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Innovation of vertical intra-industry trade: Asean-5 and China electronic and telematic sectors

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Abstract

Globalization can create opportunities and challenges, so that optimizing and minimizing the impact of globalization requires innovation. The way to increase innovation is through development in priority industries that are able to provide spillover effects on technology and international trade. The purpose of this study is to analyze the direct influence of vertical intra-industry trade in the electronics and telematics industries on innovation in ASEAN-5 and China. The results showed that the greater technological gap between developed countries and ASEAN-5 and China, the greater the effect of technological diffusion from intra-industrial trade.

Keywords: Inter-industry trade, Intra-industry trade, Horizontal intra-trade industry, Low vertical intra industry, High vertical intra industry.

Innovación del comercio vertical intraindustrial: Sectores electrónicos y telemáticos ASEAN-5 y China

Resumen

La globalización puede crear oportunidades y desafíos, por lo que optimizar y minimizar el impacto de la globalización requiere innovación. La forma de aumentar la innovación es a través del desarrollo en industrias prioritarias que puedan proporcionar efectos indirectos sobre la tecnología y el comercio internacional. El propósito de este estudio es analizar la influencia directa del comercio vertical

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dentro de la industria en las industrias electrónica y telemática en la innovación en ASEAN-5 y China. Los resultados mostraron que a mayor brecha tecnológica entre los países desarrollados y la ASEAN-5 y China, mayor es el efecto de la difusión tecnológica del comercio intraindustrial.

Palabras clave: Comercio interindustrial, Comercio intrasectorial, Industria intracomercio horizontal, Intraindustria vertical baja, Intraindustria vertical alta.

1. INTRODUCTION

Various methods are carried out by each country with the aim of obtaining optimal benefits from economic dynamics that are increasingly open and unlimited. Openness can be an opportunity because it allows domestic producers to expand their product markets, but this can also be a challenge because it increases competition with foreign companies. Competitiveness is the key to winning global competition. In the theory of international trade, a national economic entity will export and allocate its resources to output with competitiveness relatively higher than other products. This factor is the basis for gain of trade and pattern of trade (KRUGMAN, 2003).

Based on the Global Competitive Index Report for 2016-2017 compiled by the World Intellectual Property Organization (WIPO), Indonesia ranked 41st out of 138 countries with a value of 4.52. This ranking shows a decline compared to the previous year where Indonesia scored 4.52 which is the 7th out of 140 countries. However, if the performance is compared to ASEAN members, Indonesia's competitiveness loses to Malaysia, Singapore and Brunei Darussalam. In the 2010-2016 period, Indonesia's competitiveness was almost the same as Thailand, and outperformed Vietnam, Cambodia and the Philippines. Indonesia's position is increasingly lagging behind as an Asian country compared to China which consistently shows an increase in its competitiveness index over the past five years with a value above 4.8.

Based on evaluations from the 2016 and 2017 Global Innovation Index Reports, the causes of the decline in Indonesia's competitiveness performance are low values on several pillars of competitiveness: (1) pillars of basic health and education, (2) pillars of labor market efficiency, and (3) ranking for technology penetration. If there is no follow-up to overcome this condition, the decline in competitiveness will ultimately greatly impact the performance of Indonesia's international trade. The comparative process is needed as an evaluation effort and to assess the extent to which the domestic economy has developed (JARAMILLO, 2018).

The Indonesian government has designed policies to encourage innovation processes in national industries. One of them is by establishing ten priority industries, including electronics industry, computers, and communication equipment or what can be called the electronics and telematics industry (Ministry of Industry, 2016). The electronics and telematics industry plays an important role in determining Indonesia's position in the future global competitiveness.

This study aimed to analyze the direct influence of vertical intra-industry trade in the electronics and telematics industries on innovation in ASEAN-5 and China.

Global trade is dominated by intra-industrial trade patterns. This phenomenon can be seen in the rapid trade growth in Asian countries (Yoshida, 2013), especially in China, South Korea, Japan, and countries in Southeast Asia. The same pattern of trade also occurs in Italy (AFFORTUNATO ET AL., 2013), Turkey (DORUK, 2015) to European Union member countries (ATURUPANE, DJANKOV AND HOEKMAN, 2007). The popularity of intra-industrial trade practices is driven by the increasingly widespread principles of open economic politics, as well as the development of global factories or global fragmentation production methods practiced by international companies.

From a theoretical point of view, the concept of intra-industrial trade is a refinement of classical trade theory, such as the Ricardian comparative advantage and Heckscher-Ohlin, explaining the increasingly unique and diverse dynamics of global real world exchanges (RIVERA-BATIZ ET AL., 2003). Along with the development of time and new trade patterns, various new models and theories after Heckscher-Ohlin were developed. The Hecksher-Ohlin post theory is as follows: The Imitation Lag, The Product Cycle Theory, The Linder Theory, The Kemp Model, and The Krugman

Model. These five basic theories are then elaborated into the design concept of intra-industry trade (APPLEYARD, 1997).

Imitation Lag theory explains the basis of “technological diffusion flow” that occurs due to international trade (APPLEYARD, 1997). This theory illustrates the existence of two countries, each of which acts as an innovative exporting country (high R & D intensity) and non-innovative importing countries. Marketing of export products requires time to be accepted by the people of the product importing countries. This is called demand lag. The Product Cycle Theory plays an important role in explaining the innovation process at the product, industry and cluster level. The application of this theory is aimed at new products or product innovation innovations to explain the flow of complete diffusion.

Linder’s theory discusses the opposite side of the Heckscher-Ohlin theory, namely taking demand analysis or what can be called the demand-driven trade. The theory says that the majority of trade will occur in countries that have the same income level. The next theory is Kemp model. This theory integrates the concept of economies of scale in the analysis of international trade. Kemp model introduces external economies of scale, which is the production benefits derived from a decrease in average costs along with the increase in total industrial output, even though the level of production per individual small factory. The fifth theory is the Krugman Model. This theory develops ideas from Kemp’s model by incorporating internal economies of scale and monopolistic market competition structures in international trade patterns (RIVERA-BATIZ ET AL., 2003).

The next theory is the intra-industry trade theory. This theory explains the logic behind similar trade in goods between two countries. The definition emphasizes “product” and “commodities”, which means that the concept of intra-industry trade is focused on the type of product unit, although it is possible to use it for aggregate industrial data (FERTO AND HUBBARD, 2002; MOSLARES, 2009). In this study, the theory used was the intra-industry trade theory. Intra-industrial trade is divided into two types, horizontal and vertical. Vertical intra-industry trade is simultaneous trade between countries by exchanging commodities that differ in quality, while horizontal trade is the exchange of similar commodities of the same quality. Both of them occur due to economies of scale and consumer preferences, both in terms of variation and product specific characteristics (quality).

Innovation is key in winning increasingly fierce competition in the era of openness. The idea was developed through the Solow model framework on the existence of factors other than capital and labor that affect the level of output called the Total Factor Productivity (TFP). Thus, this TFP concept is used to measure innovation (SAGGI, 2002; NOLTE ET AL., 2014). Whereas, the components included in the input of innovation are: R & D expenditure, intellectual property amount, purchase or acquisition of other company’s technology, expenditures for start-up production related to innovative products, number of intangible assets, expenses for marketing new products, expenses for courses/training related to new products or processes, and changes to organizational structure and management of the company (ROGERS, 1998).

Number of components influence input innovation, so other measurements as a comparison is carried out. The measurement component is Total Productivity Factor (SAGGI, 2002; NOLTE ET AL., 2014), number of patents (BUTYTER AND WACHOWSKA, 2015; Liu and QIU, 2016; KOGAN ET AL., 2017), R & D expenditure (ABRAHAM AND VAN HOVE, 2015), and the ratio of innovative product sales to total company sales (TAVASSOLI, 2015).

The hypothesis in this study is that the trade in the electronics and telematics industry in ASEAN-5 and China will be dominated by Intra-Industry Trade types among trading partners. The greater the technological gap between the innovator and adopting countries, the stronger the effect of trade on innovation. Industry trade towards changes in adopting TFP countries will be smaller than High Vertical Intra Industry Trade and Low Intra Industry Trade.

2. METHODOLOGY

This study used a quantitative research approach with a moderated regression analysis data panel model. Four countries were selected as innovator benchmarks based on the consistency of the countries' performance in reaching the top 15 position on high-tech export indicators at the Global Innovation Index from 2013 to 2017. The countries were Switzerland, Japan, South Korea and the United States.

The dependent variable was the value of Total Factor Productivity Growth (TFPG) from technology adopting countries (tfpg_fol), which in this study consisted of ASEAN-5 members (Indonesia, Malaysia, Singapore, Thailand and the Philippines) and China. Independent variable was TFP value of the innovator country or innovation benchmark (tfpg_inov) represented by TFP from the four innovation benchmark countries. The next variables were the import value of inter-industry trade (inter), horizontal intra-industry trade (hiit), low vertical intra-industry trade (lviit), and high vertical intra-industry trade (hviit) between adopting countries (ASEAN-5 and China) with the benchmark country of innovators. The other variable was technological gap (tfp_gap) which was represented by differences in TFP between adopting countries and countries which are the benchmark of innovation.

The data used were secondary data, which came from data on exports and imports between ASEAN-5 and China with four innovation benchmark countries (Switzerland, Japan, South Korea, and the United States). Another data source used was the TFP level at current PPP value (USA = 1) originating from the Penn World Table

Ver 9.0 database. Data analysis techniques performed on the model regression test consist of stages: (1) Model making, built models which was Pooled Regression Square (PLS), Fixed Effect Model (FEM), and Random Effect Model (REM); (2) Selection of models that were in accordance with statistical tests; and (3) Statistical tests, namely simultaneous test (F test), partial test (t test), goodness of fit test (R2), multicollinearity test, heteroscedasticity test, and autocorrelation test.

3. RESULTS AND DISCUSSION

The production pattern that occurs in ASEAN-5 countries and China will act as producers of electronic and telecommunications product components.

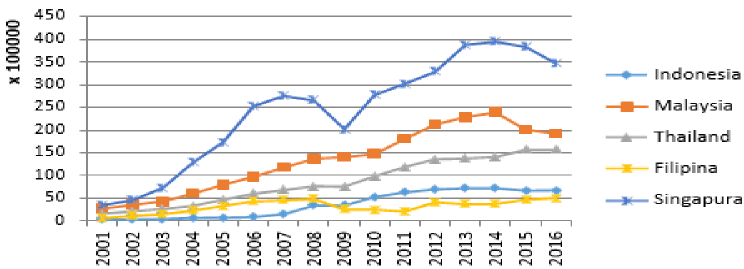

Figure 1: Graph of the Growth of the ASEAN-5 Electronic Component Export-Import Value

Based on figure 1, the growth of trade transactions between ASEAN-5 and China has been progressive since 2001. The largest trade is held by Singapore with an accumulation of transactions of US $ 387,240,323.00 with an average annual trade of US $ 25,586,080. Whereas, in the last sequence are the Philippines with US $ 50,332,978 and the average reached US $ 3,317,149. Even though it occupies a relatively low position compared to other ASEAN-5 countries, Indonesia has the highest average growth rate of 31.3%. Seeing this simple fact, there is a possibility of a greater potential for trade relations between Indonesia-China and the Philippines-China in the future.

There are differences in the amount of international trade between ASEAN-5 member countries and China. In terms of exports and imports to the whole world, China far outperformed the ASEAN-5 joint trade over the past five years.

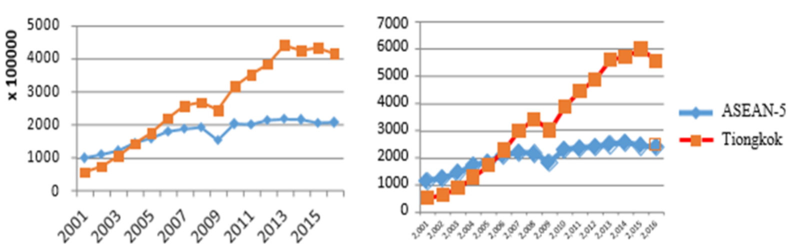

Figure 2: Graph of the total value of the import and export of the ASEAN-5 and China global electronics and telematics industry to the whole world

(a) Import in 2001-2015 (b) Export in 2001-2015

In figure 2, the value of China's imports exceeds the combined ASEAN-5 import value rather than the value of its exports. In other words, in the case of China, the electronics and telecommunications industries experienced a dramatic increase in imports (an average of 15.3%), the new ones then with a one-year lag time experienced a much higher export growth (average 18.4%).

Table 1: Innovation activities in ASEAN-5 and China

Year	Indonesia	Malaysia	Thailand	Philippines	Singapore	China
2013	29.1	43.4	36.5	31.8	59.2	50.6
2014	31.8	45.6	36.5	31.8	59.2	50.6
2015	29.8	46	38.1	31.1	59.4	47.5
2016	32.0	46.9	37.6	31.2	59.4	44.7

Among all ASEAN-5 countries and China, Indonesia kept the position with the lowest innovation index score with an average of 30.7. Whereas, the highest position was held by Singapore with an average index of 59.3; followed by China with an average of 48.4; Malaysia with an average of 45.5; Thailand with an average of 37.2; and then the Philippines with an average of 31.5.

The high and low levels of innovation of a country are determined by many factors, one of which is the amount of the budget allocated for research and development (R & D).

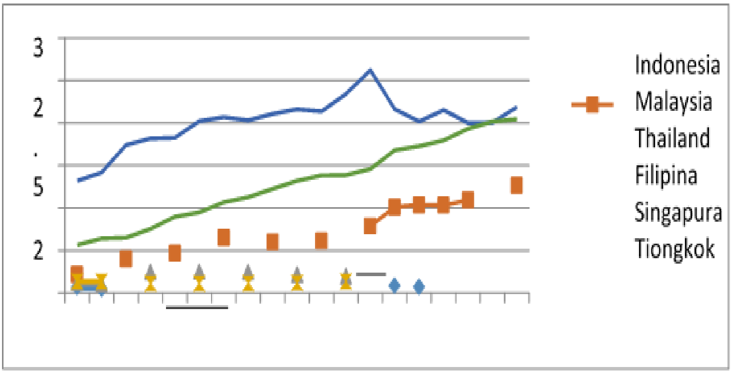

Figure 3: Proportion of ASEAN-5 and China R & D expenditures on GDP from 1996 to 2014

Figure 3 shows information that reinforces the statement about the weakness of innovation in Indonesia. Indonesia ranked the lowest in the aspect of expenditure for R & D with an average proportion of only 7.08% of GDP. This value was far behind Malaysia, which had average R & D expenditure of 76.42% of GDP, Thailand with an average of 24.37% of GDP, the Philippines with an average of 12% of GDP, Singapore with an average of 200% of GDP and China with an average of 129.45% of GDP.

Table 2: ASEAN-5 and China TFP levels in 1995-2013

Year	**Indonesia**	**Malaysia**	**Thailand**	**The Philippine**	**Singapore**	**China**
1995	0.640651	0.606306	0.455387	0.481667	0.582445	0.332541
1996	0.631878	0.571812	0.431455	0.475165	0.636254	0.317091
1997	0.575103	0.563625	0.384427	0.458946	0.670403	0.307186

1998	0.424162	0.484607	0.329356	0.407944	0.763143	0.285601
1999	0.386627	0.487875	0.335534	0.384075	0.740437	0.285701
2000	0.366072	0.526184	0.342607	0.402771	0.937844	0.297234
2001	0.357804	0.505376	0.350963	0.397173	0.796247	0.309039
2002	0.349785	0.521873	0.368596	0.400802	0.857034	0.324447
2003	0.332044	0.529233	0.396209	0.397634	0.755184	0.337338
2004	0.334966	0.561467	0.410861	0.383984	0.848768	0.360745
2005	0.352511	0.609691	0.43887	0.391411	0.949112	0.384683
2006	0.352082	0.605139	0.445413	0.395762	1.036468	0.40355
2007	0.342981	0.632697	0.451016	0.406703	1.03591	0.422219
2008	0.363999	0.669112	0.449518	0.402524	0.802049	0.416458
2009	0.355907	0.613269	0.423519	0.412115	0.782833	0.427576
2010	0.356641	0.597525	0.45065	0.425565	0.856423	0.432774
2011	0.373018	0.628908	0.447673	0.424856	0.80122	0.434468
2012	0.377752	0.631182	0.471461	0.434217	0.760654	0.430625
2013	0.377405	0.636957	0.445116	0.457549	0.72668	0.429943

The first model estimation result was panel model regression using the Swiss innovation benchmark. The results obtained a low specification model, namely R-square = 0.1538 or 15.38%. The variable of tfpg_inov showed significant relationship effect. The import share variable included in the HIIT type (hiit variable) had significant relationship to the tfpg_fol variable, and the tfp_gap variable also indicated the significance of the relationship. The second estimation result was an estimation model between ASEAN-5 and Japan as a benchmark. Model specifications were still calculated to be low with R-square = 0.3773. All basic variables (tfpg_inov to tfp_gap) showed significant relationship results.

The third estimation model was a panel regression test model for ASEAN-5 and China with South Korea. The model estimation results showed better specifications with R-square = 0.6126. However, most of the variables stated statistically not significant for the dependent variable. Only two variables had significant relationship, tfp_inov and hviit_gap. The fourth model was the model of panel estimates between ASEAN-5 and China with US innovation benchmarks. The model estimation results showed better specifications with R-square = 0.7146. The tfpg_inov variable showed significant results, while inter, hiit, lviite, and hviit variables provided insignificant results.

Intra-trade pattern in the ASEAN-5 and China electronic and telematics products industry. Results and analysis of all ASEAN member countries showed two similar intra-industrial trading patterns. The first pattern was the high intensity of intra-industrial trade (including HIIT, LVIIT, and HVIIT types) in intra-ASEAN trade, especially with fellow ASEAN-5. The second pattern, in all types of intra-industry trade (HIIT, LVIIT, and HVIIT), a significant proportion was mostly focused on developed countries that have high innovation performance. Important driving factors of intra-industry trade are technological innovation, spillover, endowment factors, and income (ABRAHAM AND VAN HOVE, 2015).

For the intra-ASEAN case, it is likely that the driving factor of the trade flow is the similarity of income which represents a common taste and economy. Whereas, transactions with other innovative countries are likely to be driven by technological innovation, spillover, and also the similarity of income for some of the upper middle class.

On the other hand, China also showed the concentration of intra-industrial trading activities on similar trading partners, except that China had more striking characteristics, namely the percentage of Chinese trade which was always dominated by the type of low-vertical intra-industry trade. This condition is driven by similarities in income and endowment factors in which Chinese electronic products and telematics will meet the demands of the lower middle class consumers of these countries (ABRAHAM AND VAN HOVE, 2015). Another possibility is that the product flow consists of input goods imported by China as raw material for domestic production. Any possibility will not be seen in this study because the data used did not distinguish between finished goods and intermediate goods.

The main points of the estimation results are: (1) the change in the direction of negative inter trade effects becomes positive and stronger after being moderated by the tfp_gap variable, and (2) strengthening the HVIIT trading effect after being moderated by technological gaps, as seen in the coefficient value. One aspect that was not in accordance with the authors' expectations was the technology gap variable (tfp_gap), which, although significant, did not provide the direction of effect according to the expectations of the authors.

4. CONCLUSION

All ASEAN-5 and China member countries have similar intra-industry trading patterns. The distribution of intra-industry type and vertical intra-industry trade is centered on countries with high innovation performance based on the Global Innovation Index ranking. There is not enough statistical evidence to show the effect of intra-industry verticals in the electronics and telematics industries on the innovation process in ASEAN 5 and China. The greater the technological gap between developed countries and ASEAN 5 and China, the greater the effect of technological diffusion from intra-industrial trade.

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