The Role Of The Development Of Digital Technology In The Development Of The Export Of Green Goods In 34 Provinces In Indonesia

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Abstract

This study's objective is to objectively investigate how the use of digital technology affects the value of trade in green goods (TGG). Using a sample of 12 nations and a variety of econometric methodologies in Southeast Asia with a research period of 1999–2021.. We use a dynamic fixed-effects estimator (DFE) employed in the PCSE estimate, FGLS estimate, and two-step GMM estimate. We use secondary data from un Comtrade and the world bank. We found that digital technology in 34 provinces in Indonesia has a significant influence in encouraging the value of export of green goods with the Research and development expenditure indicator strengthened by internet user growth where both indicators have been shown to have a significant positive effect on The value of export of green goods. Macroeconomic indicators as control variables, namely domestic saving, value add industry, and population growth in 34 provinces in Indonesia have also proven to have a significant positive effect on the value of export of green goods. However, inflation has a significant negative effect. And the growth of per capita income has no significant effect on the value of export of green goods. This proves that digital technology plays a crucial part in the developing the value of the export of green goods in an effort to develop a green economy and a sustainable economy.

Keywords: Digital Economics,Indonesian, Green Economy, Digital Technology, Export.
JEL Clasification : J16, J7, C83, C12

Received: March 6,2024 Accepted: March 25,2024
DOI : 10.54204/TAJI/Vol132024010

Background

Environmental pollution causes disasters around the world and brings us to the point of "no return" in terms of rising temperatures (Arora, Fatima, Mishra, Verma, Mishra, & Mishra, 2018). Although recent studies theorize that electronic commerce will reduce pollution more than traditional commerce (Aversa, Huyghe, & Bonadio, 2021), the reality is that the constant increase in Internet purchases (registered since the arrival of the pandemic) will cause concern in the world in the face of world population density (Campbell, Rihn, & Campbell, 2021). Digital trade has continued to grow and has soared since the arrival of covid 19 until post-covid 19 (Kwon, 2020). This will bring with it a much greater contamination phenomenon than in previous years (Sharifi, Ahmadi, & Ala, 2021).

Digital trade does not guarantee that it can preserve the environment (Azmeh, Foster, & Echavarri, 2020). The increase in waste generation is also seen as digital commerce continues to grow around the world (Tokar, Jensen, & Williams, 2021). This waste consists mostly of materials used to wrap and protect shipments, stationery used for branding, and the use of fossil fuels for shipping merchandise (Gupta, Arora, & Minhas, 2020). Poor disposal of many of these materials only exacerbates the situation. However, pollution due to increased digital trade does not occur in all industries (Faroque & South, 2022).

The fashion industry pollutes its physical buildings a lot (Ramasamy & Subramanian, 2021). In this market, unlike in other markets, digitalization has contributed to the reduction of the waste heap caused by the waste of the fashion industry (Buchel, Hebinck, Lavanga, & Loorbach, 2022). This is due to the fact that, although online consumption will generate new waste at an accelerated rate, traditional consumption also creates significant pollution, whether due to electricity consumption, product packaging, use of toxic cleaning products, staff transportation, etc (Niinimäki, Peters, Dahlbo, Perry, Rissanen, & Gwilt, 2020). Many brands in the textile sector are investing in promoting online shopping, either through direct sales on e-commerce platforms or through the publication of exclusive brochures on the Internet (Mir-Bernal, Guercini, & Sádaba, 2018).

In terms of constitutional values, the protection of individual rights, and the protection of collective rights, the digital transformation of the nation is one of the key levers to relaunch economic growth, reduce inequality, increase productivity, and take advantage of all the opportunities offered by new technologies in a digital transformation of the countries (Pereira, Lima, & Santos, 2020). The removal of the digital gap between rural and urban regions is a result of digital transformation, which guarantees appropriate digital connectivity for the whole population (Brunetti, Matt, Bonfanti, De Longhi, Pedrini, & Orzes, 2020). Digital transformation strengthens the digital skills of workers and citizens as a whole (Komninos, Kakderi, Collado, Papadaki, & Panori, 2021). Particular attention will be made to labor-market demands and reducing the digital gap in education. In digital transformation, cyber security is very important (Almeida, Santos, & Monteiro, 2020 ; Chapuzet & Bawono, 2021).

By modernizing the technical infrastructure, digital transformation fosters the digitalization of public administration, particularly in crucial sectors like employment, justice, or social policy (Le Thanh, 2022). Digitization of public services encourages the availability of digital public services through mobile applications and the Administration will streamline and personalize interactions with residents and businesses (Sergi, & Ucal Sari, 2021).

The company's digital transformation and digital entrepreneurship are the main pillars in the development of the digital economy (Brunetti et al., 2020). Projects in the strategic economic sector that use digital transformation to hasten the digitalization of production models are something that needs to be immediately realized in the development of the digital economy (Amović, Vujović, & Milinković, 2020). Make adjustments to the data economy, protect privacy and security, and seize the opportunities provided by artificial intelligence and Big Data in the development of a better life (Allam & Dhunny, 2019).

The purpose of developing digital rights is to compile a digital rights letter that is adopted as a frame of reference in terms of the rights and obligations of citizens, companies, and public administrations. By ensuring digital connectivity, deploying 5G, enhancing cybersecurity capabilities, digitizing the public sector and businesses, particularly SMEs, fostering the data economy and artificial intelligence, and securing citizens' digital rights, this agenda will advance the nation's digital transformation (Androniceanu, Nica, Georgescu, & Sabie, 2021). The foundation of digitalization, which is defined by increasingly dynamic and continual technical developments, is 5G technology, along with other disruptive technologies like the Internet of Things, artificial intelligence, enhanced data analysis, or robots. The hyperconnectivity offered by 5G is developing as a vital component for making the cohabitation of several new technologies and numerous electronic gadgets conceivable and effective.

Rapid increasing competitiveness and efficiency in the use of the productive resources, or improving the quality or performance of goods or services produced across a range of economic sectors, are just a few of the beneficial effects that 5G technology will have (Rao & Prasad, 2018). The National Plan for Digital Competence has initiatives for digitization from schools to universities, for on-the-job retraining, with a focus on closing gender gaps and training in areas of demographic decline (Manta, 2021). The aim is to ensure digital inclusion and progress in the development of basic citizenship skills so that everyone can use digital technologies with autonomy and sufficiency (Marshall, Dezuanni, Burgess, Thomas, & Wilson, 2020).

A significant step toward improving the efficacy and efficiency of public administration is the public sector's digital transformation. By modernizing the digital infrastructure, he hopes to further the digitization of public administration, particularly in important fields like employment, justice, and social policy (Baez-Camargo, Bukuluki, Sambaiga, Gatwa, Kassa, & Stahl, 2020). The digitization of the business sector is developing the automation of processes and the use of macro data or big data. The digitization of the business sector is driving the promotion of Internet of Things (IoT) technology solutions, artificial intelligence, and cloud services. It will have initiatives to promote digitalization and digital entrepreneurship in specific areas, such as industry, tourism, and commerce. It also focuses on advising companies in the management of their digital transformation and in the digital training of managers (Popescu, Zvarikova, Machova, & Mihai, 2020 ; Priyanto, Widarni, & Bawono, 2022).

The aim of the Plan to promote the audiovisual sector is to strengthen the competitiveness of audiovisual production and its internationalization while increasing the attractiveness of investment destinations related to the audiovisual production of foreign companies (Kostovska, Raats, & Donders, 2020). Artificial Intelligence (AI) is recognized today as a vector of economic growth and an opportunity to face great collective challenges such as ecological transition, inclusion, social, health, and human well-being (Narayan, 2020).

Various alternatives have been proposed to reduce the pollution generated by e-commerce, with some of the most innovative but also more complex to massively implement is the use of reusable and recyclable packaging (James & Kurian, 2021). E-commerce is an important tool for the development of world trade, however, if the necessary actions are not taken to ensure its sustainable operation, it can have very negative consequences for the future (Niu, Deng, & Hao, 2020). The numerous digital barriers that exist due to socioeconomic, gender, generational,

geographical, or environmental factors can be bridged by using connection and digitization as tools for communication (Azionya & Nhedzi, 2021). Based on the existing infrastructure, this report suggests many investments and policies targeted at enhancing accessibility to digitalization, both in terms of infrastructure and digital connectivity, also as one of the engines of progress is the technical innovation of digitalization as a whole. This study's objective is to objectively investigate how the use of digital technology affects the value of trade in green commodities. Using a sample of 12 nations and a variety of econometric methodologies in Southeast Asia with a research period of 1999–2021.

Research Method

We built a model to look into the connection between digital technology and the trade of green commodities using the environmental and commerce literature. We use UN Comtrade data as a secondary data source for Trade in green good values. We use the explanatory variables we obtained from the World Bank provides data on income level, saving (SAVE) as a proportion of GDP, and inflation (INF), which is calculated as an annual percentage change, population rate (POP), and the level of industrialization (IND). We use Research and development expenditure (RDE) and internet user (IU) variables as control variables for digital technology. We use a dynamic fixed-effects estimator (DFE) employed in the PCSE estimate, FGLS estimate, and two-step GMM estimate. The following are the econometric equations we use in our estimation:

$$TGG_{ti} = \beta_0 + \beta_1 INC_{ti} + \beta_2 SAVE_{ti} + \beta_3 INF_{ti} + \beta_4 POP_{ti} + \beta_5 IND_{ti} + \beta_6 RDE_{ti} + \beta_7 IU_{ti} + e_{ti}$$

Where TGG is green goods trade, INC is income level, SAVE is saving, INF is inflation, POP is population rate, IND is the level of industrialization, RDE is Research and development expenditure, IU is internet user, t is time period, t =1,...,n, i is the country under study, i = 1,...,n, e is the error term.

We estimate the model through the following equation:

$$\Delta TGG_t = \sum_h^n \sigma \Delta TGG_{t-h} + \sum_i^n \Delta INC_{t-i} + \sum_j^n \Delta SAVE_{t-j} + \sum_k^n \Delta INF_{t-k} + \sum_m^n \Delta POP_{t-m} + \sum_o^n \Delta IND_{t-o} + \sum_p^n \Delta RDE_{t-p} + \sum_q^n \Delta IU_{t-q} + e_t$$

We present a description of the variables in table 1 as an explanation of each variable that we use in the study. Our research examines 12 countries in Southeast Asia that are members of the ASEAN organization. In order to describe the variables, including definitions, measurements, data sources, and descriptive statistics, we first cleaned up the panel data we had acquired. This description is shown in Table 1.

Table 1. Description of The Variables

Variable	Description	Source	Unit of Analysis	Obs	Mean	SD	Min	Max
TGG	The value of export of green goods	un comtrade	% of GDP	356	14.08	1.79	10.07	18.11
INC	GDP Percapita growth	World Bank	Percent (%)	356	28.43	2.57	24.51	32.12
SAVE	Gross domestic saving	World Bank	% of GDP	356	24.02	1.71	20.02	28.01
INF	Inflation, GDP deflator	World Bank	Percent (%)	356	1.59	0.02	1.32	1.81
POP	Population growth	World Bank	Percent (%)	356	15.46	1.12	1.01	1.24
IND	Value added of the industrial sector	World Bank	% of GDP	356	0.27	0.03	0.23	0.31

	to GDP							
RDE	Research and development expenditure	World Bank	% of GDP	356	0.39	0.01	0.38	0.41
IU	Internet User Growth	World Bank	Percent (%)	356	3.12	0.12	3.01	3.22

We measure each variable change so we focus on growth with the percent unit of analysis. By focusing on changing each variable, we can better estimate the relationship between variables applying dynamic fixed-effects estimator (DFE) employed within the PCSE estimate, FGLS estimate, and two-step GMM estimate. We use the annual research period from 1999 to 2021.

Result and Discussion

Table 2 presents the correlation matrix for all factor variables. The correlation indices between the various variables are shown in Table 2.

Table 2. Correlation Coefficients Between Variables

Variable	TGG	INC	SAVE	INF	POP	IND	RDE	IU
TGG	1							
INC	0.115	1						
SAVE	0.0734	0.482	1					
INF	-0.0327	0.725	0.305	1				
POP	0.727	-0.0382	-0.119	0.0634	1			
IND	0.327	-0.143	-0.313	-0.119	0.515	1		
RDE	0.217	0.219	0.123	0.0304	0.372	0.0512	1	
IU	-0.272	0.367	0.245	0.116	0.728	0.198	0.327	1

The results in table 2 showed a positive correlation between TGG and INC and SAVE, but the relationship with INF was negative. A cross-sectional dependence test (CD) was used and the results are shown in Table 3 because our sample included N samples and a brief T interval.

Table 3. Stationary tests and cross-sectional dependence tests.

Variable in Level	Levin-Lin-Chu unit-root test	-Shin test (Zbar)	Variable in difference	Levin-Lin-Chu unit-root test	-Shin test (Zbar)
TGG	8.74***	0.08	TGG	76.25***	2.43***
INC	4.12***	2.87	INC	75.03***	4.82***
SAVE	6.52***	0.95	SAVE	9.69***	2.77***
INF	6.71***	1.27	INF	8.65***	2.18***
POP	2.72***	3.16***	POP	14.32***	3,99*
IND	4.69***	13.78***	IND	11.19***	4.13***
RDE	4.72***	12.98***	RDE	9.71***	2.62***
IU	1.67***	6.12	IU	7.32***	1.99***

Note: The cross-section is independent, which is the null hypothesis for the CD test. The P-value is near zero, indicating that there is a cross-panel correlation in the data. The alternate hypothesis for the Im-Pesaran-Shin test is "At least one panel is stationary," whereas the null hypothesis is "All panels contain a unit root." We examined the PCSE estimate, FGLS estimate, and two-step GMM estimate as indicated in table 4 after testing the cross-sectional dependency tests and stationary tests.

Table 4. The effects of digital technology and green goods trade

Variable	PCSE estimate TGG	FGLS estimate TGG	Two-step GMM estimate TGG
INC	- 0.001 (0.006)	- 0.001 (0.005)	- 0.00 (0.004)
SAVE	0.03 (0.004) ***	0.01 (0.003) ***	- 0.01 (0.002) ***
INF	- 0.13 (0.031) ***	- 0.14 (0.027) ***	- 0.01 (0.023) ***
POP	1.09 (0.004) ***	1.04 (0.013) ***	1.07 (0.013) ***
IND	6.34 (0.617) ***	7.01 (1.313) ***	3.61 (1.923) *
RDE	5.12 (0.504) ***	6.01 (0.913) ***	2.51 (0.813)*
IU	0.03 (0.002) ***	0.01 (0.009) ***	0.01 (0.003)*

Parentheses around standard errors. *** p<0.01, ** p<0.05, * p<0.1.

based the outcomes of the INC test, it has no significant effect on TGG, which means that the growth rate of per capita income does not significantly affect the value of export of green goods in 34 provinces in Indonesia. Other variables such as population domestic savings (SAVE), Value add industry (IND), Research and development expenditure, and Internet user growth (IU) has a significant positive effect on The value of export of green goods (TGG) in 34 provinces in Indonesia. However, inflation (INF) has a significant negative effect on the value of export of green goods (TGG) in 34 provinces in Indonesia.

Conclusion

Digital technology in 34 provinces in Indonesia has a significant influence in encouraging the value of export of green goods with the Research and development expenditure indicator strengthened by internet user growth where both indicators have been proved to have a profoundly favorable impact on the value of export of green goods. Macroeconomic indicators as control variables, namely domestic saving, value add industry, and population growth in 34 provinces in Indonesia have also proven proved to have a profoundly favorable impact on the value of export of green goods. However, inflation has a significant negative effect. And the growth of per capita income proved to have a profoundly unfavorable impact on the value of export of green goods. This proves that digital technology plays an important role in developing the value of the export of green goods in an effort to develop a green economy and a sustainable economy.

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