The Role of Information and Communication Technology to Indonesian Craft Export

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Submission: March 26, 2022; Accepted: July 13, 2022

ABSTRACT

Indonesian handicraft products are potential export products that can survive amid sluggish Indonesian non-oil and gas exports. Indonesian handicraft exports today are also influenced by the development of information and communication technology. This study aims to determine the effect of information and communication technology on Indonesian handicraft exports during 2010-2019. The method used is a gravity model approach for panel data. However, due to heteroscedasticity and normality assumptions problems, the method was developed into a random effect quantile regression model. The data used is panel data consisting of 10 main destination countries for Indonesian handicraft exports during the 2010-2019 period. The results indicate that mobile broadband and mobile cellular users of export destination countries and individual Indonesian internet usage, significantly affects Indonesian handicraft exports on the middle and upper quantiles data. However, in the lower quantile, Indonesia's individual internet usage does not significantly affect Indonesian handicraft exports. Increasing penetration of Indonesia's internet usage for handicraft products marketing can be directed to countries belonging to the lower quantiles, such as the United Kingdom and The United Arab Emirates.

Keywords: Craft, Gravity Model, Heteroscedasticity, ICT, Quantile Regression.

ABSTRAK

Produk kerajinan Indonesia adalah salah satu produk ekspor potensial yang mampu bertahan di tengah lesunya ekspor nonmigas akbat dampak pandemi. Ekspor kerajinan Indonesia dewasa ini juga dipengaruhi oleh perkembangan teknologi informasi dan komunikasi. Penelitian ini bertujuan untuk mengetahui pengaruh teknologi informasi dan komunikasi terhadap ekspor kerajinan Indonesia selama tahun 2010-2019. Metode yang digunakan adalah pendekatan model gravitasi untuk data panel. Dikarenakan adanya permasalahan heteroskedastisitas dan error yang tidak berdistribusi normal, maka metode tersebut dikembangkan menjadi model regresi kuantil random efek. Data yang digunakan adalah data panel yang terdiri dari 10 negara tujuan utama ekspor kerajinan Indonesia selama periode 2010-2019. Hasil yang diperoleh menunjukkan bahwa pada data kuantil tengah dan atas, mobile broadband, pengguna telepon selular negara tujuan ekspor, serta penggunaan internet individual Indonesia berpengaruh signifikan pada ekspor kerajinan Indonesia. Akan tetapi, pada kuantil bawah penggunaan internet individual Indonesia tidak berpengaruh signifikan terhadap ekspor kerajinan Indonesia. Peningkatan penetrasi penggunaan internet Indonesia untuk pemasaran produk kerajinan dapat diarahkan pada negara yang termasuk dalam kuantil bawah seperti Britania Raya dan Uni Emirat Arab.

Kata Kunci: *Kerajinan, Model Gravitasi, Heteroskedastisitas, Teknologi Informasi dan Komunikasi, Regresi Kuantil.*

INTRODUCTION

The pandemic that occurred during 2020 impacted the decline of Indonesia's non-oil and gas exports growth. However, some of Indonesia's potential products still survive and can support national exports. One of the potential exports product that can grow during a pandemic is the export of handicraft products which are part of the creative economy. Based on data from the Ministry of Industry, craft exports reached 6.17 trillion rupiahs from January to September 2020.

Rudianto and Susialawati (2019) found that the number of MSMEs, exchange rate, the number of MSMEs Credit distributions, and inflation significantly affected Indonesian handicraft exports. According to Sonia and Sudirman (2015), tourist visits, investment, inflation, and exchange rate affected handicraft exports simultaneously, while partially, inflation and exchange rate had significant and negative effect on handicraft exports in Bali. Hidayati (2019) found that the global value chain activities for leather handicraft exports from Manding, Yogyakarta, were positively and significantly influenced by marketing and sales, service, firm infrastructure, inbound logistics, outbound logistics, human resource management, and technology development. Haavisto and Vaillancourt (2017) found that logistic performance index (LPI) which represent company international trade supply chain had affected by internet infrastructure and use on emerging market.

The information and communication technology (ICT) development role today cannot be separated from international trade. Nath and Liu (2013) examined the determinants of ICT on international trade in emerging market countries. To represent ICT infrastructure, this study uses telecom investment growth and international internet bandwidth, and representing the use of ICT by internet subscriptions per 100 people and the number of internet hosts per 100 people. Ozcan and Nath (2016) mention that ICT has positive and significant effects to Turkish export and import volume. Xing (2018) concluded that the use of modern ICT and the e-commerce adoption could stimulate bilateral trade flows in developing and least-developed countries. Xing (2018) also mentioned that the trade landscape had undergone significant changes, especially those caused by ICT-based innovation. This allowed companies to access a wider market, increase sales scale, especially in customer-based businesses, to increase profits. ICT development index, real GDP, population of export partners, distance and real exchange rate significantly affected to Indonesian bilateral exports (Wardani et al., 2019).

Developing countries have greater distances, both geographically and due to differences in language, culture, and barriers with trading partner countries than richer countries. ICT investment could help developing countries overcome these barriers and increase bilateral trade with other countries (Demirkan et al., 2009). Oktora et al. (2021) found that the internet usage variable significantly affected exports of the top 5 ASEAN countries to the USA and China. Aryani et al. (2021) mentione that ICT Development Index (IDI) and B2B indexes has significant impact to indonesia's trade with ASEAN partner. Based on that identification, this study aims to determine the effect of ICT development on Indonesian craft export.

METHODS

Gravity Model

The gravity model has considerable explanatory power and empirical robustness, therefore, it has been used for policy implications on international trade for the last 60 years (Kepaptsoglou et al., 2010). The gravity model is based on Newton's law of gravity. The magnitude of the attractive force between two objects is proportional to their masses and inversely proportional to the square of their distance apart. Exports from country i to country j are described by GDP or GNP as the economic size and direct geographical distances in this equation. The trading gravity model can be simply expressed as:

$$T_{ij} = \propto \left(\frac{Y_i Y_j}{D_{ij}}\right) \quad (1)$$

where T_{ij} is the exports value from country *i* to country *j*, Y_i and Y_j are the two countries economic scales, D_{ij} is the distance between country *i* to country *j*, $\propto$ is a constant. The gravity model proposed by Tinbergen (1962) was further developed by Bergstrand (1985) into an augmented gravity model as follows:

$$\ln T_{ij} = \ln \propto + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + \beta_4 \ln A_{ij} + \ln u_{ij} \quad (2)$$

where Tij is the value of trade flows from country-i to country-j, Yi and Yj are the GDPs of country-i and country-j, Dij is the distance between country-i and country-j, and Aij is another factor that affects trade between countries. -i and state-j. Variables that represent the economic size of two countries in their application can be explained through the GDP of the exporting and importing countries.

Random Effects Quantile Regression

In the condition that longitudinal data failed to satisfy homoscedasticity assumption and error is non-normally distributed, panel data regression estimation would be inaccurate. Koenker and Hallock (2001) explained that quantile regression was the method that could be used. Classical linear regression estimates the model for conditional mean function while quantile regression estimates the model for a conditional quantile function. With a general approach, Koenker (2004) developed quantile regression to use for longitudinal data. This method, however, does not accommodate time-invariant predictors of individual effects. To accommodate heterogeneity and unfulfilled normality assumptions, Galvao and Poirier (2019) used the random effect quantile regression model on panel data with time-invariant predictors. The panel data model can be written as follows:

$$y_{it} = f(x_{it}, z_i, \alpha_i, \varepsilon_{it}) \quad (3)$$

where:

y_{it} : response variable
x_{it} : predictors with time-variation
z_i : predictors without time-variation
α_i : unobserved individual-specific components
ε_{it} : disturbance
i = 1, 2, ..., n
t = 1, 2, ..., T

in a linear version (3) the equation can follows:

$$\begin{aligned} y_{it} &= x_{it}'\beta + z_i'\gamma + \alpha_i + \varepsilon_{it} \\ &= x_{it}'\beta + z_i'\gamma + U_{it} \end{aligned}$$

where $U_{it} = \alpha_i + \varepsilon_{it}$. This model further can be generalized to the location-scale model:

$$\begin{aligned} y_{it} &= U_{it} + x_{it}'\beta + z_i'\gamma + x_{it}'h_1(U_{it}) + z_i'h_2(U_{it}) \\ &= U_{it} + x_{it}'\big(\beta + h_1(U_{it})\big) + z_i'\big(\gamma + h_2(U_{it})\big) \end{aligned} \quad (4)$$

with the assumption $x_{it}'h_1(.)$ and $z_i'h_2(.)$ were fixed. This model let the heterogeneity of U_{it} to depend on both α_i and ε_{it}. Quantile regression version proposed by Galvao and Poirier (2019) and generalization of (3) as follows:

$$y_{it} = c(U_{it}) + x_{it}'\beta(U_{it}) + z_i'\gamma(U_{it}) \quad (5)$$

where heterogeneity be represented by U_{it} and depend on both α_i and ε_{it}, as follows:

$$U_{it} = U(\alpha_i, \varepsilon_{it}) \quad (6)$$

equation (6) can make unobserved heterogeneity dependent on α_i and ε_{it} in a restricted form. Under the assumption that $U(\alpha_i, \varepsilon_{it})$follows $U_{it} \sim Unif[0,1]$, the conditional quantile of y_{it} can be expressed as:

$$Q_{y_{it}}(\tau|X_i) = c\left(Q_{U_{it}}(\tau|X_i)\right) + x'_{it}\beta\left(Q_{U_{it}}(\tau|X_i)\right) + z'_i\gamma\left(Q_{U_{it}}(\tau|X_i)\right)$$

where $X_i \equiv [X'_{i1},\ X'_{i2}, \ldots, X'_{iT}]'$, $X_{it} = [1, x'_{it}, z'_i]'$, and the quantile of interest is defined by $\tau \in (0,1)$. Unobserved components are assumed to be uncorrelated with all predictors, and strict exogeneity, yet $U(\alpha_i, \varepsilon_{it})$ is independent of X_i, than the equation can be written as:

$$Q_{y_{it}}(\tau|X_i) = c(\tau) + x'_{it}\beta(\tau) + z'_i\gamma(\tau) \quad (7)$$

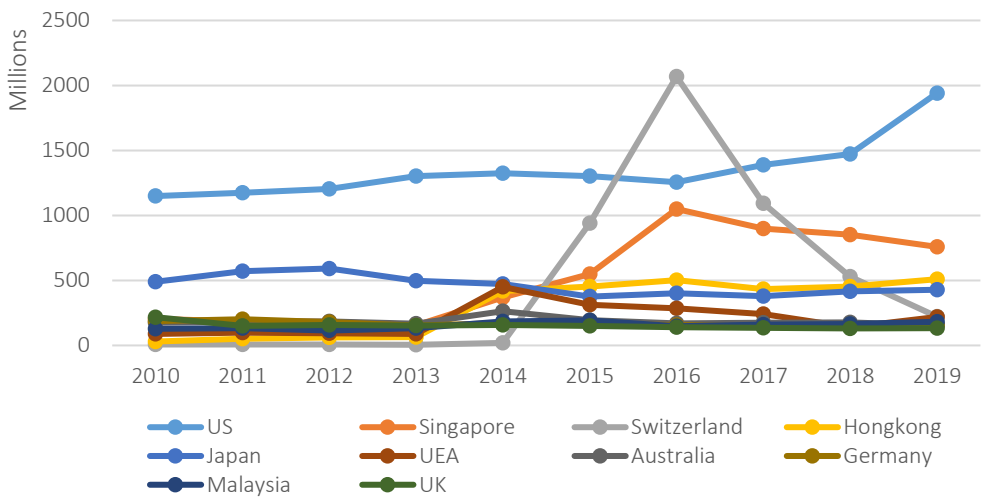
equation (7) provides the linear random effects quantile regression model, given the equation (5) – (6) and condition α_i independence from X_i.

The craft export data used in this study (in US$ Thousand) is generated from BPS-Statistics Indonesia and UN Comtrade. The predictor variables are GDP data (in US$ Thousand) and population of destination countries from the World Bank, economic distance data processed from geographic distance on CEPII, ICT data from the International Telecommunication Union (ITU). This study covers ten main destination countries for Indonesian handicraft exports (The United States of America, Japan, Singapore, Switzerland, Hongkong, The United Arab Emirates, Australia, Germany, Malaysia, and the United Kingdom).

The model follows the equation:

$$\begin{aligned} Q_{y_{ijt}}(\tau|X_{ijt}) = {} & \beta_0 + GDP'_{it}\beta_1(\tau) + GDP'_{jt}\beta_2(\tau) + Population'_{it}\beta_3(\tau) + Distance'_{ijt}\beta_4(\tau) \\ & + Broadband'_{it}\beta_5(\tau) + Broadband'_{jt}\beta_6(\tau) + Telephone'_{it}\beta_7(\tau) + Telephone'_{jt}\beta_8(\tau) \\ & + Mbroadband'_{it}\beta_9(\tau) + Mbroadband'_{jt}\beta_{10}(\tau) + Cellphone'_{it}\beta_{11}(\tau) + Cellphone'_{jt}\beta_{12}(\tau) \\ & + Internet'_{it}\beta_{13}(\tau) + Internet'_{jt}\beta_{14}(\tau) \end{aligned} \quad (8)$$

where y_{ijt} is the natural logarithm of craft export value from Indonesia to country *i*, GDP_{it} is the natural logarithm of GPD country *i*, GDP_{jt} is the natural logarithm of Indonesian GPD, $Population_{it}$ is the natural logarithm of the population in destination country *i*, $Distance_{ijt}$ is a natural logarithm of the economic distance between country *i* and Indonesia, $Broadband_{it}$ is the natural logarithm of fixed broadband subscription in country *i*, $Broadband_{jt}$ is the natural logarithm of fixed broadband subscription in Indonesia, $Telephone_{it}$ is the natural logarithm of fixed telephone subscription in country *i*, $Telephone_{jt}$ is the natural logarithm of fixed telephone subscription in Indonesia, $Mbroadband_{it}$ is the natural logarithm of mobile broadband subscription in country *i*, $Mbroadband_{jt}$ is the natural logarithm of mobile broadband subscription in Indonesia, $Cellphone_{it}$ is the natural logarithm of mobile cellular subscription in the country *i*, $Cellphone_{jt}$ is the natural logarithm of mobile cellular subscription in Indonesia, $Internet_{it}$ is the percentage of individuals using the internet in country *i*, $Internet_{jt}$ is the percentage of individuals using internet in Indonesia. Index *i* is for the destination country, *j* for Indonesia, and *t* for time (year).



Source: Badan Pusat Statistik (2017) and UN Comtrade (processed)

Figure 1. Indonesian craft export to 10 largest export destination (million USD)

RESULTS AND DISCUSSIONS

The United States became the largest market for Indonesian craft exports during the 2010 – 2019 period, although in 2016, Switzerland became the largest export destination for Indonesian crafts. The export value of Indonesian craft products to the United States reached its peak in 2019. This value is far above the other nine main destination countries. This is in line with the report of the Ministry of Trade that in 2019, Indonesia was the 7th largest handicraft exporting country to the US. The value of Indonesian handicraft exports increased by 41.49 percent compared to the previous year. The handicraft products are leather products, bags, and travel goods.

The high export of Indonesian crafts to Switzerland and Singapore in 2016 was due to the high demand for Indonesian jewelry commodities by these two countries. Switzerland needs a sustainable supply of jewelry in stones and precious metals as raw materials in the watch industry. However, in the following years, the value of Indonesian craft exports to Switzerland again declined. This was due to the weakening of the Swiss economy, which resulted in reduced demand for jewelry commodities from Indonesia.

Singapore was a transit point for Indonesian craft products before being re-exported to other countries. Indonesian jewelry commodities were exported first to Singapore because of the ease of import duty rates of 0%. The ease of this import duty tariff impacts the implementation of the ASEAN Free Trade Area (AFTA) in 2015.

Based on ITU (2020), the trend of fixed-telephone used is decreasing. mobile-cellular telephone replaced the use of a fixed-telephone. It is also reflected in the fact that the trend of mobile-cellular subscriptions per 100 inhabitants is increasing.

Tabel 1. 10 Main Destination Countries ICT Development Index (IDI) 2016-2017

Country	2016		2017	
	Score	Rank	Score	Rank
Switzerland	8,66	4	8,74	3
UK	8,53	5	8,65	5
Hongkong	8,47	6	8,61	6
Japan	8,32	11	8,43	10
Germany	8,20	13	8,39	12
Australia	8,08	16	8,24	14

Country	2016		2017	
	Score	Rank	Score	Rank
USA	8,13	15	8,18	16
Singapore	7,85	20	8,08	18
UAE	7,18	34	7,21	40
Malaysia	6,22	62	6,38	63
Indonesia	3,85	114	4,33	111

Source : ITU (2017)

Based on ITU (2017) data in Table 1, the IDI rank of destination country is higher than Indonesia. This also can be seen that ICT in destination countries is better than ICT in Indonesia on all indicators. This indicates that the opportunity to increase the marketing of Indonesian craft export products to the main destination countries through the improvement of ICT is still wide open.

This fact is also reinforced by Clarke and Wallsten (2006) that developing countries with a relatively high internet penetration will export more to high-income countries than developing countries with lower internet penetration. This is because the penetration of internet is most prevalent among manufacturing enterprises in high-income countries.

Panel data regression with gravity model corresponding to random-effect gravity model estimation. The results are shown in Table 2. It can be seen that the variable, fixed telephone and mobile broadband of the destination country has a significant effect on Indonesian craft exports.

Table 2. The random-effects gravity model of Indonesian Craft Export

Variables	Coefficient
GDP_{it}	-209.562
GDP_{jt}	154.5937
$\mathrm{Population}_{it}$	206.7135
$\mathrm{Distance}_{ijt}$	218.7154
$\mathrm{Internet}_{it}$	0.023363
$\mathrm{Internet}_{jt}$	0.020637
$\mathrm{Broadband}_{it}$	-0.95608
$\mathrm{Broadband}_{jt}$	-0.24015
$\mathrm{Telephone}_{it}$	-2.64898**
$\mathrm{Telephone}_{jt}$	-0.0231
$\mathrm{Mbroadband}_{it}$	0.840571**
$\mathrm{Mbroadband}_{jt}$	0.012289
$\mathrm{Cellphone}_{it}$	-0.95727
$\mathrm{Cellphone}_{it}$	0.046871

Notes : ** significant on $\alpha = 0.05$

Although the random effect model yields significant results for several ICT variables, the result could be misleading. It because of unsatisfied result on linear regression assumption test. Then the linear regression assumption test is carried out with the results as shown in table 3.

Table 3. Homoscedasticity and Normality test

Breusch Pagan Test	
BP	54.412
p-value	1.092e-06
Jarque Berra Test	
X-squared	11.13
p-value	0.003829

The Breusch-Pagan test yields a p-value <0.05 when the null hypothesis is homoscedasticity. It indicates that there is a heteroscedasticity problem. Furthermore, a p-value <0.05 was obtained by using the Jarque Bera test with a hypothesis of zero error and a normal distribution. According to the results of this test, the error is non-normally distributed.

Based on Koenker and Hallock (2001), in order to satisfy homoscedasticity and non-normally distributed assumption, random effect quantile regression could be an alternative model. Galvao and Poirier (2019) used the random effect quantile regression model to accommodate heterogeneity and unfulfilled normality assumptions. The estimation result of the random effect quantile regression using in this model shown in table 4.

The GDP variable of the destination country has a significant effect on all quantiles except for the lower quantile. In contrast, Indonesia's GDP variable significantly affects some of the middle and upper quantiles. The distance variable is not significant in this model. It is caused by distance constraints that can be overcome as technology develops. This aligns with Terzi (2011), which stated that initiating and making trade through electronic means and the internet can be more accessible, less expensive, and faster. Producers and consumers no longer have to meet face to face to conduct international trade, which of course, will be a huge obstacle for countries that are separated by long distances. When the barrier of distance is overcome, the volume/value of international trade will increase.

Table 4. Random-effects quantile regression estimation results on Indonesian craft export model

Variables	Quantile				
	0.2	0.4	0.5	0.6	0.8
GDP_{it}	0.601	1.431**	1.291**	1.184**	2.026**
GDP_{jt}	7.560	8.487*	-5.907	3.178	0.884**
$Population_{it}$	0.669	-0.412	0.106	0.098*	0.274**
$Distance_{ijt}$	-0.759	-0.412	-1.703	-2.627	-2.475
$Internet_{it}$	-0.015	-0.019	-0.036	-0.061	-0.060
$Internet_{jt}$	-0.203	0.010	0.050**	0.066**	0.017**
$Broadband_{it}$	-0.947	-0.499	-0.687	-0.558	-1.657
$Broadband_{jt}$	3.117*	-1.691	-0.028	-2.202	-0.146
$Telephone_{it}$	-0.929	-0.493	-0.684	-0.008	0.403**
$Telephone_{jt}$	0.482	1.646*	-0.229	-0.180	-0.176
$Mbroadband_{it}$	0.513*	0.987**	0.519**	0.400**	-0.011
$Mbroadband_{jt}$	0.410	0.199**	-0.104	-0.116	-0.164
$Cellphone_{it}$	2.102*	-0.365	2.003**	2.191**	2.116**
$Cellphone_{it}$	-3.407	0.402	1.024	-0.051	0.485**

Notes : ** significant on $\alpha = 0.05$ * significant on $\alpha = 0.10$

By conducting a one-way test, the quantile regression results show that in the upper and middle quantile data, more Indonesian ICT variables affect Indonesian handicraft exports. Meanwhile, in the lower quantile, more destination countries ICT variables that have a significant effect. Exports to the United States dominate the export value of Indonesian handicrafts in the upper quantile. Exports to lower quantile is dominated by the UK and Australia.

The significant destination country ICT variable in almost all quantiles is mobile broadband and mobile cellular users. In contrast, the significant Indonesian ICT variable in almost all quantiles is the percentage of private internet users. The effect of fixed broadband and fixed telephone variables on all quantiles is very small both in Indonesia and in export destination countries. This is because both infrastructures have been reduced and replaced by a more flexible mobile infrastructure. One percent increase in the percentage of individuals using the Internet from Indonesia leads to an increase in the Indonesian craft export by 0.01 – 0.07 percent.

CONCLUSIONS

The development of the use of ICT has a significant influence on increasing Indonesia's handicraft exports. Based on the distribution of observational data by quantile regression, it can be concluded that the development of Indonesian ICT has a significant effect on increasing exports of Indonesian crafts to countries belonging to the middle and upper quantiles, such as the United States and Singapore. It has no significant effect on export destination countries in the lower quantiles, such as the United Kingdom and the United Arab Emirates. Thus, to increase Indonesia's handicraft exports in the future, the penetration of the use of ICT in the marketing of Indonesian handicraft exports can be further increased in countries that are in the lower quantile.

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