The Development of Digital Technology and Its Impact on Indonesia's Economic Growth

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ABSTRACT

Currently, the world is in the industrial revolution 4.0 (digitalization) phase, which affects the economic conditions of each country. This study aims to analyze the development of digital technology in Indonesia and its impact on Indonesia's economic growth. Descriptive and panel data analysis for 2018-2021 are used to answer the research objectives. The study results show that Indonesia's economic growth in 2018–2021 shows fluctuating conditions. Meanwhile, the development of digitalization in Indonesia tends to increase every year. The study's results also found that the development of digital technology positively affected Indonesia's economic growth. The variables of investment, road length infrastructure, education index, and labor force participation rate also positively affect Indonesia's economic growth. In contrast, the open unemployment rate variable has a negative effect on Indonesia's economic growth.

Keywords: digitalization, economic growth, infrastructure, panel data, technology

INTRODUCTION

Economic growth in Indonesia tends to fluctuate during 2018-2021. In 2018, Indonesia's economic growth rate was 5.17 percent and decreased in 2019 and 2020 to 5.02 percent and -2.07 percent, respectively. The decline in economic growth in 2020 was caused by the Covid-19 pandemic, which caused many economic activities to stop. However, in 2021, Indonesia's economic growth will show 3.69 percent (BPS 2022). This indicates that economic growth increased significantly (a rise of 5.76 percent).

Sukirno (2013) defines economic growth as the expansion of economic activities which results in increased output through production activities and improves community welfare. Ginting and Rasbin (2010) emphasized that economic growth can be used to determine the extent to which economic activity in a place increases income or raises living standards over time. The welfare of society through economic growth can be felt from activities that support the economic situation in a certain period (Erdkhadifa 2022).

According to Todaro and Smith (2004), technological improvements are one of the main drivers of economic growth apart from the accumulation of capital goods and population growth. Technological developments also enter various sectors such as trade, education, finance, health, and so on, eventually forming a digital market that connects service providers and users so that the community can enjoy technological developments (Fuady 2018). Neo-classical economic growth theory reveals that the development of production and technological progress factors are the main determinants of economic growth from time to time (Sukirno 2013).

According to Maria and Widayati (2020), several positive and negative impacts are occurring in the current digitalization era, namely: a) increasing individual capabilities in industry through the use of technology by

increasing the type of production and business; b) simplify the acquisition of information and long-distance trading; c) provide financial services that facilitate economic transactions; d) creating new business prospects (e-business); e) increase the economic productivity of a country; f) improve soft skills; and g) increasing foreign investment into Indonesia as a result of advances in digital technology, particularly in the technology industry. However, apart from the positive impacts, there are negative impacts from digitalization, namely the threat of misuse of technology to commit criminal acts such as hacking the banking system, fraud, and so on, which can be detrimental to various parties.

Selan and Wahyuni (2022) reveal that the development of digital technology in Indonesia can be seen from the value of the Information and Communication Technology Development Index (ICT-DI). As seen in Figure 1, the value of ICT-DI in Indonesia in the 2018-2021 period has consistently increased. ICT-DI values that increased also occurred in the ICT-DI sub-index values.
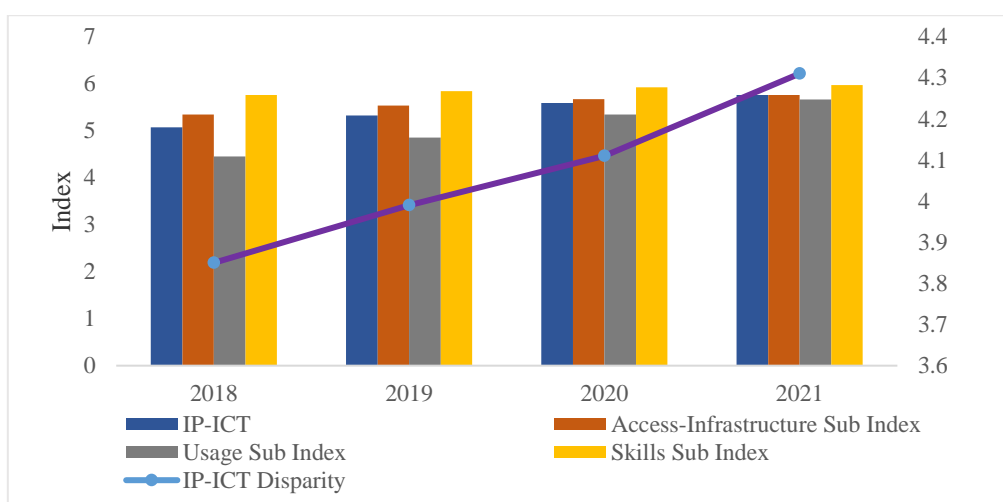
Source: Central Bureau of Statistics 2022
Figure 1 Development and disparity of ICT-DI in Indonesia 2018-2021

But on the other hand, the disparity in ICT development between provinces in the 2018-2021 period has increased. This is shown by the widening gap between provinces with the lowest and highest ICT-DI, namely 3.85 in 2018 to 4.31 in 2021. The disparities that occur between provinces can occur due to several indicators. Differences in the ownership and use of mobile phones between urban and rural areas exemplify this inequality. According to BPS data (2022), an average of 70.52 percent of the population in urban areas owns or uses a cellphone, compared to 54.95 percent in rural areas.

Based on the description above regarding the phenomenon of economic growth and the development of information and communication technology that occurred in Indonesia, this research aims to analyze the development of digital technology and its impact on Indonesia's economic growth.

MATERIALS & METHODS

The following are the types and sources of research data shown in Table 1.

Table 1. Types of variables and data sources

Variable	Information	Units	Source of Data
LnGDRP	GDRP at Constant Prices	Billion Rp	BPS
LnOCLP	Persentage of Population Owning/Operating Cell Phones	Percent	BPS
LnIBTS	Infrastructure Base Transceiver Station	Unit	BPS
LnINVT	Investment	Billion Rp	BPS
LnINRL	Road Length Infrastructure	Km	BPS
LnEDIX	Education Index	Index	BPS

LnLFPR	Labor Force Participation Rate	Percent	BPS
LnOUNR	Open Unemployment Rate	Percent	BPS

In addition, this article uses two methods of analysis, namely descriptive analysis and panel data regression analysis. Descriptive analysis is a simple technique used to explain research findings clearly. Descriptive analysis describes the economic growth and development of ICT in Indonesia. The description of economic growth is shown based on GDRP achievements in each province. Meanwhile, the ICT description is emphasized on ICT-DI values and their sub-indices. Descriptive analysis is also used to provide an overview of the relationship between economic growth and the development of digital technology in Indonesia.

Panel data regression is a data processing technique that combines cross-section data with time series data. According to Gujarati (2004), in panel data, three general estimation models are applied to the data; these models consist of the Common Effect Model or Pooled Least Square (PLS), Fixed Effect Model (FEM), and Random Effect Model (REM). To determine the selection of the model to be used, the Chow Test and Hausman Test are first carried out. Furthermore, a model suitability test is carried out to prove that the model used has estimation accuracy, is not biased, is constant, or meets the BLUE (Best Linear Unbiased Estimator) criteria. The model suitability test is carried out through classical assumption tests based on statistical and econometric criteria. Statistical criteria tests include F-statistical, T-statistical, and Coefficient of Determination Test (R-squared). Meanwhile, econometric criteria tests include normality, multicollinearity, heteroscedasticity, and autocorrelation tests. To answer research objectives related to the impact of digital technology developments and other determinants on Indonesia's economic growth, the model used in this research is:

$$lnGDRP_{it} = \alpha_0 + \beta_1 lnOCLP_{it} + \beta_2 lnIBTS_{it}$$
$$+ \beta_3 lnINVT_{it} + \beta_4 lnINRL_{it}$$
$$+ \beta_5 lnEDIX_{it} + \beta_6 lnLFPR_{it}$$
$$+ \beta_7 lnOUNR_{it} + \varepsilon_{it}$$

STATISTICAL ANALYSIS

Panel data regression is used in this study to determine the impact of digital technology developments and other driving factors on Indonesia's economic growth. We analyzed the data using the computer program E-views version 10.

RESULT AND DISCUSSION

### Overview of Indonesia's Economic Growth

Overall, the economic growth rate in the 2018-2021 period tends to fluctuate (Figure 2). In 2020, economic growth contracted due to the Covid-19 pandemic outbreak. However, in 2021, economic growth has increased.
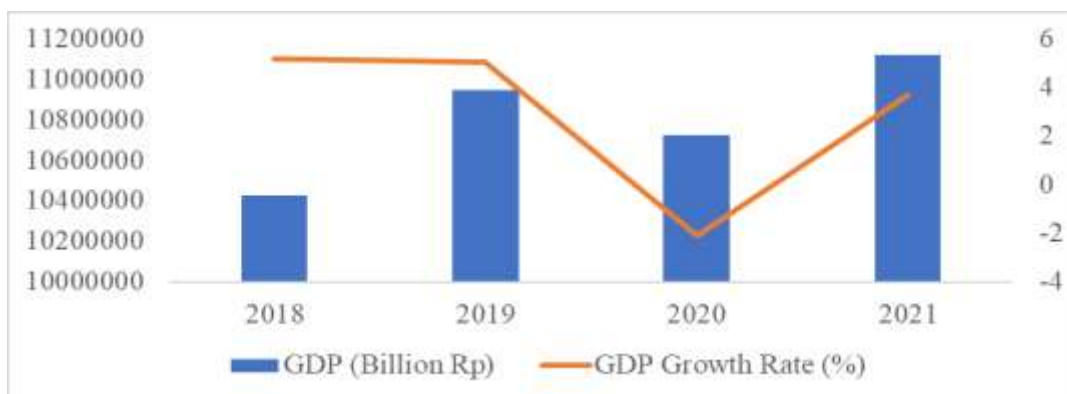
Source: Central Bureau of Statistics 2023
Figure 2 Economic growth in Indonesia in 2018-2021

Furthermore, Indonesia's economy development in each province, which is reflected in GDRP ADHK, is more varied (Figure 3). The economic growth in each province, as shown through ADHK GDRP, shows that in 2020, almost all provinces will experience a decline in economic growth. The Covid-19 pandemic has negatively affected all activities, including economic activity. If observed further, only nine provinces have GDRP for 2018–2021 higher than the national average. The provinces include DKI Jakarta, East Java, West Java, Central Java, North Sumatra, Riau, East Kalimantan, Banten, and South Sulawesi. Meanwhile, the GDRP in the other 25 provinces is below the national average.
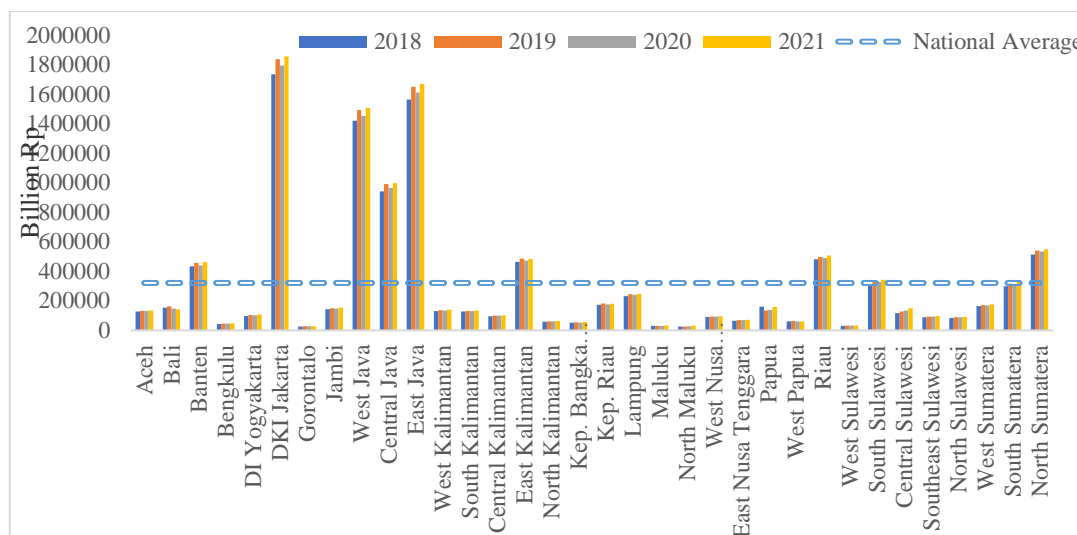
Source: Central Bureau of Statistics 2023
Figure 3 GDRP at constant prices by province in Indonesia in 2018-2021

Development of Digital Technology in Indonesia

The development of digitalization in Indonesia can be seen from the value of the Information and Communication Technology Development Index (ICT-DI). Overall, ICT-DI values in Indonesia continued to increase during 2018-2021 (BPS 2022), namely 5.07 in 2018, 5.32 in 2019, 5.59 in 2020, and 5.76 in 2021. This shows that from year to year, technological developments in Indonesia continue to progress every year.

Furthermore, the ICT-DI value is compiled through three sub-indices: the access and infrastructure sub-index, usage sub-index, and skills sub-index. In the 2018-2021 period, there are four categories in classifying the development of each ICT-DI sub-index according to provinces in Indonesia, namely very low categories (0.00 - 2.25), low (2.26 - 5.00), medium (5.01 - 7.25), and high (7.26 – 10.00) (BPS 2022). If we look at the value of each sub-index, the expertise sub-index is the sub-index with the highest score (5.97), followed by the access-infrastructure sub-index (5.76), and the usage sub-index (5.66) (BPS 2022). In addition, at the provincial level, it is known that DKI Jakarta Province has the highest average ICT-DI score (7.39). At the same time, Papua Province has the lowest average ICT-DI score (3.38) during 2018- 2021.

During 2018-2021, five provinces experienced an increase from the low to moderate category in the access infrastructure sub-index. One province remained in the low category, 26 in the medium category, and two in the high category (Figure 4). The provinces that experienced an increase from the low to moderate category were North Maluku, West Nusa Tenggara, East Nusa Tenggara, West Sulawesi, and Southeast Sulawesi.
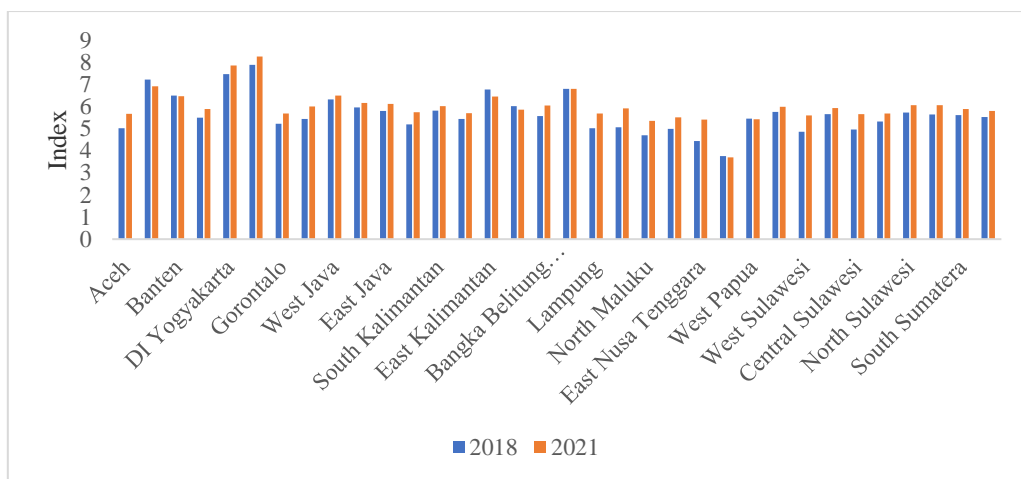
Figure 4 ICT access and infrastructure sub-index by province in Indonesia in 2018-2021

The usage subindex describes how ICT is used by society. Eighteen provinces have experienced an increase from low to medium category, two provinces from medium to high category, one province from very low to low category, one province remains in very low category, seven provinces remain in low category, and five provinces remain in category moderate (Figure 5). The provinces that experienced an increase from the low to medium category were Bengkulu, Gorontalo, Jambi, West Java, Central Java, East Java,

West Kalimantan, South Kalimantan, Central Kalimantan, and Kep. Bangka Belitung, Lampung, Riau, South Sulawesi, Southeast Sulawesi, North Sulawesi, West Sumatra, South Sumatra and North Sumatra. Furthermore, a category shift from medium to high occurred in DI Yogyakarta and DKI Jakarta provinces. Meanwhile, the province that experienced a shift from a very low to a low category was East Nusa Tenggara Province.
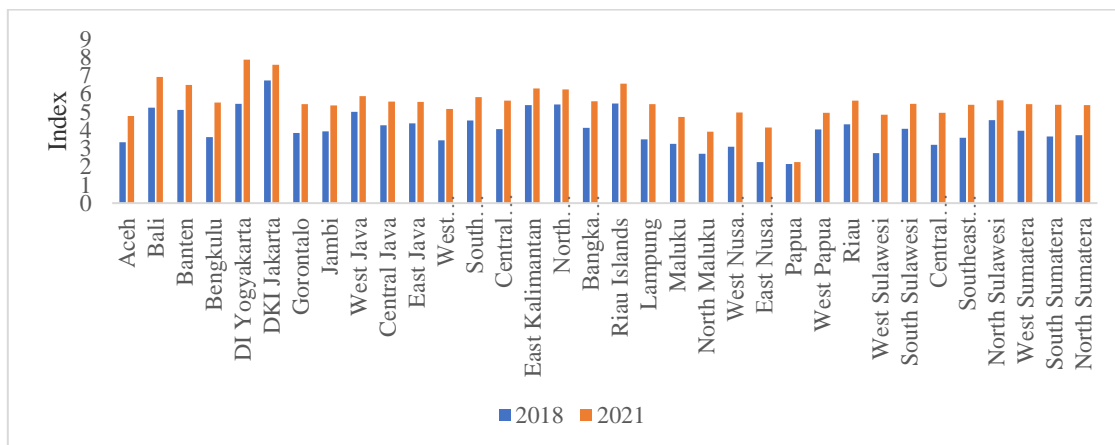
Figure 5 ICT usage sub-index by province in Indonesia in 2018-2021

The skills subindex illustrates how ability is essential in supporting a society that can take advantage of technological and information developments. During 2018-2021, there were no significant changes related to this skills subindex in each province in Indonesia

(Figure 6). There is one province remaining in the high category, namely DI Yogyakarta, 32 provinces remaining in the medium category, and one province remaining in the low category, namely Papua Province.
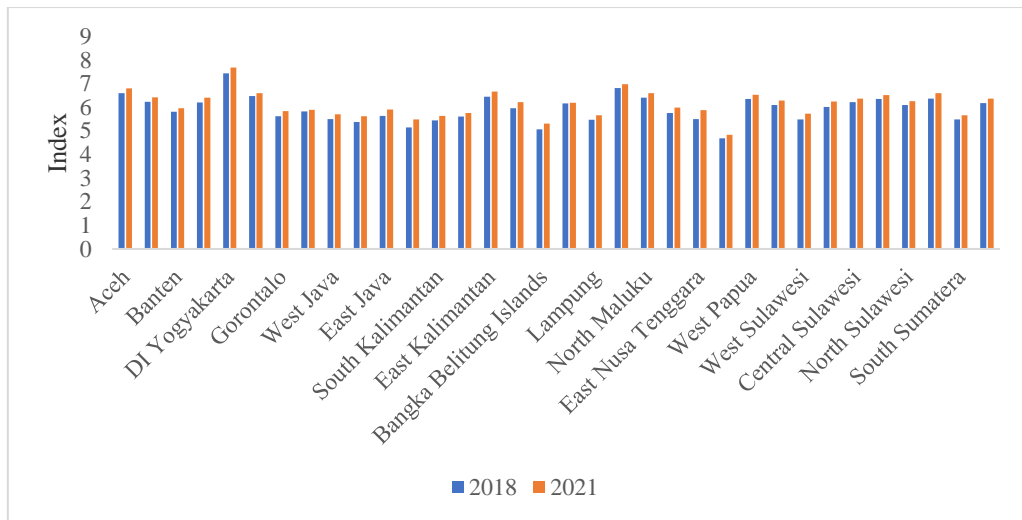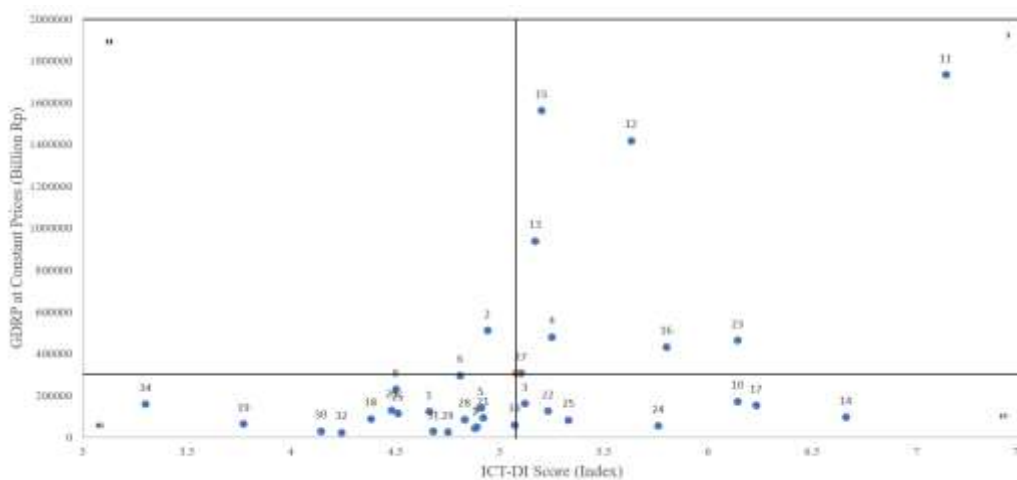
Figure 6 ICT skills sub-index by province in Indonesia in 2018-2021

The Relationship between Economic Growth and Digital Technology

The relationship between digital technology (index) as reflected through ICT-DI values and economic growth as reflected through PDRB ADHK (billion rupiah) based on provinces in Indonesia is divided into four quadrants. Quadrant I qualified provinces with high economic growth and digital technology or scores above the national average. Quadrant II is a classification of provinces with high economic growth and low digital technology. Quadrant III is a classification of provinces with low economic growth and low digital technology. Quadrant IV is a classification of provinces with low economic growth and high digital technology.

There are 34 provinces included in the classification, namely: (1) Aceh; (2) North Sumatra; (3) West Sumatra; (4) Riau; (5) Jambi; (6) South Sumatra; (7) Bengkulu; (8) Lampung; (9) Kep. Bangka Belitung; (10) Kep. Riau; (11) DKI Jakarta; (12) West Java; (13) Central Java; (14) DI Yogyakarta; (15) East Java; (16) Banten; (17) Bali; (18) West Nusa Tenggara; (19) East Nusa Tenggara; (20) West Kalimantan; (21) Central Kalimantan; (22) South Kalimantan; (23) East Kalimantan; (24) North Kalimantan; (25) North Sulawesi; (26) Central Sulawesi; (27) South Sulawesi; (28) Southeast Sulawesi; (29) Gorontalo; (30) West Sulawesi; (31) Maluku; (32) North Maluku; (33) West Papua; and (34) Papua.
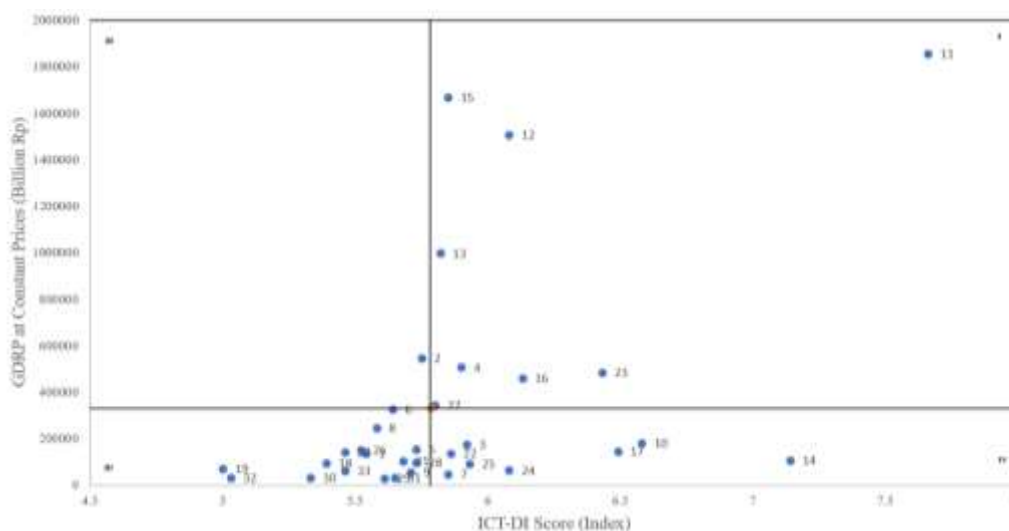
Figure 7 The relationship between economic growth and digital technology in 2018

Based on the mapping of the ICT-DI relationship (index) with economic growth in (Figure 7) which is reflected in PDRB ADHK (billion rupiah), it can be concluded as follows:

1. Quadrant I: Provinces of DKI Jakarta, East Kalimantan, Banten, West Java, Riau, East Java and Central Java
2. Quadrant II: North Sumatra Province
3. Quadrant III: West Papua Province, Central Kalimantan, Jambi, Kep. Bangka Belitung, Bengkulu, Southeast Sulawesi, South Sumatra, Gorontalo, Maluku, Aceh, Central Sulawesi, Lampung, West Kalimantan, West Nusa Tenggara, North Maluku, West Sulawesi, East Nusa Tenggara, and Papua
4. Quadrant IV: Province D I Yogyakarta, Bali, Kep. Riau, North Kalimantan, North Sulawesi, South Kalimantan, West Sumatra and South Sulawesi

Mapping results in 2018 show that seven provinces with high ICT-DI have high economic growth. On the other hand, eight provinces have high ICT-DI but low economic growth. Apart from that, there is one province with low ICT-DI but high economic growth and 18 provinces with low ICT-DI with low economic growth.

Source: Central Bureau of Statistics 2022
Figure 8 The relationship between economic growth and digital technology in 2021

Based on the mapping of the relationship between ICT-DI (index) and economic growth in (Figure 8) which is reflected in PDRB ADHK (billion rupiah), it can be concluded as follows:

1. Quadrant I: DKI Jakarta, East Kalimantan, Banten, West Java, Riau, East Java, Central Java and South Sulawesi Provinces
2. Quadrant II: North Sumatra Province
3. Quadrant III: Jambi Province, Southeast Sulawesi, Kep. Bangka Belitung, Central Kalimantan, Maluku, South Sumatra, Gorontalo, Lampung, Aceh, Central Sulawesi, West Kalimantan, West Papua, West Nusa Tenggara, West Sulawesi, North Maluku, East Nusa Tenggara, and Papua
4. Quadrant IV: Province D I Yogyakarta, Bali, Kep. Riau, North Kalimantan, North Sulawesi, West Sumatra, South Kalimantan and Bengkulu

The mapping results in 2021 show that eight provinces with high ICT-DI have high economic growth. On the other hand, eight provinces have high ICT-DI but low economic growth. Apart from that, there is one province with low ICT-DI but high economic growth and 17 provinces with low ICT-DI with low economic growth.

During 2018-2021, two provinces experienced a quadrant shift: Bengkulu

Province (III → IV) and South Sulawesi (IV → I). If we examine the respective ICT-DI constituent sub-index values further, the following are each province that occupies quadrants I, II, III, and IV (Figure 9). Overall, digital technology is reflected through ICT-DI scores, and the ICT-DI sub-index has an influence in encouraging increased economic growth in Indonesia. During 2018-2021, as the quality and use of ICT increases, economic growth also tends to increase. The existence of ICT in a high category but has low economic growth can be caused by other factors, such as leading sectors and different demographic conditions in each province (Putri 2021).

Figure 9 Mapping of provinces based on each sub-index and quadrant for 2018-2021

ICT Access and Infrastructure Sub-Index		
	2018	**2021**
Q I	DKI Jakarta, East Kalimantan, Banten, West Java, Central Java, East Java and Riau	DKI Jakarta, West Java, Banten, East Kalimantan, Central Java and East Java
Q II	North Sumatra	South Sulawesi, Riau, and North Sumatra
Q III	West Sumatra, South Sumatra, Kep. Bangka Belitung, Bengkulu, West Papua, Central Kalimantan, Jambi, Southeast Sulawesi, Gorontalo, West Kalimantan, Maluku, Aceh, Lampung, NTT, Central Sulawesi, West Sulawesi, North Maluku, NTB, and Papua	Maluku, Bengkulu, South Sumatra, North Kalimantan, West Kalimantan, Central Kalimantan, Gorontalo, Lampung, Southeast Sulawesi, Aceh, Central Sulawesi, West Sulawesi, East Nusa Tenggara, West Papua, West Nusa Tenggara, North Maluku and Papua
Q IV	D I Yogyakarta, Bali, Kep. Riau, North Kalimantan, South Kalimantan, North Sulawesi and South Sulawesi	D I Yogyakarta, Bali, Kep. Riau, North Sulawesi, West Sumatra, Kep. Bangka Belitung, South Kalimantan and Jambi
Quadrant Shift	Riau (I → II), North Kalimantan (IV → III), South Sulawesi (IV → II), Kep. Bangka Belitung (III → IV), Jambi (III → IV), dan West Sumatra (III → IV)	
ICT Usage Sub-Index		
	2018	**2021**
Q I	DKI Jakarta, Banten, East Kalimantan, West Java, East Java, Riau and Central Java	DKI Jakarta, Banten, East Kalimantan, West Java, Riau, Central Java and East Java
Q II	North Sumatra	North Sumatra and South Sulawesi
Q III	South Sulawesi, Central Kalimantan, West Papua, West Sumatra, Jambi, Gorontalo, South Sumatra, Bengkulu, Southeast Sulawesi, Lampung, West Kalimantan, Aceh, Maluku, Central	West Sumatra, Gorontalo, Lampung, Southeast Sulawesi, South Sumatra, Jambi, West Kalimantan, West Nusa Tenggara, West Papua, Central Sulawesi, West Sulawesi, Aceh,

|			
	Sulawesi, West Nusa Tenggara, West Sulawesi, North Maluku, East Nusa Tenggara, and Papua	Maluku, East Nusa Tenggara, North Maluku and Papua	
Q IV	Kep. Riau, DI Yogyakarta, North Kalimantan, Bali, North Sulawesi, South Kalimantan, and Kep. Bangka Belitung	D I Yogyakarta, Bali, Kep. Riau, North Kalimantan, South Kalimantan, North Sulawesi, Central Kalimantan, Kep, Bangka Belitung, and Bengkulu	
Quadrant Shift	South Sulawesi (III → II), Central Kalimantan (III → IV), dan Bengkulu (III → IV)		
ICT Skills Sub-Index			
	2018	**2021**	
Q I	DKI Jakarta, East Kalimantan, North Sumatra and Riau	East Kalimantan, DKI Jakarta, North Sumatra, Riau and South Sulawesi	
Q II	Banten, East Java, West Java and Central Java	Banten, East Java, West Java and Central Java	
Q III	Jambi, South Sumatra, Lampung, Kep. Bangka Belitung, West Nusa Tenggara, East Nusa Tenggara, West Kalimantan, Central Kalimantan, South Kalimantan, Gorontalo, West Sulawesi and Papua	West Nusa Tenggara, Jambi, East Nusa Tenggara, Gorontalo, Central Kalimantan, West Sulawesi, Lampung, South Sumatra, South Kalimantan, West Kalimantan, Kep. Bangka Belitung and Papua	
Q IV	D I Yogyakarta, Maluku, Aceh, North Maluku, West Sumatra, West Papua, Southeast Sulawesi, Bali, Central Sulawesi, Bengkulu, Kep. Riau, North Sulawesi, South Sulawesi and North Kalimantan	D I Yogyakarta, Maluku, Aceh, North Maluku, West Sumatra, West Papua, Southeast Sulawesi, Bali, Bengkulu, Central Sulawesi, North Sulawesi, North Kalimantan, and Kep. Riau	
Quadrant Shift	South Sulawesi (IV → I)		

Source: Central Bureau of Statistics 2022

Overview of Research Variables
Residents Who Own or Control Cellular Phones in Indonesia

Digital technology that is currently being developed and widespread in society is cellular phones. With cell phones, individuals can access the internet, banking

applications, social media applications, and other online application services. Cell phone users are increasing daily, making companies, especially those in the technology sector, compete with each other to develop service applications that can be accessed via cell phones. So that with the increasing number of residents who own or control cell phones, digital technology is increasingly developing.

Overall, the population that owns or controls cell phones in Indonesia in the 2018-2021 period has fluctuated. From 2018 to 2019, the percentage of PMTS in Indonesia increased by 1.79 percent. However, from 2019 to 2020, there was a decrease of 1.09 percent, and it increased again by 4.82 percent in 2021 (Figure 10).
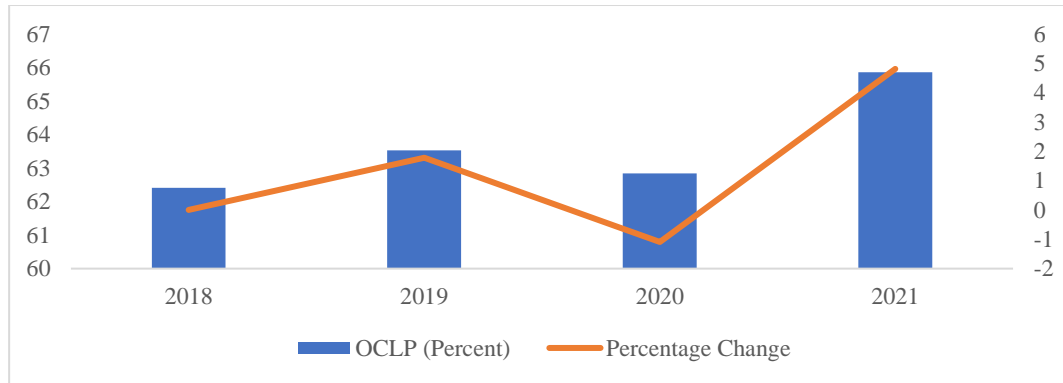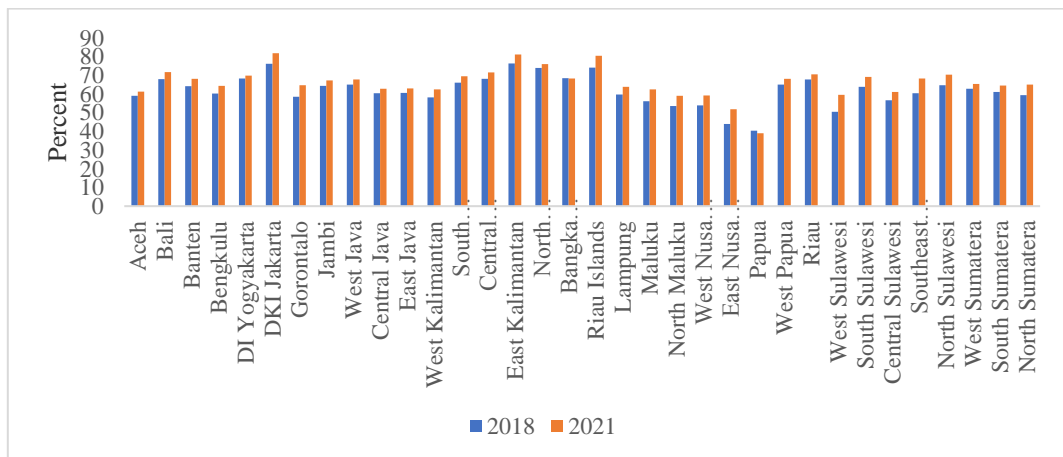

Source: Central Bureau of Statistics 2022
Figure 10 Percentage of change in population owning or controlling cellular telephones (OCLP) in Indonesia in 2018-2021

In addition, Figure 11 shows that during 2018-2021, the average population who owned or controlled a cell phone in some provinces showed an increasing trend. During 2018-2021, DKI Jakarta Province (78.4 percent), East Kalimantan (77.7 percent), and Kep. Riau (76.3 percent) is the province with the highest average percentage of the population owning or controlling cell phones. Meanwhile, the provinces of West Sulawesi (54.1 percent), East Nusa Tenggara (46.2 percent), and Papua (39.5 percent) are

the three provinces with the lowest average percentage of the population who own or control cell phones compared to other provinces. Apart from the dense population, which will reach 10,609.7 thousand people in 2021, DKI Jakarta's concentration as the center of government and business means that the daily activities of its residents cannot be separated from the use of cellular telephones, causing the number of users to be more contrasting when compared with other regions (Hidayat 2016).
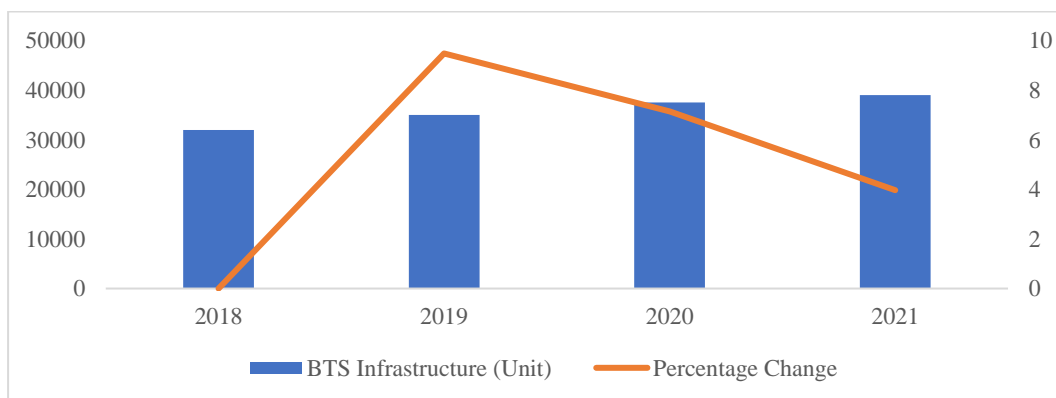

Source: Central Bureau of Statistics 2022
Figure 11 Percentage of the population owning or controlling cellular phones by the province in Indonesia in 2018-2021

With cell phones, people can more easily access digital services and applications, such as e-commerce, e-payment, e-banking, and so on, to drive economic growth. Based on the Economic Report published by Bank Indonesia, during 2018-2021, there was an increase in e-commerce, digital banking, and electronic money transactions. Apart from being used for transactions, with access to these digital services and applications, the public can conduct business transactions online and access information such as job vacancies and training that can improve the skills and quality of the workforce. Based on these conditions, increasing the number of people who own or control cellular phones can increase the use of digital technology and help increase economic growth.

4.2.2 Base Transceiver Station Infrastructure in Indonesia

Infrastructure is an important element in development. Infrastructure that has an important role in the development of digital technology is the base transceiver station (BTS) infrastructure. BTS is a tool for transmitting cell phone and data signals to user devices so that users can use digital technology access, such as internet access, social media applications, and other online application services. In addition, BTS infrastructure can also be an element of a country's competitiveness in investment and business. Investors and business people will be more attracted to countries with sophisticated and efficient BTS infrastructure.
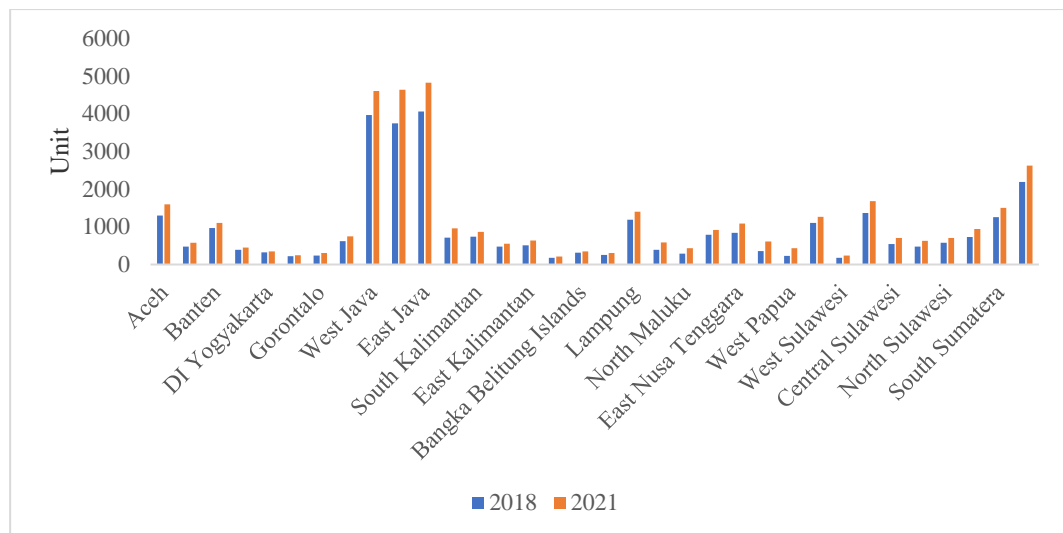

Source: Central Bureau of Statistics 2022
Figure 12 Percentage of changes in base transceiver station infrastructure in Indonesia in 2018-2021

Overall, the base transceiver station infrastructure in Indonesia in the 2018-2021 period fluctuated. From 2018 to 2019, the percentage of BTS infrastructure changes in Indonesia has progressed by 9.49 percent. However, from 2019 to 2020, even though the number of BTS infrastructure units has increased, the percentage change has decreased by 7.15 percent. The same thing happened from 2020 to 2021, where the percentage change decreased by 3.97 percent even though the number of BTS infrastructure units increased that year (Figure 12). Improving BTS infrastructure can encourage economic growth, where with better BTS infrastructure, people can access digital services and applications quickly and efficiently. The more sophisticated the BTS infrastructure, the more digital technology will develop, and the more economic growth will increase.

Based on data available at the provincial level, the BTS infrastructure available in each province, which is spread over every urban and rural area, is increasing yearly (Figure 13). During 2018-2021, the provinces of East Java (4,469 BTS), Central Java (4,324 BTS), and West Java (4,198 BTS) are the provinces that have the third highest BTS infrastructure. Meanwhile, the provinces of DKI Jakarta (237 BTS), West Sulawesi (207 BTS), and North Kalimantan (201 BTS) are the three lowest provinces that have BTS infrastructure compared to other provinces.

Figure 13 Number of villages or sub-districts that have base transceiver station (BTS) towers by province in Indonesia in 2018-2021

DKI Jakarta Province is included in the province with the third lowest BTS tower. Some of the reasons underlying this are limited physical space available because the construction of BTS requires quite large land, expensive land rentals, or the development of telecommunications infrastructure networks so that telecommunications operators focus more on increasing the capacity and quality of existing networks such as Wi-Fi and fiber optic cables.

4.2.3 Investment
Investment is the addition of capital goods and manufacturing equipment to an organization to increase output, whether sourced from within or outside the country. One of the critical components of economic growth is investment within a country. A country needs financial capital to develop and catch up with other countries (Gwijangge *et al.* 2018). Investment realization is one of the many sources of financing needed to move the business world to achieve the desired economic growth. Economic growth and investment have a positive relationship where this mutually reinforcing relationship

exists because, on the one hand, faster economic growth produces more significant state income that can be saved, which then results in higher investment (Ain 2019).
Sources of funds classified as having a significant role in the development of a region are domestic and foreign (Kambono and Marpaung, 2020). Overall, domestic investment in Indonesia during 2018-2021 shows an increasing trend. Meanwhile, foreign investment shows a fluctuating trend (Figure 14). From 2018 to 2019, the percentage change in domestic in Indonesia increased by 17.62 percent. However, from 2019 to 2020, although the realization of domestic investment has increased, the percentage change has decreased, namely 7.0 percent. Furthermore, from 2020 to 2021, the percentage change increased by 8.11 percent, followed by an increase in the realization of domestic investment. Meanwhile, the percentage change in foreign from 2018 to 2019 decreased by 3.75 percent due to the decline in foreign. From 2019 to 2020, foreign increased again with a percentage change of 1.62 percent and 8.47 percent from 2020 to 2021.
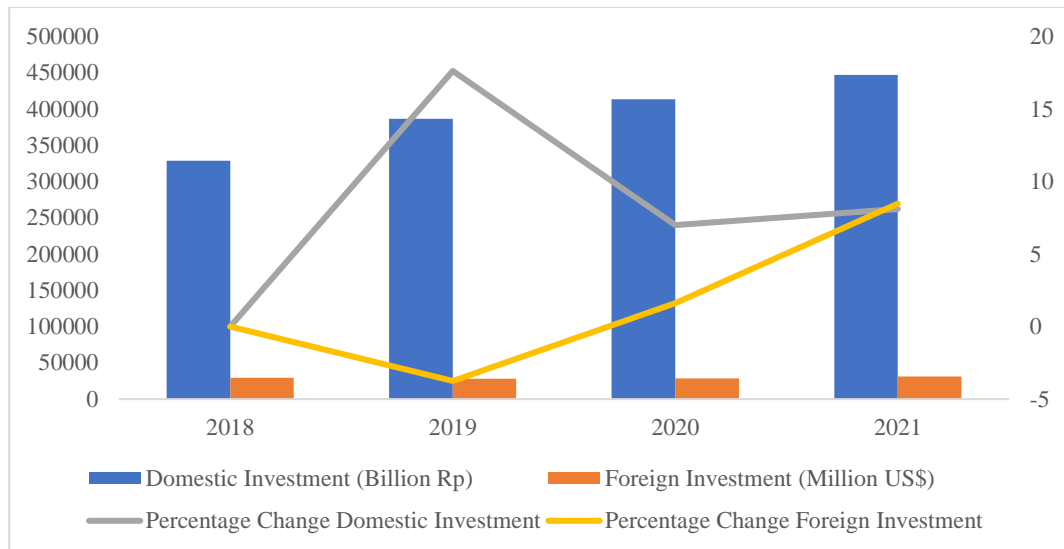
Source: Central Bureau of Statistics 2022
Figure 14 Realization of domestic and foreign investments in Indonesia in 2018-2021

Based on data available at the provincial level, the realization of foreign investments shows various conditions (Figure 15). During 2018-2021, the provinces of West Java (5,366.4 million US$), DKI Jakarta (3,981.1 million US$), and Banten (2,257.2 million US$) are provinces that have an average investment realization of the third

highest overseas—meanwhile, Kep Province. Bangka Belitung (US$ 57 million), DI Yogyakarta (US$ 31.8 million), and West Sulawesi (US$ 11.8 million) are the three lowest provinces that have realized the naming of foreign capital compared to other provinces.
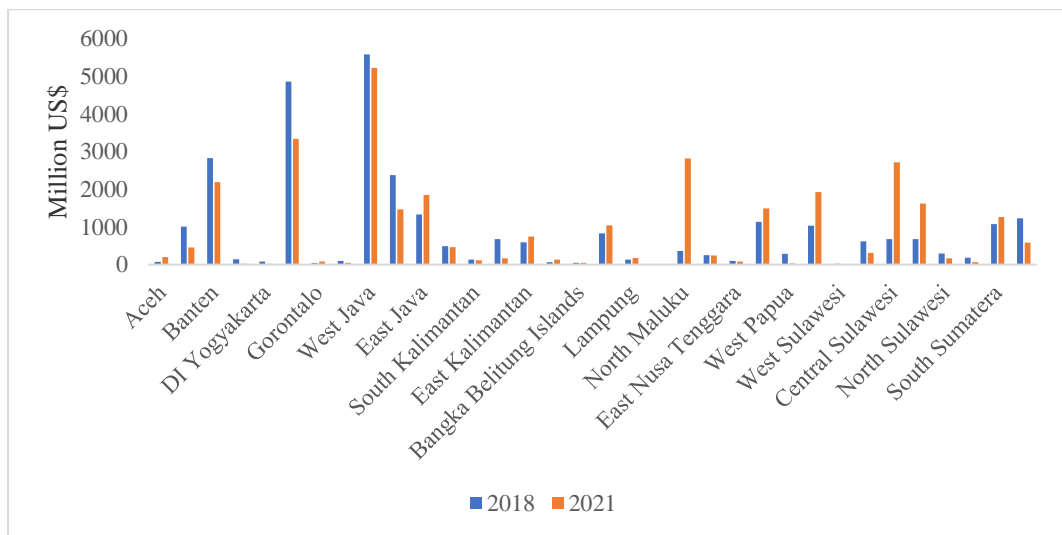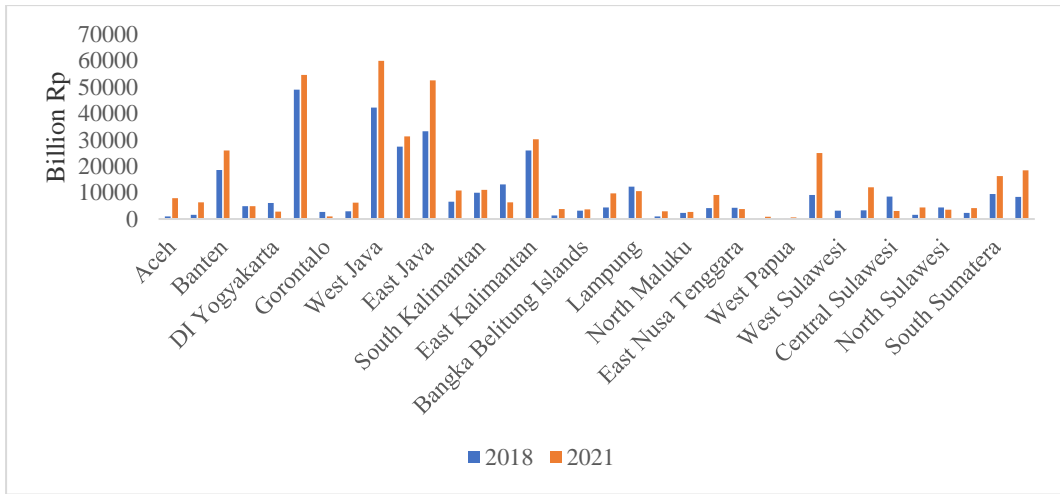

Source: Central Bureau of Statistics 2022
Figure 15 Realization of foreign investments in Indonesia in 2018-2021

Furthermore, domestic investment realized at the provincial level shows different conditions in each province (Figure 16). During 2018-2021, DKI Jakarta Province (52,213.7 billion IDR), West Java (50,727.8 billion IDR), and East Java (46,749.6 billion IDR) are the provinces that have the third

highest average realization of domestic investment. Meanwhile, the provinces of Maluku (1,177.8 billion IDR), Papua (1,076.3 billion IDR), and West Papua (748 billion IDR) are the three lowest provinces that have domestic realization compared to other provinces. Differences in each province

regarding investment realization both domestically and abroad can occur for several reasons, such as different natural resource potentials, availability of infrastructure and accessibility, local government policies, economic conditions, and social and political factors.
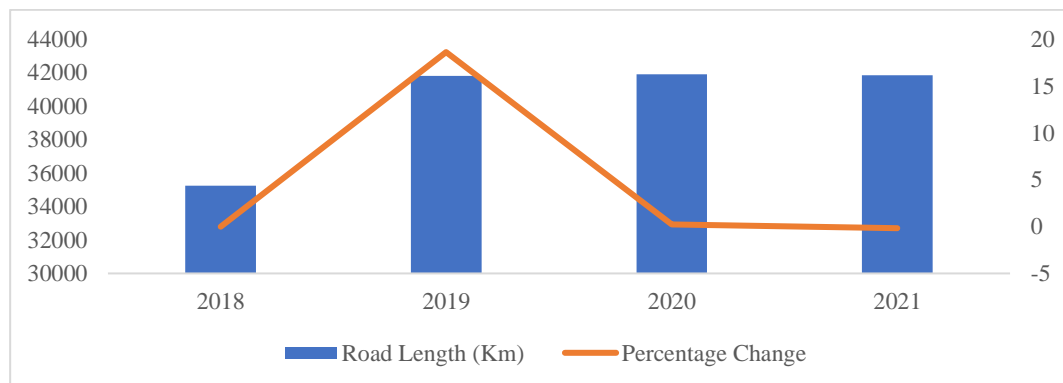

Source: Central Bureau of Statistics 2022
Figure 16 Realization of domestic investments in Indonesia in 2018-2021

Road Length Infrastructure

Roads are an infrastructure that has a significant role in facilitating the smooth running of economic activities. Road infrastructure as capital stock in physical form can increase output. With road infrastructure, it can connect remote areas with cities and other economic centers so that productivity can continue to increase. Good road infrastructure makes the distribution process more efficient so that it can improve connectivity and facilitate the flow of goods and services. In addition, when accessibility increases, it will allow transactions between producers and consumers to be carried out efficiently and at lower costs (Maimunah 2010).
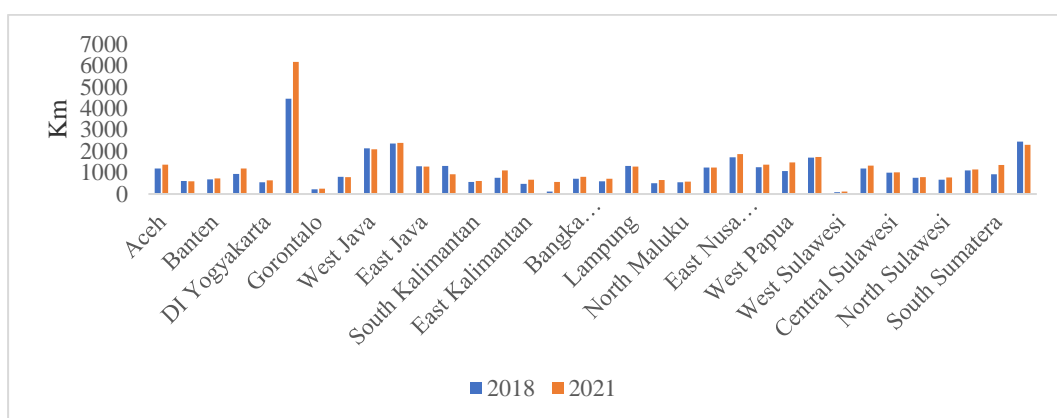
Overall, road length infrastructure in Indonesia in the 2018-2021 fluctuated. From 2018 to 2019, Indonesia's percentage change in road length infrastructure increased by 18.62 percent. Meanwhile, from 2019 to 2020, although the number of road-length infrastructure units increased, the percentage change decreased by 0.23 percent. Furthermore, there was a decrease in road length infrastructure in Indonesia from 2020 to 2021, followed by a decrease in the percentage change of -0.17 percent (Figure 17). The respective road lengths from 2018 to 2021 are 37,246 Km, 41,810 Km, 41,906 and 41,836 Km.

Source: Central Bureau of Statistics 2022
Figure 17 Percentage of change in road length in Indonesia in 2018-2021

Based on data available at the provincial level, the availability of road infrastructure in good and medium condition shows varying physical conditions (Figure 18). During 2018-2021, the provinces of DKI Jakarta (5,739 Km), North Sumatra (2,420.2 Km), and Central Java (2,353.7 Km) were the provinces that had the third highest average length of road infrastructure in good and medium condition. Meanwhile, the provinces of North Kalimantan (490.2 Km), Gorontalo (238.2 Km), and West Sulawesi (162.7 Km) are the three lowest provinces that have good and moderate road infrastructure compared to other provinces. The differences in the length of roads in good and moderate conditions in each province can be caused by several reasons, such as different budgets for the construction and maintenance of road infrastructure, traffic intensity, and climatic conditions in each province.
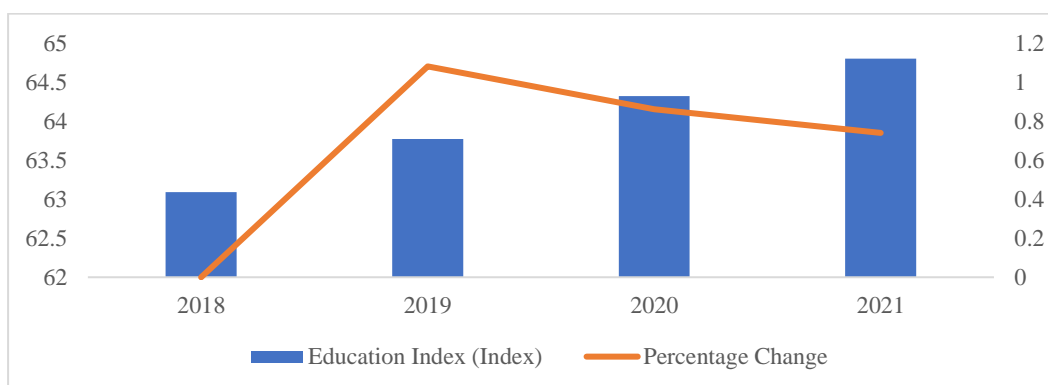

Source: Central Bureau of Statistics 2022
Figure 18 Infrastructure Road length by province (good and fair condition) in Indonesia in 2018-2021

Education Index

The education index is an index that contributes to the formation of the Human Development Index (IPM). HDI aims to evaluate the quality of human development. According to Article 13 Paragraph 1 of Law No. 20 of 2003, the education system in Indonesia consists of three channels, namely formal, non-formal, and informal education. Formal education includes elementary, secondary, and higher levels, usually in formal educational institutions. Non-formal education includes learning outside formal educational institutions, such as Al-Qur'an Education Parks (TPA), Sunday schools, etc. Meanwhile, informal education refers to pathways involving independent learning activities, such as homeschooling.
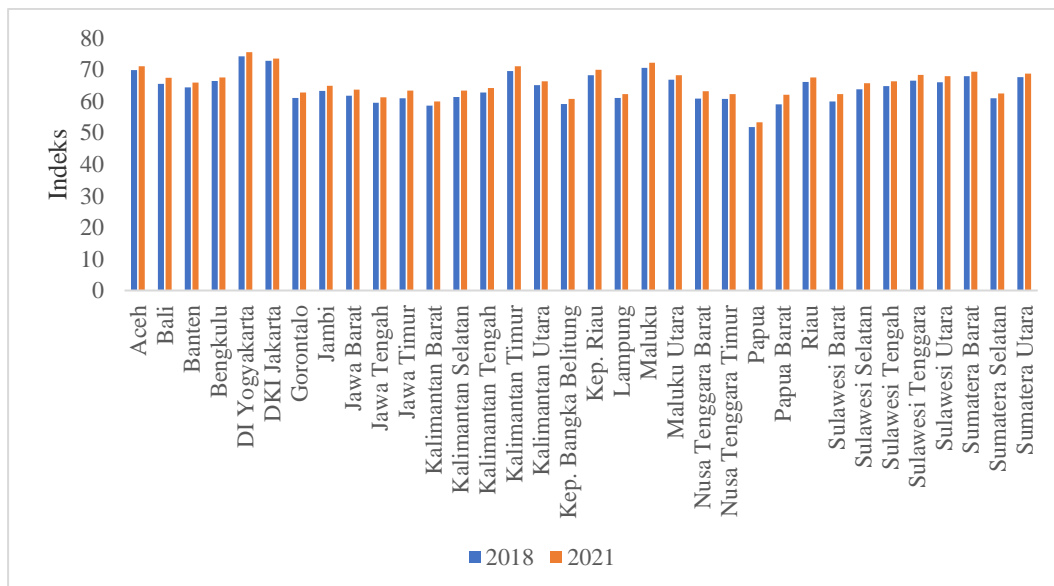

Source: Central Bureau of Statistics 2022
Figure 19 Percentage change in education index in Indonesia in 2018-2021

Overall, the education index in Indonesia in the 2018-2021 period continues to show an increasing trend. From 2018 to 2019, the percentage change in the education index in

Indonesia increased by 1.08 percent. However, from 2019 to 2020, although the total education index increased, the percentage change decreased, namely 0.86 percent. The same thing happened in the following year. From 2020 to 2021, there was a decrease in the percentage change in the education index in Indonesia by 0.75 percent, even though the education index in Indonesia in 2021 increased (Figure 19).

Source: Central Bureau of Statistics 2022
**Figure 20 Education index by province in Indonesia in 2018-2021**

In addition, based on data available at the provincial level, the education index shows varying conditions (Figure 20). During 2018-2021, Provinces D I Yogyakarta (74.8 points), DKI Jakarta (73 points), and Maluku (71.5 points) were the provinces with the highest average education index - meanwhile, Kep Province. Bangka Belitung (59.9 points), West Kalimantan (59.3 points), and Papua (52.7 points) are the three provinces with the lowest average education index compared to other provinces. Factors that allow these differences between provinces are different educational infrastructure, availability of facilities, quality of teachers and teaching staff, social and economic factors, and other factors.

Labor Force Participation Rate
The role of the labor force participation rate in economic growth is significant. A high labor force participation rate shows a large amount of labor available to create goods and services. The impact is increased productivity, which leads to increased output and encourages GDP growth. In addition, a high labor force participation rate can also encourage investment because it indicates the stability of the country's labor market, which has the potential to increase company profits.

Overall, LFPR in Indonesia during 2018-2021 shows a fluctuating trend. From 2018 to 2019, the percentage change in LFPR in Indonesia increased by 0.33 percent. From 2019 to 2020, there was another increase of 0.36 percent. However, from 2020 to 2021, the percentage change in LFPR in Indonesia decreased to 0.04 percent (Figure 21). Even though the percentage change from 2020 to 2021 has decreased, LFPR has increased from 67.77 percent (2020) to 67.80 percent (2021). The total workforce in 2021 will increase to 140.15 million people (BPS 2021). The increasing labor force participation rate is also accompanied by the growth of the Indonesian economy by 3.69 percent in 2021.
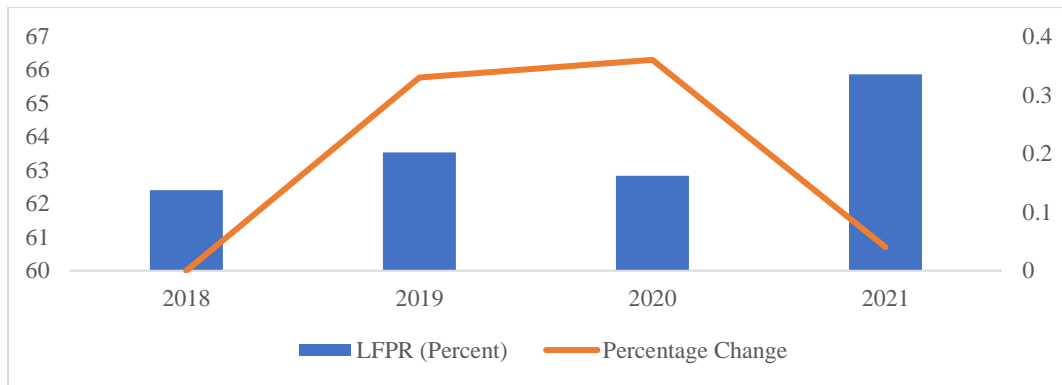
Figure 21 Percentage change in labor force participation rate in Indonesia in 2018-2021

Based on Figure 22, the percentage of labor force participation rate for each province in Indonesia shows different results in each province. During 2018-2021, North Sumatra Province (74.8 percent), Kep. Bangka Belitung (72.2 percent) and Central Kalimantan (71.7 percent) are the provinces with the highest average percentage of labor force participation rates. Meanwhile, the provinces of North Sulawesi (64.4 percent), West Papua (64.2 percent), and Aceh (64 percent) are the three provinces with the lowest average percentage of labor force participation rates compared to other provinces. Differences in unemployment rates, education levels, and industrial structures in the province can cause this.
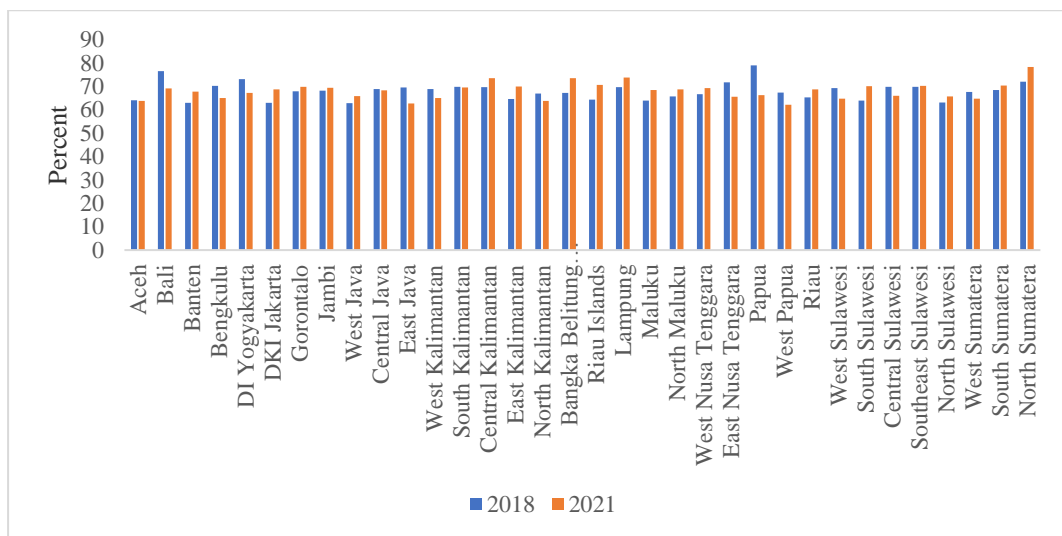
Figure 22 Percentage of labor force participation rate by province in Indonesia in 2018-2021

Open Unemployment Rate
The open unemployment rate is the proportion of the labor force that is not working and is actively looking for work. The unemployment rate plays an important role in economic growth and is also a crucial indicator of a country's labor market condition. The open unemployment rate can reflect how well a country's economy is at creating employment. The higher unemployment rate indicates that the country's economy is experiencing difficulties creating jobs that meet people's needs and vice versa. High unemployment rates can slow down economic growth.
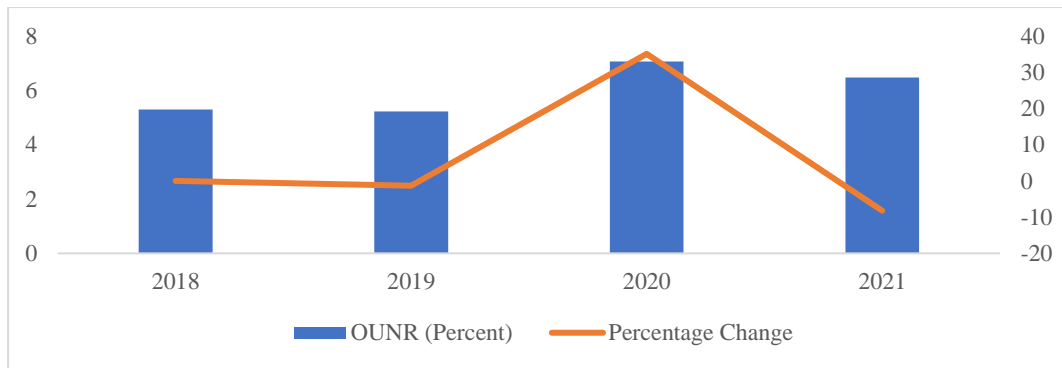
Source: Central Bureau of Statistics 2022
Figure 23 Percentage change in the open unemployment rate in Indonesia in 2018-2021

Overall, the education index in Indonesia in the 2018-2021 period continues to show an increasing trend. From 2018 to 2019, the percentage change in the education index in Indonesia increased by 1.08 percent. However, from 2019 to 2020, although the total education index increased, the percentage change decreased, namely 0.86 percent. The same thing happened in the following year. From 2020 to 2021, there was a decrease in the percentage change in the education index in Indonesia by 0.75 percent, even though the education index in Indonesia in 2021 increased (Figure 23).

Apart from that, based on Figure 30, the percentage of open unemployment rate for each province in Indonesia shows different results. During 2018-2021, the Provinces of

West Java (9.1 percent), Banten (9 percent), and Kep. Riau (8.9 percent) is a province in the top three with the highest average percentage of open unemployment rate. Meanwhile, the provinces of Central Sulawesi (3.5 percent), Bali (3.4 percent), and West Sulawesi (3.1 percent) are the three provinces with the lowest average percentage of open unemployment rate compared to other provinces (Figure 24). Differences in the average open unemployment rate that occurred in each province during 2018-2021 could be caused by several reasons, namely differences in economic structure, investment and economic growth, infrastructure, education, and different government policies in each province.

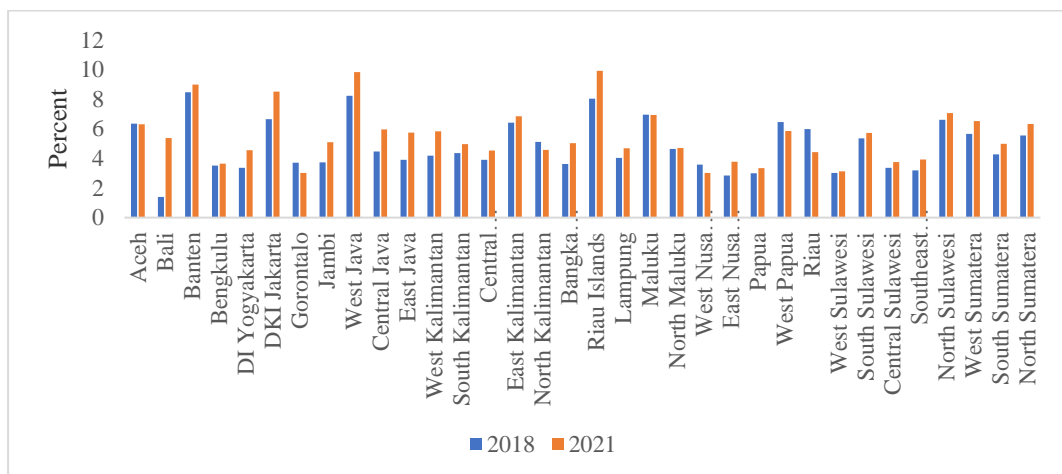*Source: Central Bureau of Statistics 2022*
Figure 24 Percentage of open unemployment rate by province in Indonesia in 2018-2021

The Influence of Digital Technology Development and Other Determinants on Economic Growth in Indonesia

In determining the best model used in research, the optimal model selection process was carried out through two tests, namely the Chow test and the Hausman test, to

determine the best model between Pooled Least Square (PLS), Fixed Effect Model (FEM), and Random Effect Model (REM). Based on the Chow test, the probability value shows a result of 0.0000 or less than the five percent actual level, so that the null hypothesis (H_0) is rejected and shows the FEM model as the selected model. Next, the Hausman test was carried out, the results show that the probability value is 0.0000 or less than the actual level of five percent. Thus, the null hypothesis (H_0) in the Hausman test is also rejected, which indicates that the FEM model is the best in the research.

Based on Table 2, it is known that the coefficient of determination (R^2) is 0.999518, meaning that around 99.95 percent of the diversity of factors that influence the development of digital technology and other determinants of Indonesia's economic growth can be explained by the independent variables in the model. In comparison, 0.05 percent of the rest is explained by other factors outside the model. Next, statistical testing was carried out using the F-test and T-test. The results show an F-statistical probability value of 0.0000, meaning at least one independent variable significantly influences economic growth. In carrying out the T-test, the probability value comparison for each independent variable in this study uses a significance level of 1 percent, 5 percent, and 10 percent.

Table 2 Regression estimation results of the influence of digital technology development and other determinants on Indonesia's economic growth using fixed effects cross-section weighted and white period (cross-section cluster)

Variable	Coefficient	Prob.	
C	5.689609	0.0000**	
LnOCLP	0.336090	0.0002**	
LnIBTS	0.111425	0.0300*	
LnINVT	0.017265	0.0000**	
LnINRL	0.023995	0.0000**	
LnEDIX	0.804242	0.0208*	
LnLFPR	0.133810	0.0000**	
LnOUNR	-0.052841	0.0477*	
Weighted Statistics			
R-squared	0.999917	Sum squared resid	0.076121
Adj R-squared	0.999882	Durbin-Watson stat	2.209991
F-statistic	28557.73	Prob(F-statistic)	0.000000
Unweighted Statistics			
R-squared	0.999518	Sum squared resid	0.084391
		Durbin-Watson stat	1.793868

Note: *) significant at the 5% level of significance; **) significant at the 1% level of significance
Source: Eviews 10 processed results

The classic assumption test is used to test whether the results of data analysis meet the BLUE (Best Linear Unbiased Estimator) criteria. Several tests are carried out in the classical assumption test, including the normality test, multicollinearity test, heteroscedasticity test, and autocorrelation test. The probability value of the Jarque-Bera test is 0.000000, which is smaller than the 5% significance level (α). This value shows that the residuals are not normally distributed. The model can be assumed to be normally distributed when the observed data exceeds 30 or n>30 (Gujarati 2011). Furthermore, the multicollinearity test using the correlation matrix, the results show no multicollinearity problems in the model because the correlation between variables is less than 0.80. Apart from that, judging from the sum square residual weighted statistics value (0.076121) < the sum square residual unweighted statistics value (0.084391), this means that there is a heteroscedasticity problem in the model.

Next, the Durbin-Watson statistical test is used to test for autocorrelation problems in the model. The number of observations (n) is 136, the number of independent variables (k) is 8, and the actual level (α) is five percent, so the information obtained is dL of 1.61326 and dU of 1.82915. It is known that the DW-stat is 1.793868, so it cannot be concluded that there is an autocorrelation problem in the model because in the interval dL (1.61326) <

DW (1.793868) < dU (1.82915). However, according to Gujarati (2011), the problem of heteroscedasticity and autocorrelation can be overcome using the GLS (Generalized Least Square) method. So, in this research, cross-section weighted and white period (cross-section cluster) weighting was carried out to overcome these two problems.

The Impact of Population Who Own or Control Cell Phones (OCLP) on Economic Growth

Based on the estimation results, the population variable that owns or controls cellular telephones positively and significantly affects economic growth. The coefficient value shows a number of 0.336090, which indicates that for every 1 percent increase in the number of people who own or control cell phones, Indonesia's economic growth also increases by 0.336090 percent, ceteris paribus. These estimation results are in line with research by Rifqi (2018), Untari *et al.* (2019), and Kamilla *et al.* (2021) in Indonesia with case studies of ASEAN countries, and Pradana (2021) in Banten Province, which also shows that cell phone users have a positive and significant impact on economic growth.

The Impact of Base Transceiver Station Infrastructure (IBTS) on Economic Growth

According to Fahmi (2022), infrastructure development is the main factor in triggering economic growth and attracting investors to continue to carry out production and productivity. The estimation results show that the base transceiver station infrastructure variable positively and significantly impacts economic growth. The coefficient value of 0.111425 indicates that if the base transceiver station infrastructure increases by 1 percent, Indonesia's economic growth will also increase by 0.111425 percent, ceteris paribus. This result is in line with Ngatono's research (2016), which shows that the telecommunications infrastructure represented by BTS positively influences GDRP in Banten Province. In addition, the results of Untari *et al.* (2019) explain that the number of BTS positively and significantly influences economic growth. The BTS infrastructure is important for transmitting cell phone signals so that people can communicate and use the internet, including taking advantage of the development of digital services.

The Impact of Investment (INVT) on Economic Growth

Based on the estimation results, the investment variable positively and significantly affects economic growth. The coefficient value shows a figure of 0.017265, which indicates that for every 1 percent increase in investment, Indonesia's economic growth also increases by 0.017265 percent, ceteris paribus. These estimation results are in line with research by Haq and Yuliadi (2018) on Kalimantan Island, Dewi *et al.* (2019) in Jambi Province, and Diannita and Wenagama (2022) in the East Bali Region, which also show that investment has a positive and significant impact on economic growth. Economic growth is supported by investment, where to encourage the emergence of investors, it needs to be supported by an attractive investment environment, both in the presence of good policies and recommendations for the development of infrastructure and facilities to support business investment, as well as the availability of information and equal business opportunities (Meliniati *et al.* 2023).

The Impact of Road Length Infrastructure (INRL) on Economic Growth

The estimation results show that the road length infrastructure variable positively and significantly influences Indonesia's economic growth. The coefficient value of 0.023995 indicates that if there is an increase of 1 percent in road length infrastructure, Indonesia's economic growth will increase by 0.023995 percent, ceteris paribus. These findings support the initial hypothesis and are consistent with previous research,

concluding that the road length variable positively correlates with economic growth (Ms *et al.* 2019 and Putri 2021). Road infrastructure is important in the distribution process and increasing production factors through mobility from existing transportation, thereby contributing to increased economic growth. Damage to road infrastructure will disrupt the distribution process and cause time inefficiencies (Kamaruddin *et al.* 2021).

The Impact of Education Index (EDIX) on Economic Growth

The estimation results show that the education index variable positively influences economic growth. The coefficient of 0.804242 indicates that if the education index increases by 1 percent, Indonesia's economic growth will increase by 0.804242 percent, ceteris paribus. This finding is consistent with previous studies, which also concluded that the education index positively and significantly influences economic growth (Dewi and Sutrisna 2017, Safitri and Wikarya 2017, and Fahira 2021). Education is an important factor in increasing income and productivity because it has a broad effect on people's lives, where people who have higher education will improve health levels and reduce crime rates, so education is important in developing a country (Yusuf *et al.* 2022).

The Impact of Labor Force Participation Rate (LFPR) on Economic Growth

Based on the model estimation results, it was found that LFPR had a positive and significant effect on Indonesia's economic growth. The obtained coefficient of 0.133810 shows that if there is an increase of 1 percent in LFPR, then Indonesia's economic growth will increase by 0.133810 percent, ceteris paribus. This finding is consistent with the initial hypothesis, which indicates that LFPR positively affects Indonesia's economic growth. Apart from that, the estimation results of this research are also consistent with previous research, which states that LFPR has a positive and significant effect on

economic growth (Rahmawati 2019, Syamsuddin *et al.* 2021, and Putriana and Aji 2022). The level of labor force participation influences economic growth, where the active involvement of the labor force will increase regional economic growth through the labor production factor (Shari and Abubakar 2022).

The Impact of Open Unemployment Rate (OUNR) on Economic Growth

The estimation results found that the open unemployment rate has a negative and significant influence on Indonesia's economic growth. The obtained coefficient of -0.052841 indicates that if there is an increase of 1 percent in the open unemployment rate, Indonesia's economic growth will decrease by -0.052841 percent, ceteris paribus. This finding is in line with research conducted by Putri and Soesatyo (2016), Harjana (2018), and Padang and Murtala (2019), which stated that the level of open unemployment has a negative and significant effect on economic growth. Unemployment that continues to increase in an area will decrease people's purchasing power, so investors are not interested in carrying out industrial development, so investment in that area will decrease and cause the area's economic growth to decline (Kusumawati *et al.* 2021).

CONCLUSION

Indonesia's economic growth in 2018-2021 shows fluctuating conditions. In addition, the development of digitalization in Indonesia, seen through the ICT-DI score and its sub-index, tends to increase yearly. The relationship between economic growth and the value of ICT-DI in each province shows different results. This means that the development of digital technology, as reflected through ICT-DI values, has a different influence on economic growth between provinces in Indonesia.
Based on the estimation results, technological developments as a proxy through the population who own or control cellular telephones and base transceiver

station infrastructure have a positive and significant influence on Indonesia's economic growth. In addition, investment, road length infrastructure, education index, and labor force participation rates positively and significantly influence Indonesia's economic growth. Meanwhile, the open unemployment rate negatively and significantly impacts Indonesia's economic growth.

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