

The Impact of Digital Economy Development on Indonesia's Export Trade

Ariel Yonathan Junior

Nanjing University of Information Science and Technology, China

ABSTRACT: The fast growth development of the digital economy has transformed international trade, providing new opportunities to expand export, especially in a developing country like Indonesia. Using panel data from 34 Indonesian provinces between 2013-2023, this study explores the impact of digital economy growth on export in each province of Indonesia. A digital economy (DIG) measurement method is constructed using the entropy method, based on indicator such as informatization, internet infrastructure, and digital transactions. The empirical analysis uses regression models. The results show that statistically significant and positive relationship between digital economy development and export volume across Indonesian provinces. Based on regional observation, the western and central Indonesia region shows the positive results, while eastern regions have negative effects. The study concludes with policy recommendation to increase Indonesia's export competitiveness in global market.

KEYWORDS: Export Trade, Digital Economy, Indonesia, Entropy Method, Regional Disparities

I. INTRODUCTION

The rapid growth development of digital economy has changed the dynamic of international trade and created new opportunities for export expansion, especially in developing country like Indonesia. Indonesia, the world's most populous with population around 276 million people in 2023, with the adoption of e-commerce, fintech innovation and digital infrastructure has experienced the significant changes in trade landscape. However, infrastructure gaps, limited digital skills gaps, and cybersecurity issues are the problem for digital economic development in Indonesia. Each province's export policies also present challenges for the development of digital economy. This study examines the impact of digital economy development on provincial export trade in Indonesia, using panel data from 34 provinces from 2013-2023. This journal examines three central aspects: (1) measuring the digital economy development using the entropy method, (2) analysing the effect of regional heterogeneity on the digital economy, and (3) providing conclusion and policy recommendation.

II. LITERATURE REVIEW

Concept of Digital Economy

Canadian professor Don Tapscott first introduced the term "Digital Economy" in his 1996 book mentioned that the digital economy was basically an economy of technological advancement, as the means of converting physical assets into the virtual forms. The digital economy transformed the traditional economic forms and now using the digital technology to transform data into information value that have benefit to the enterprise (Yi Xianrong, 2019).

Research Measurement on Digital Economy

Measuring the digital economy would be to count all economic activities in the digital age that harness (Jakubelskas, 2021). OECD described four dimensions for measuring the digital economy: information and communication technologies (ICT), models of transformation, access to networks, the risks of digital presence, and emerging technologies. Zhang Xueling and Jiao Yuexia (2017) describes indicators with five first-level dimensions, including ICT-related. Shen Yunhong (2020) uses the entropy value method to create an index system for optimizing and upgrading the structure of traditional manufacturing industries driven by the digital economy.

Research of Factor Affecting Export Trade

In economy perspective, Balassa and Helpman (1978 & 2008) describes there are three indicator that affect export trade. (1) The country's exchange rate (currency competitiveness), (2) GDP (higher GDP higher production capacities). (3) FDI (boost export and improve structure). In the technological and digital factors, Lall (2000) explores that technology innovation in production

The Impact of Digital Economy Development on Indonesia's Export Trade

process can improve product quality, cost efficiency, and increase export competitiveness, otherwise research and development (R&D) also will make the export growth more positively (Coe and Helpman, 1995). In infrastructure factors, Zhou and Wen Huwei (2022) researched that infrastructure influences export trade through the direct channel of improving efficiency, decreasing logistic costs, and reduce trade barriers.

Research Digital Economy Impact on Export Trade

The digital economy influenced export trade from microeconomic and macroeconomic perspectives. In microeconomic approach, the digital economy has extent the reduced international trade barriers that so far have been help the small and medium enterprises' to be more competitive in the global market. From the macroeconomic approach, digital solutions have transformed logistic and supply chain management and increasing export competitiveness. According to Brynjolfsson and McAfee (2014), e-commerce has reduced down logistic and geographical barriers and providing a lot opportunity for enterprises. Amity and Freund (2010) emphasized that the AI-powered logistic helps determine demand, reduce operating cost and improving efficiency.

Empirical Evidence in Indonesia

Indonesia's digital economy offers a lot of opportunities from social and economic approach, include increased market share, improved brand recognition, wider consumer contact (Zhu Yuwing 2021). This opportunities are driven by the technology perspective, the convergence of e-commerce, fintech, and digital payment systems. However, cybersecurity dangers and data privacy concerns remain major issues that necessitate strong policy frameworks. Lastly, Choi & Lee, 2020 stressed that the important thing for export success. The digital economy enables the countries to diversify their exports and shift to higher-value, knowledge-intensive goods and services. Integrating the digital economy into production and sales processes can help to upgrade export growth.

III. RESEARCH METHOD

Data Source

The data analyzed in this paper came from Indonesia bank data base. Considering the availability of the data, this paper selects the panel data from 34 provinces in Indonesia from 2013-2023, and converts the indicators of individual variables in IDR to US dollars with the average exchange rate of that year, and collects a total of 374 observation sample data.

Variable Definitions

Dependent Variable: Indonesia's export trade volume (EXP)

Under the trade conditions, international trade already contributes a lot to the development of Indonesia national economy. Under the winds of reform and opening up, Indonesia's provinces have vigorously developed their export activities and have made remarkable achievements. In this thesis is use the Indonesia's provincial statistical year selected from 2013-2023 export trade volume, adjusted exchange rate fluctuations (US\$ 1 = Rp 10.000) to ensure the stability.

Independent Variable: Digital Economy Development Level (DIG)

This paper establishes a framework for assessing the indicators of the level of digital economy from three primary dimensions: informatization development indicators, internet development indicators, digital transaction development indicators, and uses the entropy method to calculate a comprehensive evaluation coefficient that can reflect the level of development of digital economy. Control variables: Gross Domestic Product (GDP), Foreign Direct Investment (FDI), Fixed Trade Costs (Cost)

1. Gross Domestic Product (GDP): Provinces with higher GDP can invest more in digital infrastructure and innovation, this can increasing their competitiveness in the global market.
2. Foreign Direct Investment (FDI): FDI has boosted Indonesia's digital economy by bringing in advanced technology, boosting competitiveness by increasing efficiency and integrating local firms into global networks.
3. Fixed Trade Costs (Cost): Provinces different infrastructure quality and geographic accessibility, with region like Java and Bali theses region are have lower trade cost and transportation cost, regions with lower trade costs can more effectively utilize advances in digital technology to boost their export activities.

Entropy Evaluation method

In this paper use the entropy method to measure the development of the level of the digital economy in 34 provinces in Indonesia from 2013-2023. The specific steps are as follows:

1. Among them, x_{ij} is the value of the indicator that has been dimensionless, x_{ij} is the original value of the scalar data, i and j are the j year and i indicator.

$$x_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}}$$

The Impact of Digital Economy Development on Indonesia's Export Trade

2. Calculation of the weight of indicator i in year j

$$p_{ij} = \frac{x_{ij}}{\sum_{j=1}^n x_{ij}}$$

Where: n is the number of years of evaluation, $n=1, 2, \dots, 10$

3. Get the information entropy of each indicator e_i

$$e_i = -\frac{1}{\ln n} + \sum_{i=0}^n p_{ij} \ln p_{ij}, 0 \leq e_j \leq 1$$

4. Determine the information entropy redundancy of g_i and weight w_i of each indicator

$$g_i = 1 - e_i, w_i = \frac{g_i}{\sum_{j=1}^m g_i}$$

5. Calculation of the composite level score

$$score_{ij} = \sum w_i x_{ij}$$

Regression Model

The article in this chapter selects the panel data of 34 provinces in Indonesia region from 2013-2023 to examine the development of Indonesia's digital economy on export trade. This study involves a total of 5 variables: Indonesia's export size, Indonesia's digital economy level, Indonesia's gross domestic product, Indonesia's foreign direct investment, and each provinces fixed trade export cost.

$$EXP_{pt} = \alpha + \beta_1 DIG_{pt} + \beta_2 GDP_{pt} + \beta_3 FDI_{pt} + \beta_4 COST_{pt} + \eta_t$$

Which, p is for different provinces, t is for different years (time), EXP is for the export trade volume of the provinces, α is the constant top, DIG , is for digital economy level, GDP is for the gross domestic product, FDI is for the foreign direct investment, $COST$ is for the trade cost of the province, and η_t is for random error term.

IV. REGRESSION ANALYSIS RESULT

Descriptive Analysis

Table I Descriptive Analysis Table

	Mean	SD	Min	Max
Exp	7.40	2.00	1.84	10.89
Dig	0.99	2.06	0.01	14.40
GDP	4.57	1.11	1.71	7.17
FDI	5.75	1.69	0.69	9.02
Cost	15.84	36.98	0.18	241.66

Table 1 show the descriptive analysis for all the variable that uses in this thesis. The average value Indonesia export (Exp) is 7.40 with a standard deviation of 2.00, reflects high export activity across province variation. The digital economy development (DIG) variable that author's measurement has a low average value of 0.99, with the standard deviation of 2.06, with the value min of 0.01 and the max is 14.40. The mean value of Indonesia Gross Domestic Product (GDP) is 4.57 and the standard deviation of 1.69, while the mean value of Indonesia Foreign Direct Investment (FDI) is 5.75 with the standard deviation 1.69, These two results show the regional economic differences and significant heterogeneity in Indonesia provinces that will affect export competitiveness. Export costs (Cost) mean value is 15.84 but with very high standard deviation value of 36.98 and the maximum value of 241.66. The variation value of these variable will support the premise that digital economic development effect Indonesia export trade.

Basic Regression Result

Table II Basic Regression Table

	(1) Exp	(2) Exp	(3) Exp	(4) Exp
DIG	0.121** (0.048)	0.098** (0.039)	0.078** (0.038)	0.076** (0.036)
GDP		0.947*** (0.322)	0.750*** (0.201)	0.791*** (0.194)

The Impact of Digital Economy Development on Indonesia's Export Trade

FDI			0.031** (0.014)	0.027** (0.014)
Cost				-0.012** (0.005)
_cons	7.332*** (0.030)	3.032** (1.471)	3.655*** (0.949)	3.696*** (0.910)
<i>N</i>	374	374	374	374

Standard errors in parentheses

Notes: Robust standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As can be seen from table 2 the basic regression results across four way consistently show a positive impact and statically significant between the dependent variable DIG (digital economy development) and Exp (export performance) in Indonesia's provinces. After all control variable are added, the regression coefficient remains positive. With coefficients result range from 0.0076 to 0.121. This show that every 1 unit increase in digital economy, Indonesia's export trade volume will increase 0.076 point. For every 1-unit increase in the digital economy indicator, Indonesia's export volume increase by average on 7.6%. It shows that Indonesia's development in digital economy has a role in upgrading the export trade. From the point of view of control variables, GDP also shows the strong positive impact on exports, proofs that larger economic provinces likely have larger export volume. FDI is also positive corelated with Indonesia export. Meanwhile, trade cost (cost) shows a negative coefficient and significant effect, explained that reducing trade barriers of logistic expenses will improve the export value.

Regression Results by Region

Table III Region Regressions Table

	(1) Middle	(2) West	(3) East
DIG	0.049* (0.026)	0.059*** (0.019)	-0.023 (0.059)
GDP	0.963*** (0.310)	0.498* (0.271)	0.006 (0.505)
FDI	0.034*** (0.000)	-0.021 (0.000)	0.001** (0.024)
Cost	-0.009** (0.004)	-0.089* (0.047)	-0.060** (0.015)
_cons	1.914 (1.496)	6.270*** (1.170)	6.430** (1.783)
<i>N</i>	132	198	44

The regression region results across 3 regions in Indonesia show the different result of coefficients of digital economy on Indonesia's provinces. In middle region (1) and west region (2), DIG shows a positive and statically significant effect on export, this proofs that digital economy development contributes to export trade volume in this regions. It's because in this regions especially in west regions have big provinces like Jakarta, East Java, and West java. In east region (3) the coefficient become negative and significant show that in the east region like Papua and Nusa Tenggara digital economy have less effect in the region export trade condition. GDP (GDP) is positively related in middle (1) and west region (2), but become insignificant again in east region (3), possibly because the region sample size or the disparities. The FDI variable also have mixed results, it's significant in middle region (1) and east region (3), but minus and insignificant in west region (2). Trade cost (Cost) consistently show a negative and significant results, these results present that reducing export cost will improve the export trade performance in all regions.

Robustness Test

The Impact of Digital Economy Development on Indonesia's Export Trade

Table IV Robustness Test Table

	(1) Winsorized	(2) Placebo
DIG	0.074** (0.035)	0.029** (0.014)
GDP	0.791*** (0.195)	0.861*** (0.211)
FDI	0.000** (0.000)	0.000** (0.000)
Cost	-0.012** (0.005)	-0.012** (0.005)
_cons	3.706*** (0.913)	3.483*** (0.951)
N	374	374

Standard errors in parentheses

Notes: Robust standard errors in parentheses.

*, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The robustness regression test result using winsorized test in model (1) and placebo test in model (2) present the positive and significant effect between digital economy development and export trade volume in Indonesia's provinces, with coefficients results of 0.074 and 0.029. This means that digital economy development still be one of key factor of Indonesia export growth after the robustness test. Province GDP and FDI also continue show the positive coefficient and strong significant, this proofs that economic scale in improving the provinces export volume. Export trade cost (Cost) have negative and significant result, this highlights that higher trade cost will decrease the export volume. Overall, the winsorized and placebo robustness test confirm the importance of digital economy development, GDP, FDI, and trade cost in Indonesia's export performance.

V. CONCLUSION AND RECOMMENDATION POLICY

Conclusion

This study examines the impact of digital economy development has on Indonesia's export trade performance across 34 provinces in the years 2013-2023. The methodological approaches to measuring the digital economy development are using the entropy method and regression analysis test, the test results shows that digital economy significantly influence to improves export volumes, with 1% increase in digital economy development will increase export by 7.6%. However, the impact of digital economy varies across Indonesia regions. Provinces like Java and Sumatra in west region have the positive result, in contrast eastern region like Papua and Nusa Tenggara show very little or even negative impacts due to barriers in infrastructure or lower digital readiness.

Recommendation Policy

1. Advancing provincial digital growth: creat a good digital economy zone for underdeveloped regions in Eastern region Indonesia, such as Papua and Maluku to reduce disparities between provinces.
2. SME/Small Medium Enterprise Support: promote training for digital skills and cybersecurity to help with export competitiveness.
3. Integrated Policies: use digital economy strategies with trade facilitation measure for synergistic effects.

REFERENCES

- 1) HELPMAN E, MELITZ M, RUBINSTEIN Y. Estimating trade flows: Trading partners and trading volumes [J]. The quarterly journal of economics, 2008, 123(2): 441-87.
- 2) BAHMANI-OSKOOEE M, HEGERTY S W. Exchange rate volatility and trade flows: a review article [J]. Journal of Economic Studies, 2007, 34(3): 211-55.
- 3) STRASSNER E H, NICHOLSON J R. Measuring the digital economy in the United States [J]. Statistical Journal of the IAOS, 2020, 36(3): 647-55.
- 4) TAYIBNAPIS A Z, WURYANINGSIH L E, GORA R. The development of digital economy inIndonesia [J]. IJMBS International Journal of Management and Business Studies, 2018, 8(3): 14-8.

The Impact of Digital Economy Development on Indonesia's Export Trade

- 5) JAKUBELSKAS U. Evaluation of key factor of digital economy in European Union [J]. Economics and Culture, 2021, 18(2): 41-50.
- 6) ZHU Z, LIU B, YU Z, et al. Effects of the digital economy on carbon emissions: Evidence from China [J]. International journal of environmental research and public health, 2022, 19(15): 9450.
- 7) HUANG S, HAN F, CHEN L. Can the digital economy promote the upgrading of urban environmental quality? [J]. International Journal of Environmental Research and Public Health, 2023, 20(3): 2243.
- 8) WANG F, GUO B H, WANG Z X, et al. The impact of digital economy on the export competitiveness of China's manufacturing industry [J]. Mathematical Biosciences and Engineering, 2023, 20(4): 7253-72.
- 9) ZHANG L, PAN A, FENG S, et al. Digital economy, technological progress, and city export trade [J]. PloS one, 2022, 17(6): e0269314.
- 10) Wang Z C, Wang H H, Wang R. Digital economy development on import and export trade [J].
- 11) XUE D, LIU T, LI X, et al. Can the Digital Economy Accelerate "Carbon Neutrality"?—An Empirical Analysis Based on Provincial Data in China [J]. Sustainability, 2023, 15(14): 11441.
- 12) QIAN J, SHE Q Z. The impact of corporate digital transformation on the export product quality: Evidence from Chinese enterprises [J]. Plos One, 2023, 18(11).
- 13) Wang H D, Yuan Y M. Digital economy, search cost, and product quality [J].: 4-20.
- 14) ARYANI Y, ANDARI W. Impact of information technology and e-commerce on Indonesia's trade to ASEAN countries [R]: ADBI Working Paper Series, 2021.
- 15) AMELIANY N, IRYANI L. The impact of industry 4.0 in responding to the digital Economy's potential in indonesia at pandemic covid 19; proceedings of the 2nd International Conference on Social Science, Political Science, and Humanities (ICoSPOLHUM 2021), F, 2022 [C]. Atlantis Press.
- 16) BASUKI A T, PURWANINGSIH Y, SOESILO A M, et al. Determinants of economic growth in Indonesia: A dynamic panel model [J]. The Journal of Asian Finance, Economics and Business, 2020, 7(11): 147-56.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.