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Constructing Indonesian Digital Economy Index in Determining Economic Policy Priorities amidst the Covid-19 Pandemic

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Constructing Indonesian Digital Economy Index in Determining Economic Policy Priorities amidst the Covid-19 Pandemic

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Abstract

The constant increase in the number of internet users in Indonesia amid a sluggish economy caused by the Large-Scale Social Restriction (PSBB) policy is a great opportunity for a digital-based economy. However, the unavailability of relevant macroeconomic statistical measurements inhibits the digital economy from being determined as a policy priority amidst the Covid-19 pandemic. This study offers an alternative measurement of the digital economy of Indonesia by establishing Digital Economy Index (DEI). This study discovers that digital economic activities in Indonesia have grown rapidly with an average growth of almost nine percent quarterly. On the other hand, this study also utilizes the established index to determine its effect on the economy using the Error Correction Model (ECM). The analysis reveals that DEI has not affected GDP in the short term, but it has significantly and positively in the long term. Therefore, the government can apply this digital economy index to describe the development of digital economic activities to support the digital economy as a priority for economic policy amidst the Covid-19 pandemic.

Keywords: Covid-19; digital economy; Error Correction Mechanism (ECM)

JEL classifications: C5; O3

1. Introduction

The world was shocked by the outbreak of pneumonia of unknown etiology starting in Wuhan, Hubei Province. Upon its identification on February 11, 2020, the World Health Organization (WHO) announced that the pneumonia was a new type of coronavirus (Coronavirus disease-19 or Covid-19) (Susilo et al. 2020). This virus has spread significantly fast, reaching 118,000 cases in 114 countries and resulting in 4,291 deaths. Thus, on March 12, 2020, WHO declared Covid-19 as a global pandemic and established an emergency status (WHO 2020).

Joko Widodo, the President of the Republic of Indonesia, announced the first Covid-19 case in Indonesia on March 2, 2020. The number escalated to 81,668 cases up to July 16, 2020. The increasing number of Covid-19 cases in Indonesia is presented in Figure 1. The rapid spread of the virus forces the government to immediately contemplate the right policy priorities.

By means of the Government Regulation (PP) No 21 of 2020, Indonesia has established the Large-Scale Social Restriction (PSBB) policy to accelerate the Covid-19 handling. The PSBB policy definitely has an impact on the economy, particularly for business actors, instigating bankruptcy to a number of industries and stagnation to livelihoods (Sari, 2020). Statistics Indonesia (2020,n.d.) has predicted the economic growth of Indonesia in the midst of the Covid-19 pandemic, namely 2.97 percent (y-on-y) from the first quarter of 2019 to the first quarter of 2020, which is slower compared to that of the first quarter of 2019 that reached 5.07 percent. Furthermore, the growth in the first quarter of 2020 to the previous quarter was declined to 2.41 percent

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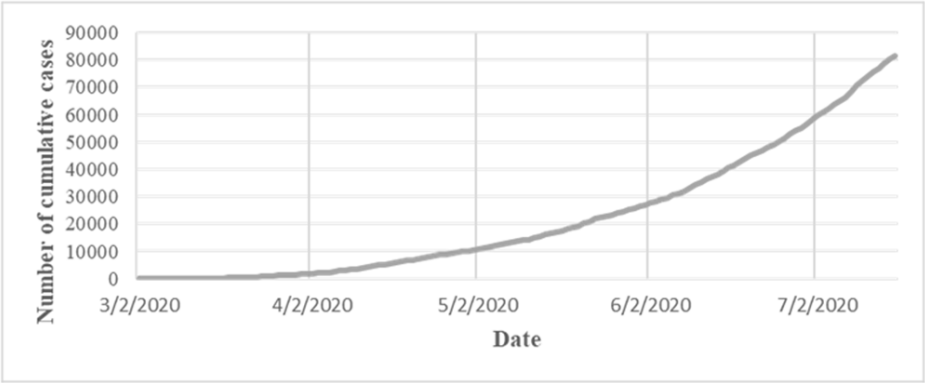

Figure 1. The Number of Covid-19 Cumulative Cases in Indonesia
Source: Worldometer (2020)

(q-to-q).

In line with the slowing economic growth, however, the Minister of Communication and Information of Indonesia, Jhony G Plate, reveals an increase in the number of internet users amidst the Covid-19 outbreak (Ministry of Communication and Information 2020). Vice President of Corporate Strategy of Telkomsel, Andi Kristanto, also asserts that the internet usage from home has increased rapidly during the pandemic, as a result of various policies that require people to conduct various activities from home.

The increase in the number of internet users as the consequence of the enactment of the government policy is a big opportunity for the digital-based economy. According to the Ministry of Communication and Information (2015,2020), digital space has a large role during the Covid-19 pandemic. In addition, through the Asia Pacific Economic Cooperation (APEC) forum, Indonesia also emphasizes the importance of the development of the digital economy as an effort to recover the economy in the Covid-19 pandemic. Thus, the Coordinating Minister for Economic Affairs, Airlangga Hartarto, states that the transformation of the economy and business towards digital, or known as digital economy, is a priority for economic policy in the midst of the crisis due to the pandemic.

Nevertheless, the importance of the digital economy in facing the Covid-19 pandemic has received limited attention. Indonesia has no comprehensive digital economic measurement tool yet. The unavailability of macroeconomic statistical measurements of the digital economy leads to an impediment for the digital economy to become a policy priority. On the other hand, monitoring and understanding the role of technology and the internet in the new economy is a priority amid this pandemic. According to Ahmad & Ribarsky (2018) and supported by Bureau of Economic Analysis/BEA (Barefoot et al. 2018), the digital economy has created new challenges in the measurements of macroeconomic statistics. Primaganis (2019) also conveys that Indonesia has no surveys, even data, to specifically monitor the development of the digital economy.

This study offers an alternative for the measurement of the digital economy of Indonesia by constructing Digital Economy Index (DEI) to support the digital economy as a policy priority during the Covid-19 pandemic and performing retracing to analyze the sources of fluctuation in the DEI values. On the other hand, this study also implements the formed index to determine its effect on the economy. This study refers to the Joint Research Center-European Commission (JRC) in 2008 that discusses the preparation of composite indicators and the BEA in 2018 that examines the definition and measurement of the digital economy as the main guidelines.

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2. Literature Review

Observed from previous related studies, it can be summarized that measuring the digital economy is a new challenge for census bureaus and other statistical institutions. Europe implements Digital Economy and Society Index (DESI) to summarize their digital performance indicators. There are five key areas in DESI, namely human capital, connectivity, digital technology integration, digital public services, and research & development in ICT. However, it is difficult to implement in Indonesia considering the limited data to match the DESI indicators. Several alternative measurements of the digital economy have been carried out in Indonesia, including ordering a digital economy satellite balance in terms of three main components, namely digital infrastructure (DI), e-commerce (EC), and digital media (DM). It can also review the digital economy through the three pillars of e-business infrastructure, e-business, and e-commerce, either through a nominal approach to total transactions using digital currencies or through the elaboration of satellite balance sheets for the digital economy that characterizes companies. Referring to the related studies, the digital economy has an influence on the economy. However, to improve the economy of a country, in addition to implementing a digital-based economic era, other factors are also required, one of which is physical investment (the realized value of domestic and foreign investment).

In addition to incomplete data, the arising problem regarding the digital economy of Indonesia is limited decision making. Based on the literature review, studies that specifically discusses digital economic activities in Indonesia are unavailable while the data on the measurements of digital economic activities in Indonesia are required to support the digital economy as a policy priority in the midst of the Covid-19 pandemic. Therefore, this study will order the digital economy index in Indonesia by utilizing three components, namely digital infrastructure (DI), e-commerce (EC), and digital media (DM). In addition, this study will also analyze the effect of the established digital economic index and physical investment on the economy.

3. Method

3.1. Theoretical Basis

3.1.1. Digital Economy

According to Bukht & Heeks (2017), the digital economy is an economy based on digital technology. Meanwhile, Encarta defines the digital economy as all types of business transactions via the internet. The Bureau of Economic Analysis (BEA) believes that the digital economy is closely related to the internet as well as information, communication and technology (ICT). Therefore, in this study, the digital economy is defined as all types of digital-based economic and business activities carried out through the internet. Barefoot et al. (2018) divides the digital economy into three main components, namely digital infrastructure, e-commerce, and digital media.

3.1.2. Digital Economy Index

The development of Digital Economy Index is one of the quantitative methods employed as an alternative in measuring digital economic activities. This index will provide a deeper understanding of the size and economic importance of the digital economy to assist policy makers, businesses, and other stakeholders in decision making. In addition, the construction of this index can also be utilized to read the direction of the movement of the national economy, especially the digital economy, and encourage corrective actions.

3.1.3. Digital Infrastructure Index

According to BEA, computer networks, such as the internet, are the basis of digital economic activities. Digital Infrastructure Index (DII) shows the availability of infrastructure composed of basic physical materials and organizational arrangements that can support the use of computer networks and the digital economy. The indicators applied to explain DII

in this study refer to Gumah & Jamaluddin (2006).

The data on each indicator of DII consist of annual data, except for CO that applies semester period, later interpolated quarterly using linear interpolation. This linear interpolation is suitable for each indicator of digital infrastructure since the addition of infrastructure generally forms a linear pattern.

3.1.4. Electronic Commerce Index

Electronic Commerce Index, or known as ECI, illustrates the prevailing transaction activities by the system in Indonesia. BEA broadly defines e-commerce as all purchases and sales of goods and services transpiring through a computer network. E-commerce transactions is deemed complete when the buyer and the seller have reached an online agreement regarding the transfer of ownership or right to use the goods or services. This online agreement, instead of the payment methods, is the benchmark for defining e-commerce. In e-commerce, only transactions with prices are measurable, while free software downloads are immeasurable. Higher ECI value indicates an increase in electronic-based trading activities.

The data on each indicator of ECI are annual data interpolated quarterly using non-cash payment patterns, namely Card-Based Payment Instruments (APMK) and Electronic Money (e-money). This approach was chosen in reference to the Katadata Insight Center (KIC), in which 76 percent of consumers use non-cash payment systems in e-commerce transactions.

3.1.5. Digital Media Index

Digital Media Index (DMI) reflects the added value of content or media through which digital economy users can create and access information. The higher the index value, the higher the output or the added value produced. It indicates the increasing use of digital media in a country. BEA defines digital media as the content to be used by an individual to create, access, store, or find information on digital devices. Furthermore, Statista (2019) defines digital media as audiovisual media content and applications distributed directly through the internet, including digital video content (films, series, and TV shows) and digital music that can be downloaded digitally or streamed through the internet as well as the content published electronically such as eBooks, eMagazines, or ePapers.

The indicators used to explain DMI in this study refer to Statista (2019). In Statista (2019), digital media are explained through four indicators, including video games, video-on-demand, e-publishing, and digital music. This study employed application and digital game developers (DAG) as the proxy for video games; videos, animations, and films (VAF) as the proxy for video-on-demand; ePublishing (EP); and digital music (DMU).

The data on DII are annual data quarterly interpolated using the patterns of the number of people searching with predetermined keywords obtained through Google Trends. Conceptually, digital media indicators have to cover all digital-based content. However, due to data limitations, the content utilized in this regard is the content or media considered to have a great value on a digital basis.

3.2. Data

The data used in the formation of DEI in this study were secondary data collected from various sources, all of which were quarterly data from 2010–2017, whose details and sources are presented in Table 1 and 2.

3.3. Analysis Method

3.3.1. The Procedure for Constructing Digital Economy Index (DEI)

The formation of DEI in this study refers to the Joint Research Center (2008), the procedures of which are explained by the following points.

1. Building a theoretical framework and determining variables
   In building a theoretical framework, one needs

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Table 1. Variables and Sources of Indicators Constructing Digital Economy Index (DEI)

Subindex	Variable	Indicator	Source
(1)	(2)	(3)	(4)
DII	Internet usage (% of population) *	IU	World Bank
	Secure internet server (unit) *	SIS	World Bank
	Mobile cellular subscriptions (unit) *	MCS	World Bank
	Computer ownership (%) **	CO	BPS
ECI	Retail e-commerce (billion dollar) *	REC	eMarketer
	Digital buyer (millions) *	DB	eMarketer
DMI	Digital application and game developer (billion rupiahs) *	DAG	Bekraf
	Video, animation, and film (billion rupiahs) *	VAF	Bekraf
	e-Publishing (billion rupiahs) *	EP	Bekraf
	Digital music (billion rupiahs) *	DM	Bekraf

Note: * Variable with the beginning of the annual period
** Variable with the beginning of the semester period
BPS - Statistics Indonesia (2014,2018)
Bekraf - Creative Economy Agency

Table 2. Variables and Sources of Macroeconomics

Variable	Unit	Source
(1)	(2)	(3)
Gross Domestic Product on the Basis of Constant Price (ADHK) ***	billion rupiahs	Statistics Indonesia (2020,n.d.)
The Realized Value of Domestic investment (PMDN) ***	trillion rupiahs	Indonesian Investment Coordinating Board (BKPM)
The Realized Value of Foreign investment (PMA) ***	trillion rupiahs	Indonesian Investment Coordinating Board (BPKM)

Note: * Variable with the beginning of the annual period

to first clearly define the phenomena that will be measured. In this study, the phenomena to be measured are digital economic activities in Indonesia. There are three dimensions explaining the digital economy, namely Digital Infrastructure Index (DII), Electronic Commerce Index (ECI), and Digital Media Index (DMI).

2. Data normalization
Data normalization was performed as the indicators employed in the formation of DEI in this study have different units of measurement. The method used was the min-max normalization method. This method will change the value of each indicator to a value between 0 and 1. The min-max normalization method is presented in the following formula:

$$\mathrm{l_k^t} = \frac{\mathrm{x_k^t} - \min(\mathrm{x_k})}{\max(\mathrm{x_k}) - \min(\mathrm{x_k})}; \quad \mathrm{k} = 1, 2, \ldots, 10; \mathrm{t} = 1, 2, \ldots, 32 \quad (1)$$

Information:
$\mathrm{l_k^t}$: the normalized value of the k-indicator at time t;
$\mathrm{x_k^t}$: the original value of the k-indicator at time t;
$\min(\mathrm{x_k})$: the minimum value of the target / possible value / data on the k-indicator;
$\max(\mathrm{x_k})$: the maximum value of the target / possible value / data on the k-indicator.

3. Weighting and aggregation
Weighting was conducted to obtain the values of DEI and subindexes. In this study, both weighting and aggregation were performed using the equal weighting method. The aggregation is formulated as follows:

$$\overline{\mathrm{DEI_t}} = \frac{4\overline{\mathrm{DII_t}} + 2\overline{\mathrm{ECI_t}} + 4\overline{\mathrm{DMI_t}}}{10} \quad (2)$$

$$\overline{\mathrm{DII_t}} = \frac{\sum_{i=1}^{4} \mathrm{DII_{it}}}{4} = 0.25\mathrm{DII_{1t}} + 0.25\mathrm{DII_{2t}} + 0.25\mathrm{DII_{3t}} + 0.25\mathrm{DII_{4t}} \quad (3)$$

$$\overline{\mathrm{ECI_t}} = \frac{\sum_{i=1}^{2} \mathrm{ECI_{it}}}{2} = 0.5\mathrm{ECI_{1t}} + 0.5\mathrm{ECI_{2t}} \quad (4)$$

$$\begin{aligned}\overline{\mathrm{DMI_t}} &= \frac{\sum_{i=1}^{4}\mathrm{DMI_{it}}}{4} = 0.25\mathrm{DMI_{1t}} \\ &+0.25\mathrm{DMI_{2t}} + 0.25\mathrm{DMI_{3t}} \\ &+0.25\mathrm{DMI_{4t}} \end{aligned} \quad (5)$$

Information:
$\overline{\mathrm{DEI_t}}$: the value of the aggregate digital economy index in the t-year;
$\overline{\mathrm{DII_t}}$: the value of the digital infrastructure subindex in the t-year;
$\overline{\mathrm{ECI_t}}$: the value of the electronic commerce subindex in the t-year;
$\overline{\mathrm{DMI_t}}$: the value of digital media subindex in the t-year.

4. Presentation of indexes
DEI that has been formed will be presented in graphs and tables with the aim of facilitating a descriptive analysis. Afterwards, DII, ECI, and DMI will also be visualized in a heat map to further analyze the sources of movement in digital economic activities in Indonesia.

3.3.2. Procedure for Building an Error Correction Mechanism (ECM) Model

1. Data Stationarity Test
Stationarity test was conducted on all research variables using the Augmented Dickey-Fuller (ADF) unit root test. Supposing the research variable is not stationary at the level but stationary at the same difference, it shows an initial indication or fulfillment of the necessary conditions for a cointegrated regression relationship.

2. Formulating the Long-Term Regression Equation
The long-term regression equation in the ECM model is generated by the Ordinary Least Square (OLS) estimation method. Referring to the Cobb-Douglass production function, the relationship between input (physical capital) and output (GDP) is nonlinear, thus:

$$\begin{aligned}\mathrm{GDP} &= \mathrm{f(PMDN, PMA)} \\ &= \mathrm{PMDN}^{\alpha}\mathrm{PMA}^{\beta}\mathrm{e}^{\varepsilon}\end{aligned} \quad (6)$$

to ensure the further understanding and operation, the equation is changed to a linear form by transforming it into a logarithmic form. Thus, the mathematical equation is obtained as follows:

$$\ln \mathrm{GDP} = \alpha \ln \mathrm{PMDN} + \beta \ln \mathrm{PMA} + \varepsilon \quad (7)$$

In addition to physical capital, referring to ITU (2018), GDP is also influenced by a new era of digitalization. Therefore, the long-term equation formed is written as follows:

$$\begin{aligned}\ln\_\mathrm{GDP_t} &= \beta_0 + \beta_1\mathrm{DEI_t} + \beta_2 \ln\_\mathrm{PMDN_t} \\ &+\beta_3 \ln\_\mathrm{PMA_t} + \mathrm{v_t}\end{aligned} \quad (8)$$

Information:
$\ln\_\mathrm{GDP_t}$: the natural logarithm of Gross Domestic Product (GDP) at constant prices in the t-period;
$\mathrm{DEI_t}$: the Digital Economy Index (DEI) value in the t-period;
$\ln\_\mathrm{PMDN_t}$: the natural logarithm of the realized value of domestic investment in the t-period;
$\ln\_\mathrm{PMA_t}$: the natural logarithm of the realized value of foreign investment in the t-period;
$\mathrm{v_t}$: residual long-term equation in the t-period;
β_0 : *intercept*;
$\beta_1, \beta_2, \beta_3$: i-independent variable regression coefficient.

3. Cointegration Test
Cointegration test in this study applied the Augmented Dickey-Fuller (ADF) unit root test on the residuals from the estimation results of the long-term equation $\mathrm{v_t}$, where the variables are not stationary at the level (equation 6). The stationary residual value at the level reveals a significance level of 5 percent of the non-stationary variables in the equation, clarifying cointegration and a long-term balance.

4. Formulating the Short-Term Regression Equation (ECM Equation)
Similar to the long-term equation, the short-term equation or ECM equation is formulated using Ordinary Least Square (OLS) regression. However, the regression in this regard is performed on variables initially non-stationary at the level but stationary at the same difference level as

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well as on the first lag of the residual results that have been obtained previously from the long-term equation. The short-term equation is written as follows:

$$\begin{aligned} \mathrm{D}(\ln\_\mathrm{GDP_t}) &= \beta_0 + \beta_1 \mathrm{D}(\mathrm{DEI_t}) \\ &\quad + \beta_2 \mathrm{D}(\ln\_\mathrm{PMDN_t}) \\ &\quad + \beta_3 \mathrm{D}(\ln\_\mathrm{PMA_t}) + \mathrm{ECT_{t-1}} \\ &\quad + \varepsilon_t \end{aligned} \tag{9}$$

The value β_4 in the short-term equation reveals that the expected speed of adjustment is negative and significant. Greater value of the speed of adjustment indicates even greater response to the deviation of the previous period, immediately making adjustments to the long-term balance.

5. The Significance of the Model Test
   The significance of the model test was conducted to observe how well the regression model is formed through the coefficient of determination indicators, partial significance test (t-test), and simultaneous significance test (F-test).

6. Classical Assumption Test
   The classical assumption test in this study consists of tests of normality, homoscedasticity, non-autocorrelation, and non-multicollinearity, carried out respectively using the Jarque-Berra test, the White test, the Breusch-Godfrey test or Lagrange Multiplier test, and by calculating the value of Variance Inflation Factors (VIF).

4. Results and Analysis

4.1. Constructing the Digital Economy Index (DEI)

4.1.1. Digital Economy Index (DEI)

DEI or digital economic index that reflects digital economic activities in Indonesia is established by three sub-indexes, namely Digital Infrastructure Index (DII), Electronic Trade Index (ECI), and Digital Media Index (DMI).

Referring to Figure 2, it is evident that Digital Economy Index (DEI) of Indonesia in 2010–2017 has a positive trend and a tendency to increase every period. At the beginning of the study period, the value of DEI of Indonesia only reaches 0.1463 or 14.63 percent. Meanwhile, in the fourth quarter of 2017, the value of DEI nearly reaches 70 percent, precisely 0.6828 or 68.28 percent. It is comparable to the digital economy and society index (DESI) of Europe, where the digital economy is increasing annually with a positive trend. This positive DEI trend is an indication that the digital economy of Indonesia has potential that should not be underestimated (Wirabrata 2016).

Discussing the digital economy is inseparable from debating the economic conditions of a country. As a validation, the formed DEI will then be compared with Gross Domestic Product. Figure 3 illustrates the growth of DEI of Indonesia towards a positive trend, in line with the quarterly GDP growth of Indonesia. It shows that DEI is valid to describe the condition of the digital economy of Indonesia.

4.1.2. Digital Economy of Indonesia Based on the Dimensions

One of the limitations in compiling the index is the difficulty in retracing the previous index (Gustiana 2018). Retracing is carried out to observe the sub-indexes as the sources of development in the aggregate index, in this regard DEI. Therefore, this study employed a heat map to retrace and analyze the sources of the fluctuating values of Digital Economy Index (DEI) of Indonesia.

The heat map is presented in gradations of color from black to white (Figure 4). The black color means low values, indicating the low role or contribution of sub-indexes to the development of digital economic activities. Likewise, the white color means high values, implying the high role or contribution of the sub-indexes to digital economic activities. The gradations of color from the positive value to the point 0 will be referred to as positive gradation,

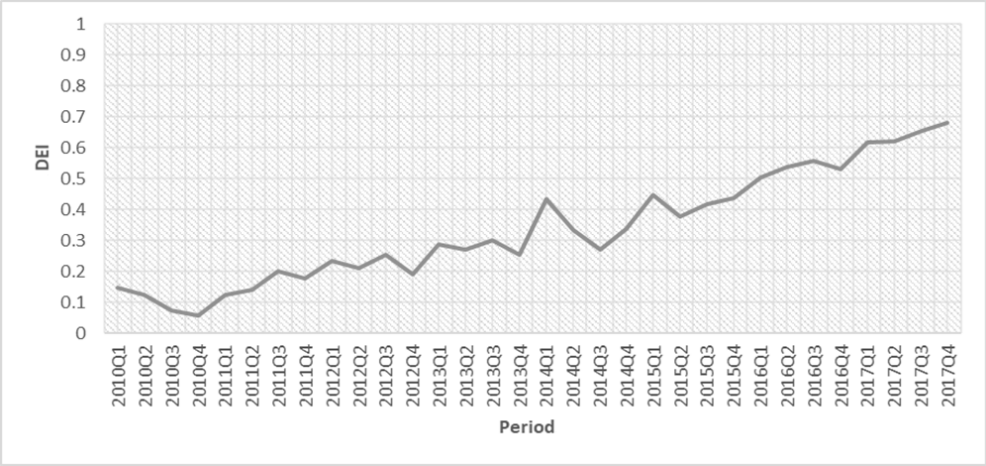

Figure 2. The Graphic Movement of Digital Economy Index (DEI) of Indonesia
Source: Statistics Indonesia [bps.go.id, accessed September 2020]

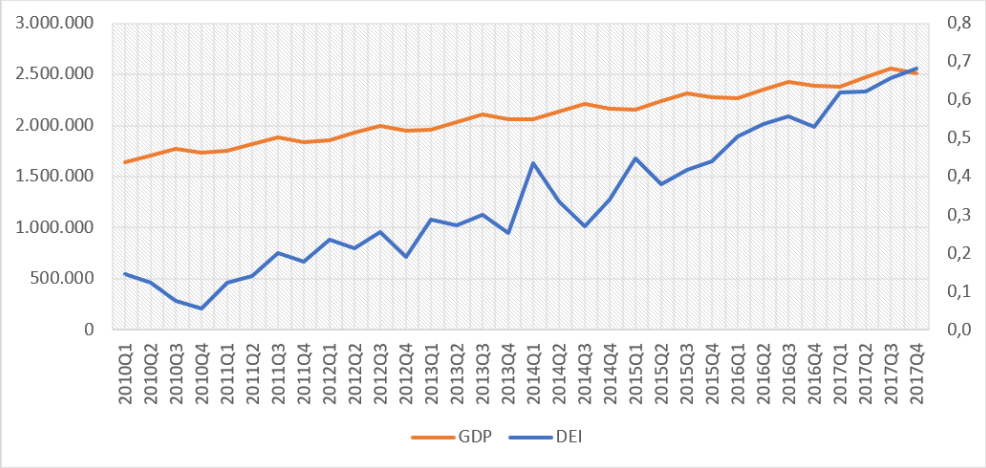

Figure 3. Gross Domestic Product (GDP) and Digital Economy Index (DEI) of Indonesia
Source: Statistics Indonesia [bps.go.id, accessed September 2020 and processed data]

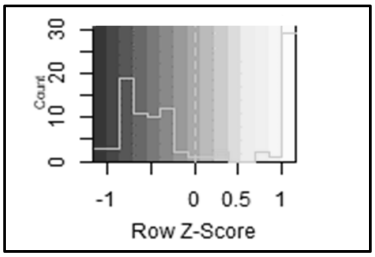

Figure 4. Color Key Heat Map

while the gradations of color from the point 0 to the negative value will be called negative gradation.

Figure 4 shows that the three sub-indexes of DEI, namely DII, ECI, and DMI, show varying positive and negative gradation, indicating the varied roles or weights of the sub-indexes over time. Observing DII, the negative gradation dominates the heat map, mainly towards the end of the period, implying that infrastructure and the internet as the facilities supporting access to the technology to support digital economy of Indonesia gradually have less role or contribution to the development of digital economic activities.

Nevertheless, it does not necessarily signify the

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decline of the infrastructure supporting the digital economy of Indonesia, as Figure 2 displays an increase instead, even though it tends to be slow compared to ECI. It implies that the relatively insignificant growth allow the contribution of infrastructure supporting the digital economy of Indonesia to be increasingly displaced by the role of other subindexes. In addition, Rohman (2019) in "Digital Economy Understanding the Core Concepts and The Overlooked Areas" suggests that the digital economy of Indonesia remains primarily focusing on other aspects, namely online-based commerce (e-commerce).

It is observed in Figure 5 that ECI, reflecting the development of trade in goods and services through a computer network (e-commerce), is the only subindex with a tendency to move from negative to positive gradation. It indicates that e-commerce in Indonesia is increasingly developing, explaining its growing role or contribution to the development of digital economic activities in Indonesia. The development of e-commerce in Indonesia began at the end of 2014, precisely in the third quarter of the year, in line with the statement released by Ministry of Communication and Information Technology (2015) that Indonesia began to have an enormous business value of e-commerce industry at the end of 2014.

Different from DII, DMI is dominated by positive gradation. It suggests that digital media as audiovisual media content and applications that are distributed directly through the internet are highly developed in Indonesia, capable of providing a large role for digital economic activities. The black color for this subindex is only discovered in the fourth quarter of 2010, as a result of the implementation of site blocking as an effort to eradicate pornography. Site blocking has an impact on the loss of ad revenues, such as experienced by *kompas.com* and *detik.com*, since ad revenues are the mainstay of digital media. However, this negative gradation is short-lived as DMI improves in the first quarter of 2015, marked by the positive gradation. However, at the end of the study, DMI shows a downtrend to negative gradation. It conveys a negative signal for digital economic activities in Indonesia.

4.2. Forming the Error Correction Mechanism (ECM) Model

4.2.1. Data Stationarity Test

This analysis begins with stationarity test on each variable using the Augmented Dickey-Fuller (ADF) unit root test, the results of which are presented in Table 3.

Based on the results displayed in Table 3, it is concluded that all variables in the study are not stationary at the level but stationary at *first difference* with a significance level of 5 percent.

4.2.2. Estimation of Long-Term Equation

Based on the output, a long-term regression equation is formulated as follows:

$$\begin{aligned}(\ln\widehat{\_GDP})_t &= 13.519^* + 0.1338(\mathrm{DEI})_t^* \\ &\quad +0.0606(\ln\_\mathrm{PMDN})_t^* \\ &\quad +0.1826(\ln\_\mathrm{PMA})_t^* \qquad (10)\end{aligned}$$

Observed from the output, the value of *Prob(F-Statistic)* in the long-term model is smaller than α (0.05), meaning that there is at least one variable with a significant effect on GDP between DEI and physical capital represented through the realized value of domestic investment and the realized value of foreign investment. Overall, independent variables have smaller *p-value* than α (0.05), indicating that with a significance level of 5 percent, DEI, PMDN, and PMA partially have a significant effect on the economy, in this regard GDP, in the long run.

Adjusted R^2 in the long-term model shows a value of 0.9781 or 97.81 percent, meaning that the variables included in the model can explain 97.81 percent of the diversity of GDP values, while the other 2.19 percent is explained by variables outside the model.

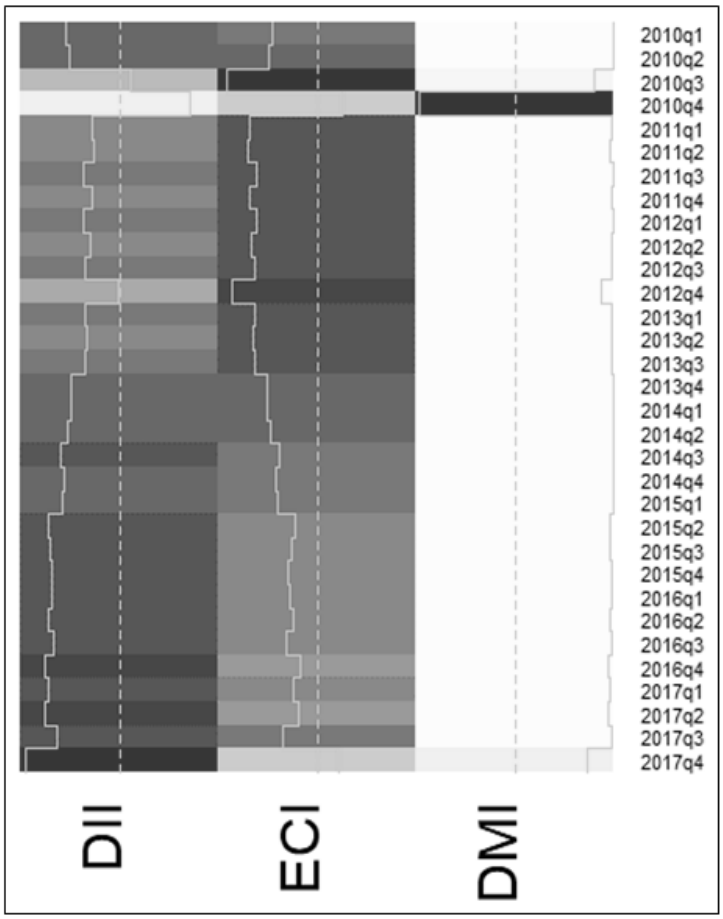

Figure 5. The Heat Map of DEI

Table 3. The Results of Stationarity Test on Level and First Difference

Variable	Notation	*p-value*	
		Level	*first difference*
(1)	(2)	(3)	(4)
LN Gross Domestic Product	ln_GDP	0.6756	0.0001
Digital Economy Index	DEI	0.9793	0.0000
LN Realized Value of Domestic investment	ln_PMDN	0.5206	0.0001
LN Realized Value of Foreign investment	ln_PMA	0.3978	0.0000

4.2.3. Cointegration Testing

The results of cointegration test are presented in the following Table 4.

Table 4. The Results of Cointegration Test

Variable	*t-statistic*	*p-value*
(1)	(2)	(3)
ECT	-4.8437	0.0005

Observed from the results of cointegration test, *p-value* is smaller than α (0.05), thus H0 is rejected. It means that the residuals of the long-term equations that have been formed are stationary at the level with a significance level of 5 percent, proving cointegration between independent variables. Therefore, the next step is to formulate a short-term equation (ECM).

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4.2.4. Estimation of Error Correction Mechanism (ECM)

Upon identifying cointegration between independent variables, a short-term equation model (ECM) will be built. The long-term regression equation obtained is as follows:

$$\begin{aligned} \mathrm{D}(\ln\_\widehat{\mathrm{GDP}})_{\mathrm{t}} &= 0.0050 - 0.0016\mathrm{D}(\mathrm{DEI})_{\mathrm{t}} \\ &\quad +0.0451(\ln\_\mathrm{PMDN})^{*}_{\mathrm{t}} \\ &\quad +0.1382(\ln\_\mathrm{PMA})^{*}_{\mathrm{t}} \\ &\quad -0.8769(\mathrm{ECT})^{*}_{\mathrm{t-1}} \end{aligned} \quad (11)$$

Referring to the output, the values of *Prob (F-Statistic)* obtained are smaller on the short-term model than α (0.05). It implies that there is at least one variable with a significant effect on GDP among the fluctuating DEI, PMDN, and PMA in the short run. DEI has a higher *p-value* than α (0.05), hence the conclusion that DEI has no significant effect on GDP in the short term. Meanwhile, the realized value of domestic and foreign investments has smaller *p-value* than α (0.05). It suggests that the two variables partially have a significant short-term influence on GDP.

Adjusted R^2 value in the short term model (ECM) is 0.5325 or 53.25 percent, signifying that the variables included in the model are able to explain 53.25 percent of the diversity of GDP values in the short term, while the remaining 46.75 percent is explained by variables outside the model. Furthermore, the coefficient value of ECTt-1 or the value of *speed of adjustment* is -0.8769 and significant (*p-value* is smaller than α (0.05)). It means that, at the 5 percent significance level, the existing short term imbalance will be corrected in a long term balance in the first quarter period by 87.69 percent, while another 12.31 percent will be corrected in the next period.

4.2.5. Classical Assumption Test

Upon obtaining a short-term equation, the classical assumption test for the equation is displayed in Table 5.

Observed from this summary, it is concluded that all classic assumptions are fulfilled with a significance level of 5 percent.

4.3. The Effect of Digital Economy Index on GDP

In the short term, Digital Economy Index that reflects digital economic activities has not been proven to have a significant effect on GDP of Indonesia. This phenomenon indicates that changes in digital economic activities in Indonesia are not immediately responded to by the economy. It is most likely due to the difficulty in building an effective environment to support the digital economy as a booster of the economy of a country in the short period. In addition, the development of economic transaction activities through internet media (online) in the short term has an impact on people who remain dependent on the conventional economy. The increase in digital economic transactions actually results in a decrease in conventional economic transactions. It causes an insignificant increase of revenue from online-based business transactions.

However, Indonesia can view the digital economy as a hope for new economic resources. Even though the short-term contribution of the digital economy to the economy is insignificant, Digital Economy Index in the long term is proven to have a significant and positive influence on the economy. It indicates that the digital economy has an important role in the economy of a country.

The conventional economy that initially becomes disadvantaged by the digital economy in the short term will contribute and play an important role in the long term. It is viable due to the potential conventional economic adjustments dominated by micro, small and medium enterprises (MSMEs/*UMKM*) from the conventional system to an online-based economic system in the long term. Moreover, an online transaction system, believed to be able to minimize the production costs and barriers to entry, will benefit the majority of the people of Indonesia engaged in micro, small and medium enterprises

Table 5. Summary of Classical Assumption Test

Assumption	Testing	Statistical Calculations	*p-value*	Decision
Normality	*Jarque-Bera*	2.3895	0.3028	H_0 is rejected (assumptions are fulfilled)
Homoskedasticity	*White*	15.7869	0.3266	H_0 is rejected (assumptions are fulfilled)
Nonautocorrelation	*Breusch-Godfrey*	0.0464	0.8480	H_0 is rejected (assumptions are fulfilled)
Nonmulticollinearity	*Variance Inflation Factor*	Value of VIF <10		(assumptions are fulfilled)

(MSMEs/*UMKM*). The emergence of cooperation between economic actors to facilitate transactions allows more practical and more attractive transactions to consumers, encouraging MSMEs/*UMKM* to be involved in the digital economy.

5. Conclusion

Based on the results and discussion of the study, it is concluded that Digital Economy Index (DEI) as a measurement of digital economic activities in the midst of the Covid-19 pandemic, formed from three subindexes consisting of Digital Infrastructure Index (DII), Electronic Commerce Index (ECI), and Digital Media Index (DMI), can explain the development of digital economic activities in Indonesia. As evidenced by the analysis, the digital economy has not significantly affected GDP in the short term. However, the digital economy has a significant and positive influence on GDP in the long run. Therefore, the government can use this digital economic index to describe the development of digital economic activities to support the digital economy as a priority for economic policy amid the Covid-19 pandemic.

References

[1] Ahmad, N & Ribarsky, J 2018, 'Towards a framework for measuring the digital economy', *Paper prepared for the 16th Conference of IAOS*, OECD Headquarters, Paris, France, 19-21 September 2018, viewed September 2020, <https://www.oecd.org/iaos2018/programme/IAOS-OECD2018_Ahmad-Ribarsky.pdf>.

[2] Barefoot, K, Curtis, D, Jolliff, W, Nicholson, JR, & Omohundro, R 2018, 'Defining and measuring the digital economy', *Working Paper 3/15/2018*, Bureau of Economic Analysis, Washington, DC, viewed September 2020, <https://www.bea.gov/research/papers/2018/defining-and-measuring-digital-economy>.

[3] Bukht, R & Heeks, R 2017, 'Defining, conceptualising and measuring the digital economy', *Development Informatics Working Paper, 68*, Centre for Development Informatics, viewed September 2020, <https://diodeweb.files.wordpress.com/2017/08/diwkppr68-diode.pdf>.

[4] Gumah, ME & Jamaludin, Z 2006, 'What is the digital economy, and how to measure it', *Conference Paper*, Knowledge Management International Conference and Exhibition 2006 (KMICE 2006), 6-8 June 2006, The Legend Hotel Kuala Lumpur, Kuala Lumpur, Malaysia.

[5] Gustiana, A 2018, *Aggregate financial stability index dan sumber instabilitas sistem keuangan Indonesia menggunakan change point analysis dan heatmap* (Undergraduated thesis, Polytechnic of Statistics STIS).

[6] Joint Research Centre-European Commission, 2008, *Handbook on constructing composite indicators: methodology and user guide*, OECD Publishing.

[7] Ministry of Communication and Information Technology 2015, 22 November, *Indonesia akan jadi pemain ekonomi digital terbesar di Asia Tenggara*, viewed September 2020, <https://www.kominfo.go.id/content/detail/6441/indonesia-akan-jadi-pemain-ekonomi-digital-terbesar-di-asia-tenggara/0/berita_satker>.

[8] Ministry of Communication and Information Technology 2020, 24 April, *Terjadi pergeseran penggunaan Internet selama masa pandemi*, viewed September 2020, <https://kominfo.go.id/content/detail/26060/terjadi-pergeseran-penggunaan-internet-selama-masa-pandemi/0/berita_satker>.

[9] Primaganis, LD 2019, *Digital economy: Pengukuran dan pengaruhnya terhadap perekonomian di Indonesia* (Polytechnic of Statistics STIS, Undergraduated thesis).

[10] Rohman, IK 2019, 'Digital economy, understanding the core concept and the overlooked areas', *A former research fellow at European Commission and United Nation University*.

[11] Sari, D 2020, 'Fenomena ekonomi dan perdagangan Indonesia di masa pandemi Corona Virus Disease-19 (Covid-19)', *Jurnal Akuntansi dan Investasi*, vol. 5, no. 1, pp. 81-93. doi: http://dx.doi.org/10.35835/aktiva.v5i1.840.

[12] Statista 2019, *Internet usage worldwide - Statistics & facts*, viewed September 2020, <https://www.statista.com/topics/1145/internet-usage-worldwide/>.

[13] Statistics Indonesia, n.d., *Produk Domestik Bruto*, viewed September 2020, <https://sirusa.bps.go.id/sirusa/index.php/variabel/1302>.

[14] Statistics Indonesia, 2014, *Statistik telekomunikasi Indonesia 2013*, BPS.

[15] Statistics Indonesia, 2018, *Statistik telekomunikasi*

https://scholarhub.ui.ac.id/efi/vol68/iss1/5
DOI: 10.47291/efi.2022.05

Indonesia 2017, BPS.

[16] Statistics Indonesia, 2020, *Pertumbuhan ekonomi Indonesia triwulan I-2020*, BPS.

[17] Susilo, A, Rumende, CM, Pitoyo, CW, Santoso, WD, Yulianti, M, Herikurniawan, Sinto, R, Singh, G, Nainggolan, L, Nelwan, EJ, Chen, LK, Widhani, A, Wijaya, E, Wicaksana, B, Maksum, M, Annisa, F, Jasirwan, COM, & Yunihastuti, E 2020, 'Coronavirus disease 2019: Tinjauan literatur terkini', *Jurnal Penyakit Dalam Indonesia*, vol. 7, no. 1, pp. 45-67.

[18] WHO 2020, 11 March, *WHO Director-General's opening remarks at the media briefing on COVID-19*, World Health Organization, viewed September 2020, <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>.

[19] Wirabrata, A 2016, 'Prospek ekonomi digital bagi peningkatan pertumbuhan ekonomi', *Majalah Info Singkat Ekonomi dan Kebijakan Publik*, vol. 8, pp. 13-16.

[20] Worldometer 2020, *Total Covid-19 cases in Indonesia*, viewed September 2020, <https://www.worldometers.info/coronavirus/country/indonesia/>.