not all industries in FDI has linkage with intra industry trade. A bilateral trade between country which is failed to have relation with FDI, maybe if we consider the industry level data, some industries will show correlation with trade. Thus, in this study, we think that it is important to consider the

disaggregation of sector into each industry to capture the relationship between FDI and intra industry trade.

Data and Methodology

The full sample period of this research is from 2000 to 2018. The data of FDI is from Indonesia Investment Coordinating Board (BKPM) database. Data of FDI is based on the newest of ISIC classification which is ISIC Rev. 4. The data of intra industry trade and trade openness is from export and import data. The data of export, import, and trade balance is from World Integrated Trade Solution (WITS). WITS trade statistic is a database created by using aggregate data from UN COMTRADE and UNCTAD TRAINS database. It can provide data about bilateral trade export and import. The export and import data are based on ISIC Rev. 3. Since the classification of FDI data and trade data is different, then we make justification of each industry such that the classification from ISIC Rev. 3 will be matched with ISIC Rev. 4. Data about GDP and real effective exchange rate is also needed in this study. The data source of GDP and real effective exchange rate is from World Bank.

The study starts with describing the manufacturing FDI in Indonesia based on country and industry. The home countries of FDI in Indonesia will be used for trading partner, in this study the home countries and trading partners are Japan, China, and ASEAN-9. Second, we evaluate the Indonesia's intra industry trade and each Indonesia's trading partner. An index of intra industry trade is calculated from Grubel and Lloyd (1975) index as follows:

$$\text{IIT}_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \times 100 \tag{1}$$

where X_i represents exports in the industry i, and M_i represents import in the industry i. The range of index is from 0 to 100 which indicates no integration for 0 value and fully intra industry trade or strong integration for 100. Austria (2004) states that if the index of intra industry trade is 0 means there is no integration while 100 means there is strong of integration.

This paper especially wants to examine the relationship between FDI and the bilateral intra industry trade. Adopting the model by Xing (2007) and Rahmaddi and Ichihashi (2013), the model will be defined as follows:

$$\begin{aligned}
\log\left(\text{IIT}_{ijt}\right) = {} & \alpha_0 + \alpha_i D_i + \beta_1 \log \text{FDI}_{ij(t-1)} + \gamma_i (D_i logFDI_{ij(t-1)}) + \beta_2 \text{GDPG}_{ht} \\
& + \beta_3 \text{GDPG}_{jt} + \beta_4 \log(\text{TB})_{kt} + \beta_5 \log(\text{TO})_{kt} + \beta_6 \log(REER)_t + \beta_7 Dcrisis_t \\
& + \beta_8 Dep_t + \varepsilon_{it}
\end{aligned} \tag{2}$$

where IIT_{ijt} represents the index of Indonesia's intra industry trade with trading partner j in industry i and time t. The intra industry trade will be compared between bilateral intra industry trade of Indonesia and Japan, Indonesia's intra industry trade with China as well as Indonesia's intra industry trade with ASEAN-9. $\text{FDI}_{ij(t-1)}$ represents FDI from each country of origin j (home country) in sector i which are FDI from Japan, China, and ASEAN-9 in previous period. GDPG_{ht} denotes the GDP growth of Indonesia in time t, while GDPG_{jt} denotes the GDP growth of each Japan, China, and ASEAN-9 in time t. TB_{kt} represents the relative trade balance between Indonesia and trading partner in time t. It is calculated by dividing absolute value of trade balance and total trade. TO_{kt} denotes the implementation of trade openness in Indonesia and trading partner in time t. The value of trade openness is measured from export and import divided by nominal GDP. $REER_t$ denotes the real effective exchange rate of Indonesia in time t. We also include dummy variable for industry which denotes as D. The subscript *i* represents the number of dummies of each category of industry.

We use total dummy from number of industries minus one since we use one industry as benchmark or base. For example, we have D_1 which means value 1 is for food industry, while value 0 is otherwise. $ɣ_i$ denotes a differential slope coefficient. If the $β_1$ and $ɣ_1$ are statistically significant then we can calculate the coefficient of FDI for industry 1 (food industry) which is ($β_1 + ɣ_1$). The other dummies are also included in this study, namely dummy crisis and dummy economic partnership. Dummy crisis exemplifies financial crisis in 2007-2008. We code 1 for crisis 2007-2008, and 0 for others. Dummy economic partnership represents trade agreement between Indonesia and each trade partner. For example, IJEPA for Indonesia and Japan which was implemented since 2008. Thus, we code dummy value 1 for IJEPA in 2008-2018, and 0 for other years.

The method of this study is panel data analysis. We conduct Hausman test to know the most fitted model whether it is fixed effect model or random effect model. In this test, we also define a null hypothesis, namely fixed effect model, and the alternative is random effect model. If we could reject a null of hypothesis, we could say that fixed effect model gives better result than random effect.

Empirical results

Bilateral between Indonesia and Japan

Table 1 below shows the estimation result of the relationship of FDI and intra industry trade (IIT) in case of bilateral pattern between Indonesia and Japan. In this estimation we use 12 industries and 19 years period from 2000 until 2018. Since our main objective is to understand the result of each industry level, so we include interaction dummy industry and FDI in the estimation. We use 11 dummies that represent industries. The coefficient result of the relationship between FDI in particular industry and IIT is from the addition between $β_1$ and $ɣ_i$. For example, if we want to know the value of food industry, then we take summation of the $ɣ_1$ coefficient and $β_1$ coefficient. The requirement here is both coefficients should be significant to justify that the summation result is considered as significant as well. For the main variable, FDI, we use lag period t-1 after taking consideration of previous study as well as comparing result using current FDI, lag 1, and lag 2. We think that as FDI needs time to justify its contribution, so we decide to use the lag in the estimation.

We have FDI in four industries which have positive and significant association with intra industry trade between Indonesia and Japan. It means that, for example, in textile industry, we can say that when FDI from Japan in textile industry increases, then the intra industry trade between Indonesia and Japan will also increase. In the case of Indonesia and Japan, we can state that the positive associations between FDI and IIT, are mainly from FDI on the labor intensive and resource-intensive manufactures. Those industries are textile industry, wood industry, and paper, paper-based goods, and printing industry. However, Indonesia also start to have bilateral IIT with Japan on the technology-intensive manufacture, which is shown in the result of vehicle and other transportation industry. In the case of other industry, we have negative coefficient. It means that FDI from other industry is failed to explain its positive association to the IIT between Indonesia and Japan. As mentioned by the Xing (2007) the FDI that give the positive relationship with IIT is the export oriented FDI. If the FDI do not target global market, then the FDI cannot create trade.

Table 1. FDI and Bilateral IIT between Indonesia and Japan

Variable	Coefficient	t-statistic
Constant ($\alpha 1$)	1.1229	0.85
Log FDI lag 1 ($\beta 1$)	**-0.1038***	-1.94
$\gamma 1$	0.0917	1.22
$\gamma 2$	**0.1598***	1.71
$\gamma 3$	0.0859	0.68
$\gamma 4$	**0.1421****	2.08
$\gamma 5$	**0.1489****	2.17
$\gamma 6$	0.0807	1.1
$\gamma 7$	0.1486	1.43
$\gamma 8$	0.0862	1.15
$\gamma 9$	-0.1783	-1.57
$\gamma 10$	0.1040	1.53
$\gamma 11$	**0.2143****	2.35
Food Industry ($\beta 1 + \gamma 1$)	-0.0120	
Textile Industry ($\beta 1 + \gamma 2$)	**0.0561**	
Leather Goods and Footwear Industry ($\beta 1 + \gamma 3$)	-0.0179	
Wood Industry ($\beta 1 + \gamma 4$)	**0.0383**	
Paper, Paper Based Goods and Printing Industry ($\beta 1 + \gamma 5$)	**0.0451**	
Chemical and Pharmaceutical Industry ($\beta 1 + \gamma 6$)	-0.0231	
Rubber, Rubber and Plastic Based Goods Industry ($\beta 1 + \gamma 7$)	0.0448	
Non-Metallic Mineral Industry ($\beta 1 + \gamma 8$)	-0.0176	
Metal, Except Machinery, and Equipment Industry ($\beta 1 + \gamma 9$)	-0.2821	
Metal, Machinery, Electronic Medical instrument, Precision, Optical, and Watch Industry ($\beta 1 + \gamma 10$)	0.0003	
Vehicle and Other Transportation Industry ($\beta 1 + \gamma 11$)	**0.1105**	
Other Industry ($\beta 1$)	**-0.1038**	
Indonesia's GDP growth	-0.0164	-0.51
Japan's GDP growth	0.0017	0.23
Log Trade Balance	0.0168	0.21
Log Trade Openness	0.2065	1.5
Log Real Effective Exchange Rate	0.3483	0.48
Dcrisis	-0.0020	-0.05
Dep	**0.1696*****	3.07
Estimation properties		
R2	0.0647	
Rho	0.9859	
N	185	

Note: the estimation uses fixed effect model.

Dependent variable = intra-industry trade. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Bilateral between Indonesia and China

The second estimation is the relationship of FDI and IIT between Indonesia and China. However, due to many of missing data, we drop several industries and period in order to have better estimation result. We only use 5 industries and 7 years period from 2012 until 2018. Our limitation here is we only have small sample size in this estimation. In the case of Indonesia and China, FDI from food industry, paper, paper-based goods and printing industry, chemical and pharmaceutical industry, and metal, except machinery, and equipment industry have positive association and statistically significant on the IIT. Here we know that FDI both from the labor intensive, resource-intensive manufactures and technology-intensive manufacture associate with the bilateral IIT between Indonesia and China. We can interpret that, for example, when FDI from China in the metal, except machinery, and equipment industry rises then bilateral intra-industry trade between Indonesia and China will grow too.

Table 2. FDI and Bilateral IIT between Indonesia and China

Variable	Coefficient	t-statistic
Constant (α_0)	-72.2952	-1.54
Log FDI lag 1 (β_1)	**0.4187***	6.26
γ_1	**-0.2708****	-2.61
γ_2	-0.0531	-0.33
γ_3	**-0.3798***	-4.25
γ_4	**-0.3195***	-4.21
Food Industry ($\beta_1+\gamma_1$)	**0.1478**	
Wood Industry ($\beta_1+\gamma_2$)	0.3656	
Paper, Paper Based Goods and Printing Industry ($\beta_1+\gamma_3$)	**0.0388**	
Chemical and Pharmaceutical Industry ($\beta_1+\gamma_4$)	**0.0991**	
Metal, Except Machinery, and Equipment Industry (β_1)	**0.4187**	
Indonesia's GDP growth	-1.4156	-1.07
China's GDP growth	1.6732	1.54
Log Trade Balance	5.5497	1.69
Log Trade Openness	13.9295	1.4
Log Real Effective Exchange Rate	45.3595	1.47
Estimation properties		
R2	0.0578	
Rho	0.9966	
N	29	

Note: the estimation uses fixed effect model.

Dependent variable = intra-industry trade. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Indonesia and ASEAN-9

We incorporate ASEAN-9 as one region including Brunei Darussalam, Cambodia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. There are some

missing data in the case of Indonesia and ASEAN-9, we decide to drop some industries and period. We use 6 industries and 16 years period from 2003 to 2018.

Table 3. FDI and IIT between Indonesia and ASEAN-9

Variable	Coefficient	t-statistic
Constant (α_0)	**5.7245*****	3.81
Log FDI lag 1 (β_1)	**-0.1098****	-2.09
γ_1	-0.1008	-1.26
γ_2	**0.2388****	3.74
γ_3	**0.0979***	1.74
γ_4	0.0162	0.26
γ_5	**0.1593****	2.31
Food Industry ($\beta_1+\gamma_1$)	-0.2106	
Textile Industry ($\beta_1+\gamma_2$)	**0.1290**	
Paper, Paper Based Goods and Printing Industry ($\beta_1+\gamma_3$)	**-0.0119**	
Chemical and Pharmaceutical Industry ($\beta_1+\gamma_4$)	-0.0936	
Metal, Except Machinery, and Equipment Industry ($\beta_1+\gamma_5$)	**0.0496**	
Vehicle and Other Transportation Industry (β_1)	**-0.1098**	
Indonesia's GDP growth	0.1530	3.51
Average Asean's GDP growth	-0.0240	-1.75
Log Average Trade Balance	-0.3836	-1.25
Log Average Trade Openness	-0.4951	-1.13
Log Real Effective Exchange Rate	**-2.7284*****	-3.81
Dcrisis	**-0.0883****	-2.04
Estimation properties		
R2	0.0045	
Rho	0.9880	
N	89	

Note: the estimation uses fixed effect model.

Dependent variable = intra-industry trade. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

We can know that there are FDI in two industries having positive and significant association with IIT between Indonesia and ASEAN-9, namely textile Industry and metal, except machinery, and equipment industry. Meanwhile, the FDI in paper, paper-based goods and printing industry and vehicle and other transportation industry are failed to have positive correlation with IIT. We think in the case of vehicle and other transportation industry, even though the trade in this industry is high between Indonesia and ASEAN-9, but the FDI inflow of this industry from ASEAN-9 is not considered high. Usually the industry which is categorized as technology-intensive manufacture, the FDI comes from the more developed country. As ASEAN-9 countries are mainly a developing country, so we believe that the FDI inflow from ASEAN-9 in the vehicle and other transportation industry is not much so that it cannot have positive association with IIT. Paper, paper-based goods and printing industry also has negative relationship and statistically significant to the intra industry trade. If we consider the trade pattern between Indonesia and ASEAN-9, we may know that this industry is not in the top industries which have high value of export and import. The FDI from

ASEAN-9 in this industry is also not included in the top five industries. Thus, we believe that the low value of FDI inflow in paper industry will offset the value of intra industry trade.

After estimating ASEAN-9 as one region, we also try to estimate Singapore separately. We want to know the relationship between FDI and intra industry trade between Indonesia and Singapore outside ASEAN-9 since FDI from Singapore has highest share in Indonesia, especially in 2018. Furthermore, Singapore also has different characteristic compare to other ASEAN countries. In this case, we include all 12 industries and 19-year period.

The FDI are from textile industry, leather goods and footwear industry, non-metallic mineral industry, metal, except machinery, and equipment industry, and vehicle and other transportation industry have have positive and significant relationship with intra industry trade between Indonesia and Singapore. However, paper, paper-based goods and printing industry and other industry have negative association with intra industry trade. FDI in paper, paper-based goods and printing industry from Singapore in Indonesia is considerably high, nonetheless, the trade in this industry between Indonesia and Singapore is not high (not in the top five). Thus, the FDI from this industry has negative relationship with intra industry trade between Indonesia and Singapore. If we compare this result with ASEAN-9 result, it has similar result in textile industry and metal, except machinery, and equipment industry. FDI from both industries have positive association with intra industry in the case of bilateral of Indonesia and ASEAN-9 and Indonesia and Singapore. The FDI from paper, paper-based goods and printing industry also shows similar result which has negative association. Nevertheless, FDI from vehicle and other transportation industry shows different result. In the case of Indonesia and ASEAN-9, FDI from this industry has negative relationship with intra industry trade, while in the case of Indonesia and Singapore, this industry shows positive association with intra industry trade. The trade between Indonesia and Singapore in the vehicle and other transportation industry is high. Meanwhile, the FDI from Singapore in this industry even though it is not the top five FDI from Singapore, the value is also not low. Probably this FDI or MNEs is not originated from Singapore but it is still counted as FDI from Singapore since those MNEs also invest in Indonesia in the name of Singapore companies. Thus, the FDI from this industry has positive association with intra industry trade with Singapore.

Table 4. FDI and Bilateral IIT between Indonesia and Singapore

Variable	Coefficient	t-statistic
Constant (α1)	**3.7687****	2.55
Log FDI lag 1 (β1)	**-0.1552****	-2.2
ɣ1	0.1182	1.24
ɣ2	**0.4372*****	4.22
ɣ3	**0.1971****	2.11
ɣ4	**0.2359****	2.22
ɣ5	**0.1506***	1.86
ɣ6	0.0785	0.88
ɣ7	0.1082	1.03
ɣ8	**0.2150*****	2.73
ɣ9	**0.2522*****	2.84
ɣ10	0.0581	0.31
ɣ11	**0.1804***	1.79
Food Industry (β1+ɣ1)	-0.0370	
Textile Industry (β1+ɣ2)	**0.2820**	
Leather Goods and Footwear Industry (β1+ɣ3)	**0.0420**	
Wood Industry (β1+ɣ4)	**0.0807**	
Paper, Paper Based Goods and Printing Industry (β1+ɣ5)	**-0.0045**	
Chemical and Pharmaceutical Industry (β1+ɣ6)	-0.0766	
Rubber, Rubber and Plastic Based Goods Industry (β1+ɣ7)	-0.0469	
Non-Metallic Mineral Industry (β1+ɣ8)	**0.0599**	
Metal, Except Machinery, and Equipment Industry (β1+ɣ9)	**0.0971**	
Metal, Machinery, Electronic Medical instrument, Precision, Optical, and Watch Industry (β1+ɣ10)	-0.0971	
Vehicle and Other Transportation Industry (β1+ɣ11)	**0.0252**	
Other Industry (β1)	**-0.1552**	
Indonesia's GDP growth	0.0312	0.56
Singapore's GDP growth	0.0081	0.98
Log Trade Balance	**0.1261***	1.96
Log Trade Openness	0.2976	1.59
Log Real Effective Exchange Rate	-1.0327	-1.38
Dcrisis	0.0071	0.1
Dep	0.0760	0.91
Estimation properties		
R2	0.0189	
Rho	0.9491	
N	179	

Conclusion

The objective of this study is to examine the relationship between manufacturing FDI in Indonesia and bilateral intra industry trade between Indonesia and each Japan, China, and ASEAN-9. Especially, we want to know FDI in what industry in each trade partner has association with bilateral intra industry trade. The full period is between 2000 and 2018, and we use fixed effect model to estimate the model.

We find that FDI in several industries has positive and significant association with bilateral intra industry trade. First, in the case bilateral between Indonesia and Japan, FDI from Japan which have positive relationship and statistically significant with bilateral intra industry trade are mainly in the labor intensive and resource-intensive manufactures. Those industry are textile industry, wood industry, and paper, paper-based goods, and printing industry. However, one FDI from Japan in technology-intensive manufacture also has positive and statistically significant association with intra industry trade, namely vehicle and other transportation industry. Second, in the case bilateral between Indonesia and China, the same with Japan result, FDI from China in paper, paper-based goods, and printing industry has positive relationship and statistically significant with intra industry trade between Indonesia and China. The other industries which also have positive and statistically significant correlation with intra industry trade are food industry, chemical and pharmaceutical industry, and metal, except machinery, and equipment industry. We may know that in the case of Indonesia and China, FDI both from the labor intensive, resource-intensive manufactures and technology-intensive manufacture associate with the bilateral IIT between them. Third, in the case of Indonesia and ASEAN-9. Unlike the two other trade partners, here we treat ASEAN-9 as one region. We find that only FDI from ASEAN-9 in two industries has positive and statistically significant association with intra industry trade between Indonesia and ASEAN-9. Those industries are textile industry and metal, except machinery, and equipment. Meanwhile, FDI from ASEAN-9 in other two industries, paper-based goods, and printing industry and vehicle and other transportation industry, have negative relationship with intra industry trade.

Limitation

The limitation of this study is that we have some missing data. Especially in the case of China and ASEAN-9 data. We do not include all industries and decide to drop some industries because of the data availability. Furthermore, the study about FDI and intra industry trade in the industry level is considered rare. Thus, we cannot confirm and compare this result of this study with the previous study. In the next research, the study about FDI and intra industry trade in industry level should be more carefully conducted so that it can capture the reliable result. The other method is also needed to answer the relationship of FDI and intra industry trade in industry level.

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APPENDIX

Justification of Industry Categorization Based on ISIC Rev. 3 and ISIC Rev. 4

Industry	ISIC 2 Digit	
	ISIC Rev. 3	ISIC Rev. 4
Food Industry	15, 16	10, 11, 12
Textile Industry	17, 18	13, 14
Leather Goods and Footwear Industry	19	15
Wood Industry	20	16
Paper, Paper Based Goods and Printing Industry	21, 22	17, 18, 58
Chemical and Pharmaceutical Industry	23, 24	19, 20, 21
Rubber, Rubber and Plastic Based Goods Industry	25	22
Non-Metallic Mineral Industry	26	23
Metal, Except Machinery, and Equipment Industry	27, 28	24, 25
Metal, Machinery, Electronic Medical instrument, Precision, Optical, and Watch Industry	29, 30, 31, 32, 33	26, 27, 28
Vehicle and Other Transportation Industry	34, 35	29, 30
Other Industries	36, 37	31, 32, 37, 38