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## Article

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# Strategy for Increasing Exports Through ICT Development and Potential Market Mapping: Case Study of Indonesia Labor Intensive Industries

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## ABSTRACT

**Purpose:** This research aims to specifically identify the role of ICT in the export performance of Indonesia's labor-intensive industries and Mapping potential market for Indonesia's labor-intensive industries export.

**Design/methodology/approach:** The analysis was carried out by developing a gravity model and estimated using the Pseudo Poisson Maximum-Likelihood (PPML) and Generalized Method of Moment (GMM) methods as robustness tests.

**Findings:** The estimation results show that ICT, both from the quantity aspect and the quality aspect, has a positive and significant impact on the volume of Indonesian exports. The results of this estimation have been proven to be consistent through several tests by controlling the problems of endogeneity, simultaneity, and auto-correlation.

**Research limitations/implications:** The model developed in the study tends to interact with variables from both countries, namely Indonesia as an exporter country and a partner country for importing Indonesian products. The application of this kind of interaction causes the results of the interpretation to be unable to specifically explain the effect of variables in each country.

**Originality/value:** This study discussed the impact of ICT through the quality and quantity aspects, this study also used product-level data, so the interpretation results more specifically explained the impact of ICT. Further analysis in this study also contributes significantly to identifying which partner has a potential market as the main destination of Indonesia's exports.

*Keywords: International trade, Labor-intensive industries, Gravity model, ICT, Internet, PPML, GMM*

## I. Introduction

The world's industrial climate is experiencing quite big differences due to the encouragement of globalization. This development creates a new thing,

where all countries in the world are merged into one in a borderless concept. This condition allows an industry to expand its market reach across countries (Steyaert & Gould, 2009). The manifestation of this globalization phenomenon is the existence of a modern communication system (Information Communication Telecommunication/ ICT) as a means that enables the borderless concept to be achieved so that a country's readiness to provide ICT facilities has an important role in their activities in the era of

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globalization (Priede & Pereira, 2013).

Discussions about ICT are becoming increasingly popular and conclude that the presence of ICT makes physical distance as an obstacle irrelevant (Demirkan et al., 2009). ICT presents a new era of the "death of distance", where ICT can accommodate the need for virtual face-to-face interactions that are more effective and efficient (Dettmer, 2014). ICT is one of the innovations that has an important role in international trade as well as being a solution to the problem of geographic distance, which often becomes a barrier to cross-border trade. Optimal ICT adoption can play a role in increasing trade linkages between countries (Freund & Weinhold, 2000).

Furthermore, the benefits of ICT adoption will create a network effect that arises between the two international trade partner countries. Network effect is an interaction between users of goods or services, where the greater the intensity of use, the greater the value of the benefits of the goods or services (Shapiro, 1986). Several previous studies have proven that the impact of the Internet on trade tends to be greater in developed countries (Lee, 2012). The results of this study prove that the value of the benefits of ICT itself is very dependent on the intensity of ICT use, especially the intensity of use by the two countries that carry out international trade.

ICT has several mechanisms for influencing international trade flows, through easy access to information (Jungmittag & Welfens, 2009) and transaction costs such as communication costs, coordination costs, and market entry costs (Jaruwachirathanakul & Fink, 2005). In particular, ICT can create trade creation or trade enhancement through online platforms or e-commerce. The presence of online platforms allows for non-physical interaction between sellers and buyers. According to the buyer's perspective, the presence of e-commerce allows unlimited access to information to get the best products according to each buyer's preferences. From the seller's point of view, e-commerce is an opportunity for them to increase market reach and has great potential to increase their profits (Lin, 2015). Several of these findings prove that businesses with a business-to-

consumer character have a considerable advantage when utilizing ICT in their business activities (Vemuri & Siddiqi, 2009).

Some examples of industries that have a business-to-customer character are the textile and furniture industries. Both industries have product output characteristics that tend to be final products and are ready to be distributed directly to consumers. One strategy that can be used to improve the business performance of these two industries is to adopt ICT, which has been explained previously that the impact of ICT will tend to be greater in industries that have a business-to-consumer character. Indonesia is a country that has great potential in the furniture industry, especially rattan furniture, and the textile industry, especially the footwear industry. Indonesian rattan industry products have a share in the international market of 63% and the Indonesian footwear industry has a share of 49%. This phenomenon shows that Indonesia has a strong position as an exporter of rattan furniture and footwear products.

Based on these assumptions, this study aims to identify the impact of ICT on exports of the Indonesian rattan and textile industry. Research on the impact of ICT on exports is quite varied, especially in the use of indicators that represent ICT. In general, the indicators used fall into several categories, namely quantity aspects, quality aspects, and infrastructure aspects. The quantity aspect is often represented by the number of internet users (Aryani & Andari, 2021; Oktora, 2019; Rodríguez-Crespo & Martínez-Zarzoso, 2019) and mobile phone users (Soeng & Cuyvers, 2022; Xing, 2008). The quality aspect is represented by bandwidth capacity (Abeliansky & Hilbert, 2017), and for the infrastructure aspect, the ICT development index value or ICT index is calculated by the International Telecommunication Union (ITU). Some studies use the ICT index value as a whole (Francois, 2007; Minges, 2005) or aggregate the ICT index value according to 3 pillar components (Ozcan, 2017).

Furthermore, to understand more deeply the trading patterns of rattan furniture and footwear commodities in Indonesia, this study applies the gravity model first developed by (Tinbergen, 1962). The gravity

model is a model that is often used to explain international trade patterns and can also be combined to analyze the impact of ICT (Ahmad et al., 2011; Keita, 2016). In particular, this study adopts the gravity model used by (Ozcan, 2017) because of the suitability of the subject used, namely a single exporter, and has similar study objectives.

The gravity model is considered to be the most suitable model for this study, considering that this gravity model can be elaborated to identify other important factors such as the influence of FTAs which also describe globalization (Handoyo et al., 2021). FTA is an agreement between several groups of countries that aims to facilitate international trade activities (Clayton, 2003). FTAs are considered capable of reducing barriers to trade, such as tariffs (Baier & Bergstrand, 2004) and transaction costs (Cheong et al., 2018). Furthermore, using a gravity model makes it possible to map potential markets for the rattan industry (Maulana & Suharno, 2013) and the Indonesian textile industry (Prasetyani et al., 2020). Extensive analysis of gravity model estimates is the main contribution of this study in filling the gap in export development research at the level of specific data at the industry level through ICT adoption and potential market mapping analysis.

## II. Literature Review

As previously explained, this study aims to identify the impact of the Internet, both in terms of quantity and quality, on exports of Indonesia's leading commodities. The analysis was carried out by paying attention to the intensity of internet use from Indonesia as an exporter and Indonesia's trading partner countries as importers. The aim of reviewing aspects of these two countries is to identify the network effects created by internet use, where according to (Shapiro, 1986) the beneficial value of these network effects is very dependent on the intensity of internet use, both in the exporting country and in the importing country.

Several previous studies were quite varied in the use of indicators to measure internet variables. Most studies tend to look at ICT from the quantity aspect of internet users (Clarke & Wallsten, 2006), but several studies look at it from the quality aspect using bandwidth capacity indicators (Abeliansky & Hilbert, 2017). Several studies have elaborated to examine the impact of the internet on exports using several indicators such as cell phone users, fixed line telephone users (Minges, 2005), and ICT Development Index computing (Francois, 2007).

ICT has a big role in business aspects, especially its role as a means of supporting business networking (Van Wijk et al., 2008). Networking development has an important role in creating a learning space that provides business development stimulus through improving product quality, searching for new markets, and increasing profits (Khavul et al., 2010). In the case of labor-intensive industries such as furniture and textiles, global marketing activities start from networking with foreign customers who have purchased their products while visiting Indonesia (Tambunan, 2009). This phenomenon proves that modern ICT communication systems have an important role as a factor that facilitates the transition process of Indonesian textile and furniture producers to become export-oriented producers.

If we look specifically at the case of Indonesian trade, the internet has proven to have a significant impact. The Internet has proven to have an important role in the trade flows of the ASEAN group of countries (Vu, 2017). Specifically, in Indonesia, the Internet has been proven to have a positive impact on exports (Aryani & Andari, 2021), both exports of goods (Putri & Hayati, 2021) and exports of services (Wardani et al., 2020). The development of research regarding the impact of ICT in Indonesia is still limited to the aggregate data level, for specific industries the analysis carried out is only limited to understanding the international trade patterns of that industry. In the rattan industry, the analysis carried out is only limited to the implementation of the gravity model (Maulana & Suharno, 2013), and in the textile industry research developments are still at the stage of

determining macro indicators (Hermawan, 2011; Prasetyani et al., 2020).

Based on these findings, one of the contributions of this study is to identify the impact of ICT on Indonesian exports at the industry data level. Analysis at the commodity level to produce specific and unbiased estimated coefficients (Chit et al., 2010). The furniture industry and textile industry were chosen because they are superior labor-intensive industries with a fairly large share in the international market, however, there are several other basic reasons why this industry was chosen. First, the strategy of optimizing the performance of intensive industrial work will make a major contribution to economic growth, especially on developing countries (Mottaleb & Sonobe, 2011) and Social welfare, considering that Indonesia is one of the developing countries that has low skilled labor abundance (Ambos et al., 2021; Otsuka & Ali, 2020; Rahman et al., 2019). Second, labor-intensive industries are suitable and relevant in explaining the era of digitalization in international trade, Many labor-intensive industries have succeeded in absorbing and adopting knowledge or advanced skills from developed country partners (Schmitz & Knorringa, 2000).

Furthermore, this study tries to accommodate other important factors in international trade, namely FTAs. The Free Trade Agreement is an agreement between several countries that is expected to increase international trade flows (Hermawan et al., 2019). The existence of trade agreements between countries is another form of globalization that carries the borderless concept between countries. FTAs can play a role in international trade flows through several transmissions such as reducing barriers to trade, reducing tariffs, and facilitating trade (Kohl et al., 2016). FTAs have been empirically proven to be able to increase trade flow between groups of countries that agree to the same FTA as in the case of the ASEAN group of countries (Handoyo et al., 2021) and the SAARC group of countries (Banik & Roy, 2021).

Several studies analyzed the impact of the internet by elaborating an analysis of the development of

a gravity model (Ahmad et al., 2011; Demirkan et al., 2009; Ozcan, 2017). The gravity model was first developed by (Tinbergen, 1962), where the model assumes that bilateral relations between countries are influenced by the economic scale and geographical distance between the two countries. The assumptions in this gravity model are still relevant and proven empirically (Hlaing et al., 2021). The economic scale of a country still acts as a driving factor in international trade (Ahmad et al., 2011) and geographic distance, which is also an indicator of transaction costs, remains an obstacle and suppresses international trade flows (Choi, et al., 2017).

The gravity model has also been combined several times to analyze the impact of ICT (Ahmad et al., 2011) and FTA (Ozcan, 2017) in international trade cases. Several studies have also further explored the estimation results of gravity models to gain new insights into international trade patterns. The results of the gravity model estimation can be used to map potential partners (Maulana & Suharno, 2013).

The results of the analysis in this study have at least two major contributions. First, this study has a role as an extension of proving the relevance of the gravity model in explaining trade patterns and tries to depict the network effect created between Indonesia and its trading partners, as a result of the adoption of internet technology. Second, the results of this study analysis will be further elaborated technically to map market potential for Indonesia which can be used as the main reference for market penetration.

### III. Methodology

The data used in this study is panel data for each product. In the rattan furniture industry, the product sample used is a rattan chair with the HS code 940153. The analysis was then carried out in the period 2015-2022 with a total of 42 trading partners in the country. The next industry sample is the textile

industry which is represented by footwear products with HS code 640323. Then the analysis was carried out on 29 partner countries in the period 2010-2022. The data in this study refers to several sources, such as the International Trade Center, World Bank, and GeoCEPII. Furthermore, details regarding the list of sample trading partners for each industry can be seen in the Appendix.

The baseline model in this study refers to , where adjustments are made to the gravity model for single exporter analysis. The treatment given for the analysis of single exporter cases is by interacting several variables between Indonesia and its trading partner countries (see Eq. 1).

$$X_{ijt} = \beta_0 + \beta_1(ICT_{it} * ICT_{jt}) + \beta_2(GDP_{it} * GDP_{jt}) + \beta_3(POP_{it} * POP_{jt}) + \beta_4 EcoDIST_j + \beta_5 REER_{jt} + \beta_6 FTA_{jt} + \epsilon_{ijt} \quad Eq. 1$$

$X_{ijt}$  is the dependent variable in the model which represents the export volume for commodity  $i$  in importing country  $j$  and in year  $t$ . By what was previously explained, 3 variables are interacted with, namely ICT, GDP, and POP. This interaction process aims to overcome the problem of data repetition that occurs due to the analytical data construct used being a single exporter. Repetition of this data can cause auto-correlation problems in the estimation process, so it is hoped that by carrying out this interaction the resulting estimation results will be unbiased. The special thing that needs to be paid attention to is that the ICT variable interaction also aims to identify the network effect created by the use of the internet in both countries on Indonesian exports. More information about definition another explanatory variabel can be seen in Table 1.

The study's estimation strategy utilizes the pseudo-Poisson maximum-likelihood (PPML) method, first developed by (Silva & Tenreiro, 2006). PPML is ideal for international trade data due to its heightened sensitivity to zero values, prevalent in such data. Consistency tests were conducted by adding various explanatory variables to the baseline gravity model. Initial tests included only the baseline

model, followed by incorporating the Free Trade Agreement (FTA) variable and ICT proxies such as internet users, bandwidth capacity, and a combined measure of internet users and bandwidth capacity. Several previous researchers also used this technique in their research (Ambya & Hamzah, 2022; Bahrini & Qaffas, 2019; Banik & Roy, 2021).

To obtain good estimation results, in this study several tests were carried out to test the consistency of the estimation results. Referring to previous empirical studies (Handoyo et al., 2021), to obtain consistent estimation results in the gravity model to transform the gravity model into a dynamic model (see Eq. 2). This change aims to overcome several problems in the model such as autocorrelation, endogeneity and simultaneity which cause estimation results to be biased. The following is the form of a dynamic model intended for robustness testing.

$$X_{ijt} = \beta_0 + \beta_1 X_{ijt-1} + \beta_2 (ICT_{it} * ICT_{jt}) + \beta_3 (ICT_{it-1} * ICT_{jt-1}) + \beta_4 (GDP_{it} * GDP_{jt}) + \beta_5 (POP_{it} * POP_{jt}) + \beta_6 EcoDIST_j + \beta_7 REER_{jt} + \beta_8 FTA_{jt} + \epsilon_{ijt} \quad Eq. 2$$

Dynamic model transformation is carried out by adding a lag to the dependent variable and a lag to the ICT variable, which refers to (Blundell & Bond, 1998). This dynamic model will be estimated using the GMM method. This method was chosen because it has ideal prerequisites to be used as a robust test (Rodríguez-Crespo & Martínez-Zarzoso, 2019). The GMM estimated coefficient is said to be valid if it has tested the validity of the instrument which can be carried out by carrying out the Sargan test and is free from auto-correlation at least at the second-order level (Baltagi, 2008). several studies use the GMM technique as their robustness test (Hermawan et al., 2019; Purwono et al., 2022; Rodriguez-Crespo et al., 2021; Sugiharti et al., 2020).

The final stage in this study is identifying potential partners for the Indonesian furniture and textile industry. This calculation was carried out by the

**Table 1.** Definition operational variable

Variable	Definition	Source
$X_{ijt}$	Export volume for industry $i$ at country partner $j$ in year $t$ .	TradeMap
$ICT_{it} * ICT_{jt}$	Interaction of Indonesia's ICT indicator with ICT of country partner $j$ in year $t$ . the ICT variable will be represented by 2 indicators, namely the percentage of users, namely the percentage of internet users (quantity aspect) and bandwidth capacity (quality aspect).	Internasional Telecommunication Union (ITC)
$GDP_{it} * GDP_{jt}$	Interaction of Indonesia's GDP with GDP of country partner $j$ in year $t$ .	World Bank
$POP_{it} * POP_{jt}$	Interaction of Indonesia's population with population of country partner $j$ in year $t$ .	World Bank
$EcoDIST_j$	Economics distance $EcoDIST_{ijt} = \frac{DIST_{ij}}{\frac{GDP_{jt}}{\sum GDP_{jt}}}$	Geo-CEPII
$REER_{jt}$	Rupiah exchange rate on country partner $j$ currency in year $t$ . (rasio of IDR-USD/ country $j$ currency-USD)	Internasional Monetary Fund (IMF)
$FTA_{jt}$	Free Trade Aggrement between Indonesia and country partner $j$ in year $t$ . (1 if Indonesia has a FTA with country partner $j$ in year $t$ )	Geo-CEPII

calculations carried out by (Maulana & Suharno, 2013). The potential partner assessment is obtained from the ratio between the estimated export value ( $\hat{y}$ ) and the actual export value ( $y$ ), see Eq. 3.

$$Potential\ Partner = \frac{\hat{y}}{y} \quad Eq. 3$$

A country can be said to be potential if the calculated ratio value shows a value  $> 1$  and if the value is  $< 1$ , then the partner is said to be not potential (Narayan & Nguyen, 2016). The thing that needs to be considered is that there are two possibilities why a country does not become a potential partner, namely because the partner has exceeded the potential point, so it no longer has potential in the next period or fundamentally, the products of the Indonesian furniture industry and textile industry in that country's market do not have potential (Batra, 2006).

## IV. Result

The results of the analysis will be presented in several sections for each industry. Each section will

explain the interpretation of the estimation results. The next analysis is the results of potential partner calculations, which aim to determine the main market penetration targets for the Indonesian furniture and textile industry.

### A. Furniture Industry

In general, the internet has a positive influence on exports of the rattan furniture industry, both from the quantity aspect (3) and the quality aspect (4), even the combination of the two also has a positive impact (5). The thing to note is that the quantity aspect tends to have a bigger impact (see Table 2).

The estimation results elucidate the international trade pattern of the rattan furniture industry, aligning with gravity model assumptions. The economic scale, represented by GDP and POP variables, consistently yields positive and significant coefficients in multiple tests, affirming their role as driving factors for Indonesian rattan industry exports. Economic distance calculations for geographic distance align with gravity model assumptions, indicating a decrease in transaction volume with greater distance from trading partners. These findings hold true across various tests.

The exchange rate exhibits results in line with

theoretical concepts, consistently presenting negative coefficients. A stronger rupiah leads to increased domestic product prices for foreign buyers, resulting in decreased demand. The FTA coefficient aligns with expectations, indicating a positive impact on the rattan furniture industry when an FTA trade agreement is in place.

## B. Textile Industry

Having relative estimation results shows a similar direction to the estimation results in the rattan furniture

industry. In the case of the textile industry, the estimation results show that ICT has proven to have a positive impact on exports of the textile industry in Indonesia. Table 3 shows that ICT, both from the quantity aspect (8) and the quality aspect (9) shows positive and significant coefficients.

The baseline gravity model tests confirm the established hypothesis: economic scale significantly drives textile industry exports from Indonesia. However, geographical distance remains a hindering factor. Notably, the negative coefficient of economic distance is notably larger than GDP and population coefficients, suggesting that economies of scale don't

**Table 2.** Estimated result for furniture industry

Variabel	1	2	3	4	5
	Base Gravity	+FTA	+INET	+BAND	+MIX
<i>INET</i>			0,086***		
<i>Bandwidth</i>				0,005*	
<i>INET * Bandwidth</i>					0,001**
<i>GDP</i>	0,004**	0,004**	0,003**	0,004**	0,003**
<i>POP</i>	0,005**	0,005**	0,007**	0,004**	0,005**
<i>ECODIST</i>	-0,181***	-0,181**	-0,152**	-0,174**	-0,147**
<i>REER</i>	-0,044*	-0,044**	-0,4**	-0,044**	-0,043**
<i>FTA</i>		0,04**	0,169**	0,054**	0,072**
Obs	168	168	168	168	168
R-squared	0,6375	0,6777	0,7473	0,7387	0,7272

\*sig 10%, \*\*sig 5%, and \*\*\*sig 1%.

**Table 3.** Estimated result for textile industry

Variabel	6	7	8	9	10
	Base Gravity	+FTA	+INET	+BAND	+MIX
<i>INET</i>			0,016***		
<i>Bandwidth</i>				0,003**	
<i>INET * Bandwidth</i>					0,007**
<i>GDP</i>	0,004***	0,004**	0,005**	0,004**	0,005**
<i>POP</i>	0,003**	0,003**	0,003**	0,001*	0,003*
<i>ECODIST</i>	-0,233***	-0,228***	-0,264***	-0,237**	-0,253**
<i>REER</i>	-0,038*	-0,035***	-0,498*	-0,053*	-0,052*
<i>FTA</i>		0,059**	0,108**	0,125**	0,006**
Obs	112	112	112	112	112
R-squared	0,7718	0,7708	0,7422	0,8391	0,7781

\*sig 10%, \*\*sig 5%, and \*\*\*sig 1%.

fully offset the high transaction costs associated with long distances.

Additional model variables support the hypothesis. Exchange rates play a crucial role in international trade, consistently showing significant results. The FTA variable also exhibits a consistently positive and significant coefficient, particularly amplifying when ICT variables are included in the estimation process.

### C. Robustness Test

As a control for the estimation results, this study applies a dynamic model estimated using the GMM method. This method is used to overcome the problems of simultaneity, endogeneity, and bidirectional relations between dependent and independent variables. There are several modifications in the model to be able to transform the baseline research model into a dynamic model, namely by adding the dependent variable lag to one of the predictor variables in the model (see Eq. 3).

The robustness test estimation results (see Table 4) show that all model instruments are valid which can be seen in the Sargan test probability values and are free from autocorrelation problems at order

1 level. The coefficient results in dynamic model testing also show that the estimation results are quite consistent by testing on the previous model baseline.

Estimation results reveal positive coefficients for lagged export volume, indicating a past positive impact on current exports. Notably, the ICT variable, measured by internet users and bandwidth capacity, exhibits a significant positive influence on exports across commodities. The larger coefficient for the ICT lag variable suggests an even more optimal impact on future export values. Overall, determinants of the rattan and textile industry exports in Indonesia consistently align with gravity model assumptions, highlighting positive effects of economic scale and negative effects of geographic distance (Aisyah, 2021). Exchange rates consistently show a negative coefficient, underscoring their importance despite occasional non-significance (Prasetyo et al., 2017).

### D. Potensial Trade

The study concludes by evaluating potential importing countries for Indonesian rattan furniture and footwear. The aim is to formulate an export strategy, optimizing exports to countries with a coefficient value of >1 based on assessments aligned

**Table 4.** Robustness test using GMM

Variabel	Furniture		Textile	
	1	2	3	4
<i>Expor</i> (T-1)	0,1103**	0,0279*	1,8262*	1,6381*
<i>INET</i>	1,0357*		0,31**	
<i>INET</i> (T-1)	2,2097**		0,6369**	
<i>Bandwidth</i>		0,2054**		0,2684**
<i>Bandwidth</i> (T-1)		0,1759*		0,3229**
<i>GDP</i>	6,4698**	2,3543**	1,4377*	7,8825*
<i>POP</i>	9,9147*	9,3849**	4,7027	5,2509
<i>ECODIST</i>	-0,4158	-1,9717	-2,0872**	-1,7569**
<i>REER</i>	-5,4772**	-1,9717	-10,726*	-8,0975
Sargan Test	0,5196	0,0738	0,7003	0,7024
AR (1)	0,2615	0,7977	0,1863	0,1761

\*sig 10%, \*\*sig 5%, and \*\*\*sig 1%.

**Table 5.** Result for potential partner calculation

Trade Potential	Rattan	Textile
Potential	44.83%	46.34%
Not Potential	55.17%	53.66%

with (Batra, 2006).

In general, the majority of Indonesia's trading partners have exceeded their potential export volume, which indicates that these partner countries will no longer have potential in the next trading period (see Table 5). In the rattan furniture industry, it shows that there are 55.17%, while in the textile industry, there are 53.66% of partner countries have exceeded the potential point.

On the other hand, in the case of the rattan industry, it is known that there are 19 partner countries, or around 46.34% of all Indonesian partner countries, while in the textile industry, there are 13 partner countries, or around 44.83% of all trading partners. Details regarding the results of potential traders' calculations can be seen in the attachment.

The intriguing aspect of the potential trading partners' calculation results lies in the diverse characteristics of these countries. Geographically, the potential partners extend beyond Asia, defying the expectation of proximity. For instance, in the textile industry, the USA and Switzerland emerge as potential partners, challenging the regional trend. Similarly, in the rattan furniture sector, non-Asian countries like Italy, Canada, Mexico, Portugal, Norway, and Panama are identified as potential partners. Additional potential partner groups encompass ASEAN countries, East Asia, South Asia, and the Middle East, showcasing a varied and global spectrum.

## V. Discussion

The discussion stage will start with discussing the results of the model estimation. As previously explained, ICT has a positive and significant

influence, and these results are consistent and proven in the two industries sampled in this study. In general, the variables used to explain ICT, both in terms of quantity and quality, show positive and significant coefficients. The quantity aspect has been empirically proven to have a greater impact. This estimation result is by the assumptions of the networking effect theory (Shapiro, 1986), where the useful value of an item will be greater when the number of users of the item increases. Based on the estimation results and assumptions in this theory, it can be concluded that the more internet users there are in the two countries (Indonesia as an exporter and other partner countries as importers), the greater the benefits of the internet in increasing Indonesian trade flows, especially in the industries that are the study sample. This is marked by an increase in the export volume of these two industries.

The test results from this study regarding the impact of ICT also validate the findings in previous empirical studies (Abeliansky & Hilbert, 2017; Clarke & Wallsten, 2006; Minges, 2005), especially in studies that use indicators of the number of internet users as a measuring tool to measure ICT (Ahmad et al., 2011). The coefficient for the bandwidth indicator as a representation of the quality aspect shows a positive coefficient, although the bandwidth coefficient value is still relatively small. This is because to increase bandwidth capacity it is necessary to develop adequate telecommunications infrastructure and in terms of data, Indonesia is still relatively behind in this aspect when compared to other trading partners. Data released by the International Telecommunication Union (ITU) states that currently, Indonesia's bandwidth capacity is only 105 out of 141 countries in the world (ITU, 2020).

Seeing this phenomenon can be an input for the Indonesian government to improve the quality of telecommunications infrastructure. Although the quality aspect does not have as much influence as the quantity aspect, the quality aspect has an important role in complementing the quantity aspect. The massive number of internet users will not have a big impact if the quality of the internet access they

use is still poor. This has also been mentioned in several previous studies (Soeng & Cuyvers, 2022; Vu, 2017).

The next discussion is the performance of the empirical model that has been built to explain the determinants of Indonesia's export patterns. As previously explained, the international trade pattern of the rattan furniture and textile industry is still by the assumptions in the gravity model, where economies of scale have a positive influence, while distance has a negative influence (see Table 2 and Table 3). This baseline estimation model also has good performance which can be seen from the fairly large r-square value, where in the rattan furniture industry it is 63%-74% and in the textile industry it is 74%-83% (see Table 2 and Table 3).

The Free Trade Agreement (FTA) plays a crucial role in enhancing the export performance of Indonesia's rattan furniture and textile industries in international trade. Notably, when FTA and ICT variables are integrated into the model estimation process, the FTA coefficient increases, and the r-square value in model testing expands compared to the baseline model. This suggests that ICT enhances the effectiveness of FTA agreements, aligning with research by (C. Choi, 2010), emphasizing the significance of communication in international diplomatic activities.

Conclusively, through several tests, it is determined that incorporating FTA and ICT variables into the gravity model baseline testing provides a more effective combination of predictors in explaining the export performance of Indonesia's rattan furniture and textile industries.

The subsequent discussion focuses on formulating an export development strategy for Indonesia's labor-intensive industry. This strategy is crafted based on model estimates, coupled with calculations of potential trading partner countries, serving as guidance to augment market penetration for Indonesian rattan furniture and textile products. The calculated potential trading partners help map Indonesia's partner countries and provide a reference for prioritizing partner countries in the penetration of Indonesian

rattan furniture and textile products.

As previously mentioned, there are several countries from the ASEAN, East Asia, and South Asia group of countries that are potential partners for Indonesia, all of which have FTA agreements with Indonesia. Indonesian domestic producers can take advantage of FTA facilities to distribute their products to this group of countries, while the government can consider improving telecommunications infrastructure to improve the quality aspects of ICT services in Indonesia. Improving the quality aspect is a necessity because it has been proven that the quality aspect also has a positive impact, and is complementary to the quantity aspect, and the quality of ICT services in Indonesia is still far behind other countries (Tang & Abosedra, 2019).

Infrastructure has an important role in the process of international trade activities. In general, ICT can be reviewed based on quantity and quality aspects. Fundamentally, the quantity aspect tends to be good, which has a big role in creating network effects (Rodriguez-Crespo et al., 2021). ICT is the main supporting factor in the digital economy, especially in the networking process between countries in trade activities (Abendin & Duan, 2021) and this digital economic system has a big role, especially in labor-intensive industries which tend to have a business-to-consumer character (Wang & Choi, 2019).

Domestic producers can also expand their market reach to groups of countries outside Asia. Although based on the results of model estimates geographic distance tends to hurt export activity, the results of calculations of potential partner countries show that there are several potential partners outside the Asian continent. The government can pay special attention to domestic producers oriented towards expansion outside Asia. This is because many partner countries outside Asia are not covered by FTA facilities.

## VI. Conclusion

This research aims to comprehensively identify the impact of ICT on exports, focusing on two aspects: quantity (internet users) and quality (bandwidth capacity). Labor-intensive industries are chosen as the study sample due to their suitability in explaining ICT impact. Using proxies for the rattan furniture and textile footwear industry, the study covers the 2010-2020 period, involving 42 countries for the furniture industry and 29 countries for textiles. The gravity model, incorporating ICT, exchange rates, and free trade agreements, serves as the baseline analysis model.

Estimation results reveal a positive and significant impact of ICT on Indonesia's labor-intensive industrial exports, consistently confirmed while addressing simultaneity, endogeneity, and auto-correlation issues. Indonesia's trade patterns align with gravity model assumptions, where economic scale drives exports, and geographic distance acts as a trade barrier. Free trade agreements positively impact Indonesia's trade performance.

In an extensive analysis, potential trade calculations show that a significant majority of international trade partners in the furniture and textile industries exceed the potential export value (55.17% and 53.66%, respectively). To optimize market penetration, Indonesian labor-intensive industry players can prioritize potential partner countries (see Appendix).

Based on empirical findings, recommendations include a focus on developing telecommunications infrastructure. The small coefficient value for the ICT quality aspect and Indonesia's low bandwidth capacity indicate a need for improvement. Optimizing ICT benefits requires a balanced composition of both quantity and quality aspects. Quality ICT access is crucial for Indonesian labor-intensive industry players to connect with foreign customers, particularly from potential countries. Enhancing these aspects can significantly improve the export performance of Indonesia's labor-intensive industries.

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## Appendix

No	Furniture Industry			No	Furniture Industry		
	Partner	Rasio	Keterangan		Partner	Rasio	Keterangan
1	USA	0.86	Not	1	Australia	0.00	Not
2	Australia	0.73	Not	2	Netherlands	0.00	Not
3	Japan	0.61	Not	3	Viet Nam	0.51	Not
4	Netherlands	0.71	Not	4	Cambodia	0.93	Not
5	rusia	0.70	Not	5	United States of America	0.96	Not
6	France	0.86	Not	6	Korea, Republic of	0.73	Not
7	Belgium	0.66	Not	7	China	0.62	Not
8	UK	0.90	Not	8	Singapore	0.62	Not
9	Germany	0.88	Not	9	India	0.97	Not
10	Sweden	0.66	Not	10	Italy	0.53	Not
11	Spain	0.71	Not	11	Germany	0.98	Not
12	Denmark	0.63	Not	12	Brazil	0.68	Not
13	Taipei, Chinese	0.91	Not	13	Spain	0.53	Not
14	Finland	0.75	Not	14	Portugal	0.48	Not
15	Poland	0.93	Not	15	Morocco	0.96	Not
16	Israel	0.83	Not	16	Serbia	0.72	Not
17	kroea	0.79	Not	17	Switzerland	1.98	Potential
18	Chile	0.74	Not	18	Malaysia	1.15	Potential
19	New Zealand	0.00	Not	19	Japan	2.38	Potential
20	Greece	0.94	Not	20	Bangladesh	2.00	Potential
21	Bulgaria	0.99	Not	21	Philippines	5.64	Potential
22	Argentina	0.98	Not	22	Myanmar	4.59	Potential
23	Latvia	0.61	Not	23	Pakistan	4.23	Potential
24	China	1.22	Potential	24	United Kingdom	1.13	Potential
25	Italy	1.10	Potential	25	Taipei, Chinese	3.72	Potential
26	Arab Emirates	1.09	Potential	26	Albania	1.41	Potential
27	Canada	1.13	Potential	27	Thailand	1.06	Potential
28	Mexico	1.06	Potential	28	Hong Kong, China	1.08	Potential
29	South Africa	1.02	Potential	29	Türkiye	1.62	Potential
30	Saudi Arabia	1.31	Potential				
31	Malaysia	1.25	Potential				
32	Singapore	1.54	Potential				
33	Türkiye	1.14	Potential				
34	Romania	1.24	Potential				
35	Portugal	1.18	Potential				
36	Peru	1.22	Potential				
37	Norway	5.09	Potential				
38	India	2.32	Potential				
39	Colombia	1.31	Potential				
40	Uruguay	1.15	Potential				
41	Ukraine	1.30	Potential				
42	Panama	4.24	Potential				