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IMPACT OF INFORMATION TECHNOLOGY AND E-COMMERCE ON INDONESIA'S TRADE TO ASEAN COUNTRIES

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Abstract

This paper aims to confirm the impact of ICT on Indonesia's trade with ASEAN partner countries and the use of ICT on business activities (e-commerce). The analysis method used in this study is a quantitative analysis of static panel data with a gravity model approach. The study period covers the years 2010 to 2018 and it includes a cross section consisting of nine ASEAN member countries from Indonesia's trading partners. Furthermore, this study uses two groups of variables, namely variables that describe the development and utilization of ICT (IDI and B2B indexes) and variables as indicators of macroeconomic performance (GDP growth, distance, and market size). The results of the analysis show that the IDI and B2B indexes have a significant positive impact in increasing the trade value of Indonesia to trading partner countries in ASEAN. In addition, the economic growth of Indonesia, economic distance, and market size are also proven to have a significant impact on trade between Indonesia and ASEAN countries. Based on the results, the use of ICT can be a key booster for Indonesia's trade performance. Therefore, the development of ICT needs to be a priority agenda for Indonesia's government.

Contents

1. INTRODUCTION

Massive technological development trends are leading to a fourth industrial revolution that emphasizes the use of information and communication technology (ICT) as a basis in various fields including economics. ICT is fully utilized not only in the production process but also throughout the industrial chain, and more than that is giving birth to new business models. At the macro level, technological development encourages economic development and contributes to the economic growth of a country (Arsyad 1999; Cette, Lopez, and Noual 2005; Choi and Yi 2009) by contributing to productivity and efficiency and competition in trade (Choi and Yi 2009).

ASEAN is one of the regions with great potential as a world economic power. This is because ASEAN has a large population that amounts to 8.5% of the world population and was able to contribute 3.5% of world gross domestic product (GDP) in 2018. In terms of trade, goods trade in ASEAN grew 9.4% and service trade grew 10.7% in 2018. ASEAN's main external trading partners are the People's Republic of China (PRC) (17.12%), the European Union (10.20%), and the United States (9.31%). Intra-ASEAN trade is the largest share of ASEAN trade, reaching 23.03%.

In terms of exports, in 2018 the proportion of exports from ASEAN countries to intra-ASEAN countries reached 24% or equivalent to US$346.46 billion, while the proportion of exports to extra-ASEAN countries reached 76%. This shows that ASEAN's exports to intra-ASEAN countries are quite large. Out of the total value, Indonesia's total exports to intra-ASEAN countries alone amounted to US$41.19 billion or 12% of the total intra-ASEAN exports.

Figure 1 shows that ASEAN countries have been connected online and enjoyed the communication service through a smartphone. Bankole, Osei-Bryson, and Brown (2013) and Chu and Guo (2019) explain that progress in using ICT plays an important role in facilitating trade. With a population of more than 649.1 million people and an internet penetration rate of 53.4 per 100 people in 2018, this also makes ASEAN the third-largest country of Internet users in Asia, after the PRC and India (Sen, Attavar, and Jaiswal 2016). Various studies state that internet penetration drives a country's international trade, which then drives economic growth.

Figure 1: The Level of ICT Use in ASEAN Countries (per 100 Persons)
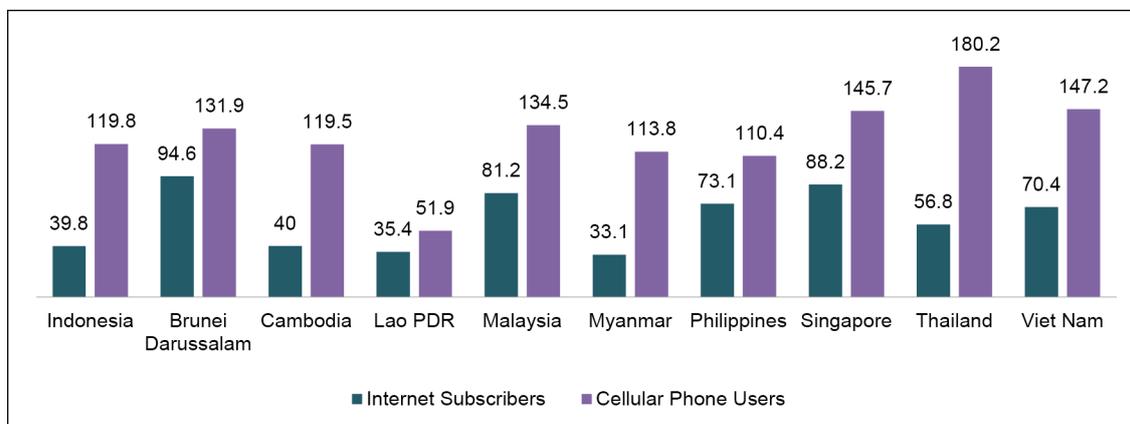
Source: ASEAN Secretariat 2019.

Improved ICT infrastructure along with demographic bonuses that are technology literate are the main drivers of ASEAN economic growth. Studies conducted by Xing (2017), Chu and Guo (2019), and Ozcan (2017) show that the use of ICT in trade offers several benefits, including: (i) integration of markets and industries with transactions, and distribution of goods and services with no time and geographical limits; (ii) efficiency of trade costs; (iii) opening and expanding of market access; and (iv) acceleration of business activities in the intra-ASEAN and global markets. Furthermore, the ICT revolution with digitalization has led to the creation of e-commerce. E-commerce continues to experience rapid growth in the world of trade, because it has a significant influence that can be seen from the quality of transactions through this facility, whether done by business to business (B2B) or business to consumer (B2C) or other forms of utilization. Google, Temasek, and Bain & Company (2019) state that the internet economy in ASEAN will reach US$300 billion in 2025 with a compound annual growth rate (CAGR) of 33%. In The 2016 Global Information Technology Report released by the World Economic Forum, B2C trade in ASEAN was reported to have experienced rapid development with CAGRs from five ASEAN countries (Singapore, Malaysia, Thailand, Indonesia, and Viet Nam) projected to grow by 37% from US$7 billion in 2013 to US$34.5 billion in 2018.

In order to optimize market potential, in the ASEAN ICT Masterplan 2020 (ASEAN 2015) ASEAN member countries agreed that the ASEAN economy is driven through involvement in the digital economy and e-commerce. For this reason, ASEAN countries have carried out several leading ICT development programs, such as enhancing digital connectivity aimed at minimizing obstacles and increasing public access to e-commerce. Furthermore, in 2018, ASEAN countries agreed to form an ASEAN Coordinating Committee on Electronic Commerce, which aims to bridge the needs of cross-border e-commerce trade in promoting economic growth in ASEAN.

In the midst of the intense application of ICT in stimulating trade, the digital economy contributes significantly to Indonesia's economic growth. This is supported by research facts regarding the positive impact of ICT on development and economic growth, e.g., an internet penetration of 10% causes an increase of 1.3% of GDP, and an Internet usage rate of 21.5% equals an increase of 10% of GDP per capita (Andres et al. 2010; Choi and Yi 2009). At the ASEAN level, Indonesia is the largest e-commerce market. The study of Google, Temasek, and Bain & Company (2019) shows that Indonesia's digital economy reaches US$40 billion. This figure means that the digital economy transactions of Indonesia are ranked first for the Southeast Asian region with a CAGR of 32%. The growing demographic and telecommunications infrastructure bonus with increasing internet penetration (reaching 68.4% in 2018) causes the contribution of this sector to the Indonesia economy to continue to increase and it is projected to reach US$133 billion in 2025.

Studies on the impact of ICT and the development of e-commerce have been widely carried out. Several studies have focused on exploring the impact of ICT on trade in the markets of ASEAN partner countries and the use of e-commerce in driving trade activities, but there has been no research illustrating the impact of ICT and e-commerce utilization from optimizing its own market, namely intra-ASEAN. For this reason, further research is needed related to trade interactions between Indonesia and ASEAN countries to gain a comprehensive understanding of the impact of the development of ICT and the use of e-commerce on increasing Indonesia's trade in ASEAN countries.

The remainder of the paper is structured as follows. Section 2 is a brief summary review of the relevant literature. The data and model specification are described in

Section 3. The empirical findings are reported in Section 4. Section 5 concludes the paper by providing relevant policy implications.

2. LITERATURE REVIEW

2.1 Information and Communication Technology and Its Impact on International Trade

In the recent massive digitalization and globalization era, the use of ICT in every aspect of human activity has been very important, especially in international trade. There are several studies that analyze the impact of ICT on regional trade flows and have become references in this study. One recent one from Chu and Guo (2019) explains that ICT has a positive and significant impact on international trade betweenthe PRC and ASEAN countries. This study also concludes that ICT is the key determinant of international trade between the PRC and ASEAN countries. In terms of exports from ASEAN countries to the PRC, the internet has a bigger impact than telephones or cellular phones. On the other hand, the Internet and cellular phones have a positive impact on the imports and bilateral trade of ASEAN countries from the PRC.

Xing's (2017) study on OECD countries explains that the application of ICT has a positive and significant impact because it improves two-way communication between trading partner countries. The study also explains improvements in terms of faster internet access and server security will increase trade. Moreover, ICT-based technology will encourage people and companies to find the best service providers or producers regardless of distance.

In particular commodity cases such as international trade of fruits and vegetables by APEC countries, Chung, Fleming, and Fleming (2013) explain that landline telephones (traditional ICT devices) in the export value chain sector have a positive impact on fruits' and vegetables' trade value between trading partner countries, while the impact on imports is not significant. Therefore, we can infer that the positive impact of ICT on the trade value of fruits and vegetables is only found in exports, and not in imports.

Bianchi and Mathews (2015), in a study conducted in developing countries, show that the use of ICT, in this case internet marketing capabilities, has a positive effect on the availability of export information, which in turn has an impact on the development of business network relationships and the growth of export markets. Furthermore, in a study conducted by Demirkhan et al. (2009), it is stated that the use of ICT can affect trade costs. The study states that with the use of ICT, the flow of trade will decrease with distance. This is based on the notion (Venables 2001) that ICT can positively affect trade through:

  a. *Search cost.* ICT-supported intermediation between buyers and sellers creates an e-marketplace that lowers buyer costs of acquiring information about seller prices and produce offerings. This reduces buyer search cost inefficiency.

  b. *Management and control cost.* Monitoring employees and trading partners ensures transactions can be performed electronically by the principal, thereby reducing cost.

  c. *Shipping cost.* ICT reduces coordination cost, which reduces shipping cost. This reflects ICT-led reductions in supply chain management overall.

  d. *Time cost.* ICT supports communication at lower cost; the marginal cost of communicating at any greater distance is essentially zero.

2.2 ICT Development Index (IDI) and Its Impact on Trade

The ICT Development Index (IDI) is a composite index that combines 11 indicators into one index, which becomes a benchmark measure. This index is used to monitor and compare developments in ICT between countries and over time (ITU 2021). We can identify the three-stage model, which shows the ICT development process and a country's evolution towards becoming an information society as illustrated in Figure 2.

- Stage 1   :   ICT readiness
             reflecting the level of networked infrastructure and access to ICTs
- Stage 2   :   ICT intensity
             reflecting the level of use of ICTs in the society
- Stage 3   :   ICT impact
             reflecting the results/outcomes of more efficient and effective ICT use

Figure 2: Three Stages in the Evolution Towards an Information Society
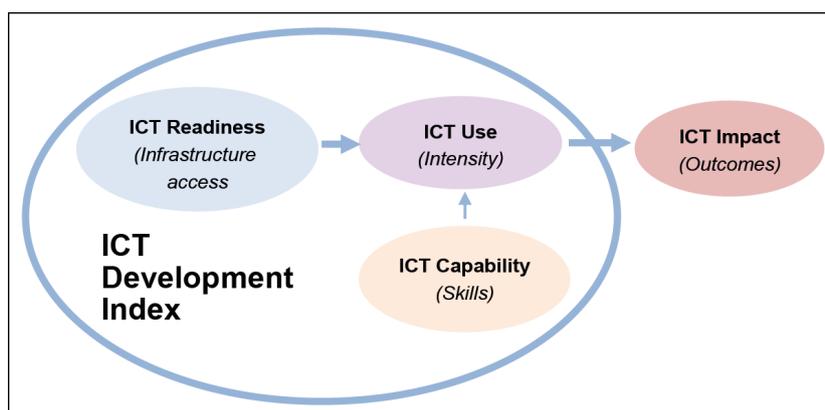
Source: ITU 2021.

Based on the conceptual framework shown in Figure 2, the IDI is divided into three subindices and 11 indicators.

- *Access subindex* (captures ICT readiness), consisting of indicators such as: fixed-telephone subscriptions, mobile/cellular telephone subscriptions, international Internet bandwidth per Internet user, households with a computer, and households with Internet access.

- *Use subindex* (captures ICT intensity), including individuals using the Internet, fixed broadband subscriptions, and mobile-broadband subscriptions.

- *Skills subindex* (captures capabilities or skills), such as mean years of schooling, gross secondary enrollment, and gross tertiary enrollment.

Several studies used the IDI as an indicator to determine the impact of ICT on trade. The study of Ozcan (2017), who saw the impact of ICT on international trade in Turkey, also found that the IDI has a significant and positive impact on the bilateral export and import volume of Turkey. The positive impact of ICT is the result of the decreasing cost related to trade, such as fixed-market entry cost, and communication and information cost. The increasingly connected ICT between the two countries will also increase the bilateral trade between them. Overall, ICT has a positive and significant impact on Turkey's export and import volume, but the impact is bigger on import than export. Furthermore, for export, access and high-level ICT skills are crucial to increasing export volume.

**Table 1: The Indicators, Reference Values, and Weight
in the ICT Development Index**

ICT Access (40%)	Reference Value	%
Fixed-telephone subscriptions per 100 inhabitants	60	20
Mobile/cellular telephone subscriptions per 100 inhabitants	120	20
International internet bandwidth (bit/s) per internet user	976'696*	20
Percentage of households with a computer	100	20
Percentage of households with internet access	100	20
ICT Use (40%)	**Reference Value**	**%**
Percentage of individuals using the internet	100	33
Fixed-broadband subscriptions per 100 inhabitants	60	33
Active mobile-broadband subscriptions per 100 inhabitants	100	33
ICT Skill (20%)	**Reference Value**	**%**
Mean years of schooling	15	33
Secondary gross enrollment ratio	100	33
Tertiary gross enrollment ratio	100	33

Note: *This corresponds to a log value of 5.99, which used in the normalization step.
Source: ITU 2021.

The research by Wardani, Azizurrohman, and Tanthowy (2019) on the case of the bilateral trade between Indonesia and ASEAN countries shows that ICT development has positive and significant impacts on Indonesia's volume of exports toward ASEAN countries. Moreover, other variables, such as the real GDP of Indonesia, the real GDP of partner countries, and population, have a positive and significant effect on Indonesia's export. Meanwhile, distance and real exchange rates have a negative and significant effect on Indonesia's export.

Another study by Wardani, Nahar, and Hairunnas (2020) shows that sub-indexes of the IDI such as mobile/cellular telephone subscriptions have a positive and significant impact on Indonesia's service export to ASEAN countries. The other variables that have a significant impact on Indonesia's export in terms of service are GDP and distance. GDP reporters, GDP partners, and common language have a positive and significant effect on Indonesia's service export. Meanwhile, distance has a negative and significant effect on Indonesia's service export.

2.3 The Impact of E-Commerce on International Trade

The study conducted by Xing (2017) confirms the impact of ICT adoption and e-commerce on bilateral trade flows. This research used a panel data approach (gravity model) with a cross section consisting of 21 least developing/least developed countries and 30 OECD countries. Specifically, this study used B2B and B2C indexes (data taken from the WEF report), which are part of the Network Readiness Index. The index consists of 54 indicators and is regulated by 10 pillars. The B2B index measures the extent of ICT adoption for B2B transactions, while B2C shows the extent to which businesses use the internet to sell their goods and services to consumers. This index is below the business use subindex (7th pillar) and is measured on a scale of 1 to 7 (with 7 being the best result). The results show significant linkages to countries that are increasing their trade through e-commerce, use of the internet, and export of goods to other countries. The study also found that there is a great potential of e-commerce for developing and least developing countries. Moreover, B2B and B2C e-commerce has a great role as a potential booster of trade, so the government must continue to carry out

efficient e-commerce import and export procedures (including handling fast-track intermediary goods in e-commerce transactions).

Furthermore, Yushkova (2014) used the Business internet Index to estimate the influence of the Internet on total goods exports in 2011. The study used data from 40 countries (OECD countries plus Brazil, the PRC, India, Indonesia, the Russian Federation, and South Africa). The results show a significant positive relationship between internet use and export and import activities. Then, Ueasangkomsate (2015), in a study of the Adoption of E-Commerce for Export Market of Small and Medium Enterprises (SMEs) in Thailand, shows that there is a relationship between SME exporters and e-commerce adoption, which is significantly dependent. Terzi (2011), in her study, tells us that international trade volume will increase via e-commerce, but the gains that are caused by e-commerce will likely be concentrated among developed countries in the short run, although developing countries will gain more benefit in the long run. The countries open to imports from high-income economies will benefit from knowledge spillovers.

In line with the above research, this study will further examine the nexus of e-commerce (i.e., B2B and B2C) adoption in Indonesian trade flows with trading partner countries in ASEAN. The following sections discuss data and variable definitions, method, and model specifications.

3. DATA, MODEL, AND ESTIMATION METHODOLOGY

3.1 Data and Variable Definitions

The data set used in this study comprises panel data collected from a variety of sources (see Table 2). The cross-sectional data come from nine ASEAN member countries that are trade partners of Indonesia, namely Brunei Darussalam, Cambodia, the Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam. The variables used include factors that affect Indonesia's exports to ASEAN member countries, which consist of macroeconomic variables and ICT variables. There are data limitations particularly on the ICT and e-commerce variables, therefore this study limits the research period to the years 2010 to 2018.

Table 2: Variable Definition and Source

Variable	Definition	Source
$Export_{ijt}$	Total exports of goods from country i to country j for year t	World Bank (UN Comtrade)
$GGDP_{it}$	GDP growth in country i for year t	World Bank
$GGDP_{jt}$	GDP growth in country j for year t	World Bank
$Distance_{ijt}$	Economic distance between country i and country j for year t	French Research Center in International Economics (CEPII)
$MarketSize_{ijt}$	Relative market size of country i in country j for year t	World Bank (UN Comtrade)
IDI_{it}	Index value of ICT development in country i for year t	International Telecommunication Union (ITU) Report 2010–2013 and Report 2015–2017
IDI_{jt}	Index value of ICT development in country j for year t	ITU, Report 2010–2013 and Report 2015–2017
$B2B_{it}$	Index value of internet usage in business-to-business transactions in country i for year t	INSEAD, The Global Information Technology Report 2012–2015, World Economic Forum (WEF)
$B2B_{jt}$	Index value of internet usage in business-to-business transactions in country j for year t	WEF, Report 2012–2015

3.2 Method and Model Specification

The analysis method used is a quantitative and qualitative analysis of static panel data with a gravity model approach using the fixed-effect model. The gravity model is used to explain bilateral trade flows by dividing the size of the economy between two countries represented by GDP and the distance between the trade centers of the two countries (Bergstrand and Egger 2011). According to Burger, van Oort, and Linders (2009), the gravity model equation is as follows:

$$trade_{ij} = A\frac{(GDP_i)^{b1}(GDP_j)^{b2}}{(distance_{ij})^{b3}}$$

where $trade_{ij}$ shows the trade value between countries i and j, GDP_i shows the national income of country i, GDP_j shows the national income of country j, $distance_i$ shows the economic distance between countries i and j, and A shows a constant. The formula shows that the trade value is positively influenced by the national income of the origin country and the national income of the destination country, and negatively influenced by the economic distance between the origin country and the destination country.

Furthermore, the basic equation for the gravity model is developed by including variables that have a potential impact on trade value. Therefore, to analyze the impact of ICT and e-commerce on Indonesia's trade with ASEAN member countries, several variables are used based on previous theory and studies. Xing (2017) used ICT-related infrastructure variables such as broadband subscriptions and number of internet users, and e-commerce indices such as B2B and B2C indexes to analyze the impact of ICT and e-commerce on bilateral trade flows. Meanwhile, Ozcan (2017) used ICT indices such as the IDI to analyze the relationship between ICT and international trade.

This study divides the variables into two groups, namely macroeconomic variables and ICT variables. The difference between this study and previous studies is the research period from 2010 to 2018 and it specifically discusses Indonesia's trade interactions with ASEAN member countries. To avoid biased models, two models are used in this study, with model (1) aiming to analyze the impact of ICT and model (2) aiming to analyze the effect of e-commerce on ASEAN member countries among Indonesia's trading partners. The model used in this study is formulated as follows:

$$LNExport_{ijt} = \beta_0 + \beta_1\,GGDP_{it} + \beta_2\,GGDP_{jt} + \beta_3\,LNDistance_{ijt} + \beta_4\,MarketSize_{ijt} + \beta_5\,IDI_{it} + \beta_6\,IDI_{jt} + \varepsilon_{it} \tag{1}$$

$$LNExport_{ijt} = \beta_0 + \beta_1\,GGDP_{it} + \beta_2\,GGDP_{jt} + \beta_3\,LNDistance_{ijt} + \beta_4\,MarketSize_{ijt} + \beta_5\,B2B_{it} + \beta_6\,B2B_{jt} + \varepsilon_{it} \tag{2}$$

where:

$LNExport_{ijt}$ is the natural log of total exports of goods from Indonesia to ASEAN partner countries in current US$;

$GGDP_{it}$ is the GDP growth of Indonesia;

$GGDP_{jt}$ is the GDP growth of ASEAN partner countries;

$LNDistance_{ijt}$ is the natural log of economic distance between Indonesia and ASEAN partner countries;

$MarketSize_{ij}$ is the market size of Indonesia in ASEAN partner countries;

IDI_{it} is the level of ICT development in Indonesia;

IDI_{jt} is the level of ICT development in ASEAN partner countries;

$B2B_{it}$ is the level of internet usage in business-to-business transactions in Indonesia;

$B2B_{jt}$ is the level of internet usage in business-to-business transactions in ASEAN partner countries;

ε_{it} is the disturbance term.

Based on the background and literature review, the independent variables used in this study are expected to have an impact on trade value. The first macroeconomic variable, namely the $GGDP_{it}$ variable, shows the market strength of Indonesia as an exporter country as it is expected to have a positive impact on the export value of Indonesia. The $GGDP_{jt}$ variable shows the market strength of ASEAN member countries as importer countries as it is expected to have a positive impact on the export value of Indonesia. The $LNDistance_{ijt}$ variable describes the time and cost of international trade, which is expected to have a negative impact on the export value of Indonesia. The $MarketSize_{ijt}$ variable describes the market size of Indonesia in ASEAN member countries, which is expected to have a positive impact on the export value of Indonesia.

The ICT variable, which is the level of ICT development both in Indonesia (IDI_{it}) and ASEAN partner countries (IDI_{jt}), is expected to have a positive impact on the export value of Indonesia. The e-commerce variable, namely the use of the internet in B2B transactions both in Indonesia ($B2B_{it}$) and ASEAN partner countries ($B2B_{jt}$), is expected to have a positive impact on the export value of Indonesia.

Furthermore, the formulated model needs to go through several stages, namely the selection of estimation models, criteria test, and analysis of estimation results. More complete estimation results are presented in the next section.

4. RESULTS AND DISCUSSION

4.1 Preliminary Data Analysis

The general description of the descriptive statistics of the variables used in this study is divided into two groups: first, variables that describe the development and level of ICT use as shown in Table 3; second, variables that describe the performance of macroeconomic indicators as shown in Table 4.

The ICT Development Index (IDI) is an indicator that we use to describe the level of ICT development between countries. Table 3 shows that the IDI of ASEAN countries is quite good (scale 0–10). The average score for the IDI for Indonesia's trading partner countries in ASEAN is 4.66, with the highest score being 7.90 for Singapore. During the research period, Singapore consistently recorded an IDI score above 7, while Myanmar consistently recorded the lowest IDI score.

Furthermore, Indonesia itself has an average IDI score of 3.86, which is lower than the average of its trading partner countries in ASEAN. In 2015, Indonesia recorded the highest IDI score with a value of 3.94. However, in 2012 the value of Indonesia's IDI was only 3.43, which is the lowest score for Indonesia during this research period. Thus, between the highest and lowest average values of Indonesia's IDI, the values

are not too different. This can be a signal that ICT development in Indonesia is still not very significant.

There are interesting things that emerge from the B2B variable. This indicator describes the level of ICT use in the business or economic activities of a company (e-commerce) on an index scale between 1 and 7. During that period, the level of ICT use in business activities (e-commerce) in ASEAN countries was almost the same. This is indicated by the average value of the level of ICT use for business activities in Indonesia ($B2B_i$), which is not very different from the ASEAN region ($B2B_j$). This indicates that although the IDI of each country in ASEAN has significant differences, in general the public or companies in these ASEAN countries have used ICT to help their economic activities (e-commerce) properly.

Table 3: Descriptive Statistics of ICT Variables (Indexes)

	IDI_i	IDI_j	$B2B_i$	$B2B_j$
Mean	3.860000	4.658095	4.876190	4.990476
Median	3.860000	4.760000	4.900000	5.000000
Maximum	3.940000	7.900000	5.100000	6.000000
Minimum	3.430000	1.950000	4.600000	3.300000
Std. Dev.	0.110091	1.844371	0.216575	0.724503
Skewness	−2.902903	0.291864	−0.291064	−0.850650
Kurtosis	12.33792	2.236821	1.451022	3.315098
Jarque-Bera	105.7911	0.807783	2.395931	2.619496
Probability	0.000000	0.667716	0.301808	0.269888
Sum	81.06000	97.82000	102.4000	104.8000
Sum Sq. Dev.	0.242400	68.03412	0.938095	10.49810
Observations	21	21	21	21

Source: Eviews Output.

The next section is the group of macroeconomic variables that are the control variables in this study. The *Export$_{ij}$* variable is an indicator that describes Indonesia's total exports (merchandise trade) to trading partner countries in ASEAN. During the 2010–2018 period, Indonesia's export performance continued to increase with an average export rate of US$4.27 billion. This is also in line with Indonesia's market share in ASEAN partner countries (*MarketSize$_{ij}$*), which also continues to increase. In 2017, Indonesia's market share even reached 6.73% (Philippines was a trading partner country), which is quite high compared to several other trading partner countries in ASEAN.

The data in Table 4 also show that on average, Indonesia's economic growth rate (*GGDP$_i$*) is slightly higher than the GDP growth of ASEAN partner countries (*GGDP$_j$*). In 2010, Singapore was one of Indonesia's trading partners in ASEAN and achieved the highest economic growth rate of 14.53%. Lastly, the indicator that describes the economic distance between Indonesia and trading partner countries in ASEAN, namely *Distance$_{ij}$*, shows an average value of 213.71 km. Meanwhile, Indonesia's economic distance to the closest trading partners in ASEAN is 72.55 km (to Singapore) and the farthest distance is 396.21 km (to Viet Nam).

Table 4: Descriptive Statistics of Macroeconomic Variables

	$Export_{ij}$ (million US\$)	$GGDP_i$ (%)	$GGDP_j$ (%)	$Distance_{ij}$ (km)	$MarketSize_{ij}$ (%)
Mean	4,269.805	5.460000	5.457778	207.7243	3.403333
Median	2,451.200	5.170000	6.250000	215.7300	3.600000
Maximum	18,443.89	6.220000	14.53000	370.2300	6.730000
Minimum	4.210000	4.880000	–2.510000	72.55000	0.080000
Std. Dev.	4,919.618	0.517076	2.757447	78.90537	1.698373
Skewness	1.167569	0.436944	–0.720354	0.041910	–0.270269
Kurtosis	3.473790	1.453144	5.000191	2.035552	2.339872
Jarque-Bera	19.16103	10.65300	20.50785	3.163000	2.456829
Probability	0.000069	0.004861	0.000035	0.205666	0.292756
Sum	345,854.2	442.2600	442.0800	16,825.67	275.6700
Sum Sq. Dev.	1.94E+09	21.38940	608.2812	498,084.6	230.7576
Observations	81	81	81	81	81

Source: Eviews Output.

4.2 ICT and E-Commerce Impact on Indonesia's Trade with ASEAN

The next section is an analysis of how the influence of ICT and the use of ICT for business activities (e-commerce) impact the performance of Indonesian trade ($LNExport_{ij}$) with trading partners in ASEAN. Table 5 shows the estimation results used with the selected approach. This model approach is based on the results of selecting the best model through the Chow test and Hausman test.

Table 5: Chow Test and Hausman Test

	Chi-Square Probability		
	Chow Test	Hausman Test	Model Approach
Model 1	0.0000	1.0000	*Random-Effect Model (REM)*
Model 2	0.0000	0.0469	*Fixed-Effect Model (FEM)*

Source: Eviews Output.

In addition, in the selected estimation results, the classical assumption test has been carried out in order to obtain a regression model that is free from problems such as multicollinearity (the variable value of the inflation factor variance < 10; see Appendix 1A.), normality (Jarque-Bera probability value > 0.05), and autocorrelation (DW values 1.050736 and 2.706250), and heteroscedasticity (sum square residual unweighted > sum square residual weighted), which have been overcome by weighting the cross section weight and period weight (Prasanti, Wuryandari, and Rusgiyono 2015; Sutikno, Faruk, and Dwipurwani 2017).

Based on the estimation results shown in Table 6, the results show that the ICT variable, the use of ICT for business activities (e-commerce), and the macroeconomic variables have a significant effect on Indonesia's trade performance with trading partner countries in ASEAN. The influence of ICT can be shown by the significance of the IDI_i and $B2B_i$ variables, while the effect of macroeconomic indicators is shown by the significance of the variables $GGDP$, $LNDistance_{ij}$, and $MarketSize_{ij}$.

Table 6: Estimation Results

Independent Variable	Dependent Variable: $LNExport_{ij}$	
	[1]	**[2]**
$GGDP_i$	0.371384**	0.134126*
	(2.156878)	(1.899804)
$GGDP_j$	0.006028	0.077533***
	(0.355371)	(6.177529)
$LNDistance_{ij}$	1.062185**	0.474788***
	(2.666720)	(4.269426)
$MarketSize_{ij}$	0.250827***	0.546811***
	(2.771705)	(13.27166)
IDI_i	0.533355*	
	(1.948705)	
IDI_j	0.063989	
	(0.742054)	
$B2B_i$		0.386182***
		(3.520757)
$B2B_j$		0.048204
Constant	−3.832662	−0.402092
Adj-R2	0.174459	0.999690
F-Stat	3.113262	6448.519
Cross-section/N	61	29

Note: The value in () is the t-stat; ***, **, and * significant at 1%, 5%, 10%.

Source: Eviews Output.

The estimation results confirm that the variable IDI (IDI_i) has a significant positive relationship in increasing Indonesia's trade with trading partner countries in the ASEAN region. This finding is in line with the initial hypothesis that there is a positive relationship between IDI_i and $LNExport_{ij}$. These results are also in line with research conducted by Chu and Guo (2019), Xing (2017), and Ozcan (2017). This positive relationship is also in line when we look at data from the Indonesian Internet Service Providers Association (APJII), which show that the number of internet users in Indonesia continues to increase. The increase in the number of internet users is also followed by the characteristics of the behavior of Indonesian internet users who actively utilize ICT (internet) as a medium for communication and business activities (trade). For example, in 2017, with the number of internet users in Indonesia reaching 143.26 million people (58.08% of the population), based on the type of ICT services used, 32.19% used ICT (internet) for purchasing activities and 8.12% used ICT for selling goods. Furthermore, the use of ICT (internet) in the economic sector is also dominated by price-seeking activities (45.14%), online buying activities (32.19%), and online selling activities (16.83%). This proportion of the behavioral characteristics of internet users in Indonesia was stable during the period in which this research was conducted. In addition, the positive relationship between IDI_i and $LNExport_{ij}$ is indirectly the impact of the ICT infrastructure development carried out by the government, including the development of the Palapa Ring network.

Then, to further confirm what the impact of ICT is, we also use an indicator of the use of ICT for business activities (e-commerce), namely the B2B index. Table 4 shows that the use of ICT for business activities (e-commerce) carried out by Indonesia ($B2B_i$) has a significant positive effect on increasing the value of Indonesian exports ($LNExport_{ij}$) to trading partner countries in ASEAN. The results of this study are in line with research conducted by Xing (2017). Studies conducted by Xing (2017) and Chu and Guo (2019) state that through e-commerce activities, business actors, both individuals and the general public, no longer have time and distance constraints in carrying out trading activities. Trading activities, including transaction activities, can also be carried out online. In addition, business actors and individuals in general also have the opportunity to attract more consumers. This finding can be confirmed from the e-commerce business landscape in Indonesia. The study of Google and Temasek (2018) states that the gross merchandise value (GMV) of the e-commerce industry in Southeast Asia reached US$23.2 billion or the equivalent of Rp336.4 trillion, with the GMV of e-commerce in Indonesia reaching US$12.2 billion. The GMV of Indonesian e-commerce in 2018 was higher than that of Malaysia (US$2 billion), Philippines (US$1.5 billion), Singapore (US$1.8 billion), Thailand (US$3 billion), and Viet Nam (US$2.8 billion). This value is predicted to continue to increase.

In another context, macroeconomic variables ($GGDP_i$, $LNDistance_{ij}$, and $MarketSize_{ij}$) have a significant positive effect on Indonesia's trade with intra-ASEAN partners. Indonesia's economic growth ($GGDP_i$) shows a significant positive relationship with the value of Indonesian trade in the intra-ASEAN market. These results are in line with studies conducted by Arsyad (1999); Cette, Lopez, and Noual (2005); and Choi and Yi (2009). Mankiw (2007) explains that GDP is used as an indicator in determining the direction of development and the level of income of a country. In addition, GDP also describes the size of a country's economy and shows the potential capabilities of that country. From the Indonesian perspective as an exporting country, increased economic growth will lead to increased production, thereby increasing the supply of goods and services, which in turn will encourage increased exports.

Furthermore, the economic distance variable is a proxy for transportation costs. The estimation results show a positive relationship between economic distance ($LNDistance_{ij}$) and Indonesia's trade with partner countries in ASEAN ($LNExport_{ij}$). These results are not in line with studies conducted by Wardani, Azizurrhoman, and Tanthowy (2019) and Demirkhan et al. (2009). This positive relationship can be explained by the fact that the distance variable in the gravity regression is a proxy for several determinants of international trade and also combines some of the effects of improvements in communication and technology. In addition, the data plots for exports and economic distance show a unidirectional relationship. For example, Indonesia's exports to Viet Nam, which was the farthest country for export during the study period, continued to increase. This indicates that the focus of Indonesia's exports is to target the main market for the commodity to be exported and not only the proximity of the export destination countries. As a compensation for geographical distance, producers will increase export volume so that transportation costs become more efficient. Therefore, the farther the distance between Indonesia's main trading partners, the greater the exports carried out by Indonesia.

Then, the market share variable ($MarketSize_{ij}$) shows a significant positive relationship with Indonesia's exports to trading partner countries in ASEAN. A large and increasing market share will have an impact on increasing demand for goods and services. This will then be followed by an increase in export activity so that in the end it will have an impact on Indonesia's economic growth. The results of this study are in line with the study conducted by Xing (2017).

4.3 Government Policies in Accelerating the Wave of Digital Economy in Indonesia

In order to optimize the growth of the digital economy (including e-commerce) in Indonesia, which is projected to have a substantial impact on the Indonesian economy, the government will focus on developing digital infrastructure. One aim is the completion of the National Strategic Project (PSN), namely the Palapa Ring. The Palapa Ring is a telecommunication infrastructure project in the form of fiber-optic development that will reach 34 provinces and 440 cities/regencies throughout Indonesia. This project consists of three development packages, namely the West Package (2,275 km), the Central Package (2,995 km), and the East Package (6,878 km). The development of the Palapa Ring is aimed at maximizing internet connectivity in all regions in Indonesia so that it can encourage electronic-based economic activities that reach all communities.

In addition, in order to build a more efficient trading system and ecosystem, Indonesia also compiled Presidential Regulation Number 74 of 2017 concerning the Electronic-Based National Trade System (SPNBE). This presidential decree served as strategic direction and guidance in accelerating the implementation of the e-commerce road map in the 2017–2019 period. This road map contains an action plan with seven pillars that are components of the e-commerce ecosystem, namely funding, taxation, consumer protection, education and human resources, communication infrastructure, logistics, and cybersecurity.

During the period when this research was carried out, there were at least two main outputs that supported the development of the electronic commerce ecosystem (e-commerce), namely Government Regulation Number 80 of 2019 concerning Trade Through Electronic Systems (PP PMSE) and Government Regulation Number 71 of 2019 concerning System Implementation and Electronic Transactions (PP PSTE). PP PMSE regulates business opportunities for all parties, legal certainty and protection, as well as the prioritization and protection of national interests. Meanwhile, PP PSTE regulates the operation of electronic systems and transactions, which include, among other things, the management, processing, and/or storage of electronic systems and electronic data in and/or outside the territory of Indonesia, as well as the principles of protection of personal data.

The government's efforts to maximize the potential of the digital economy in Indonesia also come from the external side through various collaborations in the e-commerce field. In one of them, in November 2019, Indonesia stated that it had joined the Joint Statement Initiative (JSI) on e-commerce. It is hoped that Indonesia's participation will become a counterweight and bridge between developed and developing countries. In addition, the government has begun to include issues related to e-commerce in the negotiation of free trade agreements in both bilateral and regional negotiations.

Going forward, Indonesia's government will focus on implementing government regulations related to the use of ICT in trade. In addition, the government will encourage the completion of integrated e-commerce data collection, which will be used as a reference for evaluation and policy formulation, as well as a monitoring and guidance tool. Cooperation in the field of e-commerce and the use of digital infrastructure (Palapa Ring) will continue to be enhanced to encourage the development of domestic electronic commerce. Furthermore, in capturing and optimizing digital opportunities in economic activity, the government will formulate a national digital economic strategy (not only covering e-commerce). These various efforts can be a catalyst for national economic growth.

5. CONCLUSION AND POLICY IMPLICATIONS

Based on the results of the research that has been carried out, this study confirms that the ICT indicated by the ICT Development Index (IDI_i) indicator and the use of ICT for business activities (e-commerce) shown by the $B2B_i$ variable have a positive influence on Indonesia's trade (export) activities with Indonesia's trading partner countries in ASEAN. In addition, the macroeconomic indicators described by the GDP growth of Indonesia ($GGDP_i$), the economic distance ($LNDistance_{ij}$), and the market size of Indonesia in ASEAN partner countries ($MarketSize_{ij}$) also have a significant positive effect on increasing Indonesia's exports to trading partner countries in ASEAN.

In order to optimize the use of ICT, the government needs to continue to encourage economic activity through the use of ICT (e-commerce and/or the digital economy). Furthermore, digital infrastructure development also needs to be continuously improved so that the IDI continues to improve. In addition, ICT development must also be followed by innovation in its use, so that in addition to encouraging connectivity, the use of ICT can be more inclusive. Business actors who use ICT in business activities (e-commerce) also need to be given incentives. This is aimed at motivating business actors to increase the use of ICT in trading activities, so that Indonesia's trade activities with partner countries in ASEAN can be more effective and efficient. Then, from the use of ICT, in the end Indonesia's exports to ASEAN can increase.

In the future, with the existence of government regulations related to e-commerce, it is expected that the implementation of these regulations can run well. This can happen through increasing the role and coordination of each stakeholder. Then business actors are expected to be able to optimize economic and digital economic opportunities through the use of existing digital infrastructure facilities. In the end, the increase of the IDI and the use of ICT in business activities will encourage the development of the digital economy and create more inclusive economic activities, so that the use of ICT can be a catalyst for national economic growth.

REFERENCES

Andres L., D. Cuberes, M. Diouf, and T. Serebrinsky. 2010. Diffusion of the Internet: A Cross-Country Analysis. *Telecommunications Policy* 34(5-6): 323–340.

Arsyad L. 1999. *Economic Development 4th Edition*. Yogyakarta: STE YKPN Publishing Department.

Association of Southeast Asian Nations. 2015. The ASEAN ICT Masterplan 2020. https://www.asean.org/storage/images/2015/November/ICT/15b%20--%20AIM%202020_Publication_Final.pdf (accessed 14 August 2019).

ASEAN Secretariat. 2019. *ASEAN Statistical Yearbook 2019*. Jakarta: ASEAN Secretariat.

Bankole F.O., K. Osei-Bryson, and I. Brown. 2015. The Impact of Information and Communications Technology Infrastructure and Complementary Factors on Intra-African Trade. *Information Technology for Development* 21(1): 12–28.

Bergstrand J. H., and P. Egger. 2011. Gravity Equations and Economic Frictions in the World Economy: A Survey. *Palgrave Handbook of International Trade:* 532–570.

Bianchi C., and S. Mathews. 2015. Internet Marketing and Export Market Growth in Chile. *Journal of Business Research* 69(2): 426–434.

Burger M., F. van Oort, G. Linders. 2009. On the Specification of the Gravity Model of Trade: Zeros, Excess Zeros and Zero-Inflated Estimation. *Spatial Economic Analysis* 4(2):167–190.

Cette G., J. Lopez, and P. Noual. 2005. Investment in Information and Communication Technologies: An Empirical Analysis. *Applied Economic Letters* 12(5): 309–312.

Choi C., and Yi M. H. 2009. The Effect of the Internet on Economic Growth : Evidence from Cross-Country Panel Data. *Economics Letters* 105(1), 39–41.

Chu S. H., and S. Y. Guo. 2019. Information and Communication Technology and International Trade: A Case of China-ASEAN Countries. *Advances in Economics, Business and Management Research* 87: 206–211.

Chung K. C., P. Fleming, and E. Fleming. 2013. The Impact of Information and Communication Technology on International Trade in Fruit and Vegetables in APEC. *Asian Pacific Literature* 27(2):117–130.

Demirkhan H., M. Goul, R. J. Kauffman, and D. M. Weber. 2009. Does Distance Matter? The Influence of ICT on Bilateral Trade Flows. Proceeding of the Second Annual SIG GlobDev Workshop, Phoenix, USA.

Google, and Temasek. 2018. e-Conomy SEA 2018: Southeast Asia's Internet Economy Hits and Inflation Point. https://storage.googleapis.com/gweb-economy-sea.appspot.com/assets/pdf/e-Conomy_SEA_2018_report.pdf (accessed 7 September 2019).

Google, Temasek, and Bain & Company. 2019. e-Conomy SEA 2019 (Swipe up and to the right: Southeast Asia's $100 billion Internet economy). https://storage.googleapis.com/gweb-economy-sea.appspot.com/assets/pdf/e-Conomy_SEA_2019_report.pdf (accessed 7 September 2019).

International Telecommunication Union (ITU). 2021. The ICT Development Index (IDI): Conceptual Framework and Methodology. https://www.itu.int/en/ITU-D/ Statistics/Pages/publications/mis/methodology.aspx (accessed 5 December 2019).

Mankiw GN. 2007. Macroeconomic 6th Edition. Jakarta: Erlangga.

Ozcan B. 2017. Information and Communications Technology (ICT) and International Trade: Evidence from Turkey. *Eurasian Economic Review* 8(1): 93–113.

Prasanti T. A., T. Wuryandari, and A. Rusgiyono. 2015. Aplikasi Regresi Data Panel untuk Pemodelan Tingkat Pengangguran Terbuka Kabupaten/Kota di Provinsi Jawa Tengah. *Jurnal Gaussian* 4(3): 687–696.

Sen A., A. Attavar, and R. Jaiswal. 2016. Internet E-Commerce in ASEAN – Taking Off. *Jefferies Franchise Note.*

Sutikno B., A. Faruk, and O. Dwipurwani. 2017. Penerapan Regresi Data Panel Komponen Satu Arah untuk Menentukan Faktor-Faktor yang Mempengaruhi Indeks Pembangunan Manusia. *Jurnal Matematika Integratif* 13(1): 1–10.

Terzi N. 2011. The Impact of E-Commerce on International Trade and Employment. *Procedia Social and Behavioral Sciences* 24: 745–753.

Ueasangkomsate P. 2015. Adoption E-Commerce for Export Market of Small and Medium Enterprises in Thailand. *Precedia Social and Behavioral Sciences* 207: 111–120.

Venables A. J. 2001. Geography and International Inequalities: The Impact of New Technologies. *Journal of Industry Competition and Trade* 1(2): 135–159.

Wardani D. T. K., M. Azizurrohman, and A. H. Tanthowy. 2019. The Effect of Information and Communication Technology (ICT) on Indonesian Bilateral Trade with ASEAN Countries. *Buletin Ilmiah Litbang Perdagangan* 13(2): 187–210.

Wardani D. T. K., F. H. Nahar, and H. Hairunnas. 2020. The Role of Information and Communication Technology on Service Trade: Case Study of Indonesia's Export to ASEAN Countries. *Media Trend* 15(2): 236–248.

Xing Z. 2017. The Impact of Information and Communication Technology (ICT) and E-Commerce on Bilateral Trade Flows. *International Economics and Economic Policy* 15: 565–586.

Yushkova E. 2014. Impact of ICT on Trade in Different Technology Groups: Analysis and Implications. *International Economics and Economic Policy* 11: 165–177.

APPENDIX I

Table A1: Variance Inflation Factor (VIF)

Independent Variable	Dependent Variable: *LNExport*_{ij}	
	[1]	**[2]**
GGDP$_i$	8.896876	7.730544
GGDP$_j$	1.295156	2.039052
LNDistance$_{ij}$	2.358691	2.276406
MarketSize$_{ij}$	1.132277	1.178516
IDI$_i$	8.523769	
IDI$_j$	2.253196	
B2B$_i$		6.869972
B2B$_j$		1.911534