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THE IMPACT OF DIGITALIZATION ON ECONOMIC GROWTH IN ASEAN COUNTRIES

Abstract

Digitalization with the Sustainable Development Goals (SDGs) Program is an essential means of encouraging the government to operate more openly and effectively, which can increase global economic growth. This research aims to assess how education, digitalization, and trade openness affect the economic development of ASEAN. This study uses independent variables in the form of government spending on education, cell phone users, individual internet users, foreign direct investment and consumer price inflation. The dependent variable is economic growth. This study uses the panel data regression method, from 2001 to 2020, with a cross-section of 7 ASEAN countries (Indonesia, Malaysia, Thailand, Laos, Singapore, the Philippines and Cambodia).

According to the study, the economic growth in seven ASEAN countries is significantly influenced by government expenditure on education, the number of cell phones and individual internet users, and foreign direct investment. Empirical evidence confirms that digitalization positively impacts both the economy and society, as reflected in lower unemployment rates, improved quality of life, and increased access to public services and information. Furthermore, digitalization simplifies learning about various aspects and activities related to conducting trade, thereby contributing to economic growth.

Keywords: Digitalization, economic openness, economic growth, ASEAN

INTRODUCTION

The Sustainable Development Goals 2030 program continues the global millennium development goals (MDGs), which ended in 2015. The SDGs are a framework of reference for development until 2030. There are 17 goals and 169 achievement targets in the 2030 SDGs related to changes in the world situation, which are committed globally and nationally to sustainable development worldwide (Gusdwisari, 2020). The agreement and goals set out in SDGs 2030, indirectly in the current era of digitalization, requires young people around the world to master technology and information so that they can compete globally (Gusdwisari, 2020). The advanced technology and information available in the digital era can support the education sector, which aims to provide quality education as part of the 2030 Sustainable Development Goals (SDGs) program. Education is a structured form of business and awareness

that can develop the abilities of every human being; through education, each individual can design existing capabilities within himself to play a role in the community environment (Pratomo & Herlambang, 2021).

Education plays a vital role for individuals and groups that can increase human resources (HR) and influence the overall growth of the nation and state, so education affects productivity and facilities in society (Safitri et al., 2022). Quality education is undoubtedly desired for the progress of a nation; education is not only a means of *'agent of change'* for the younger generation who will become the successors of a nation but also must become an *'agent of the producer'* to create a fundamental transformation. Innovative and quality education will motivate someone's creativity, especially the younger generation, to encourage their curiosity as innovators who can play an important role and use the concept of sustainable development (Safitri et al., 2022). The primary objective of implementing the Sustainable Development Goals (SDGs) program is to advance both the quality of education and people's well-being by improving them (Humaida et al., 2020).

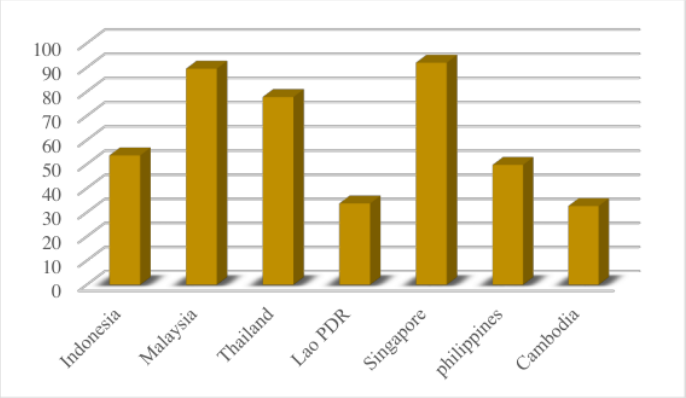
The digital era has changed the world with various technological sophistication that can help facilitate public activities and services. The increasingly widespread use of digitization is one of the most impressive developments. Digitization is changing printed, audio or video information into a digital format. Digitalization plays a crucial role in stimulating economic and social activities in both developed and developing nations. It has the potential to enhance living standards and decrease unemployment. The utilization of digital technology can contribute positively to economic growth by fostering digital trade transactions and online businesses, enabling flexible banking operations, and facilitating communication. These factors can ultimately lead to increased productivity and economic growth (Habibi & Zabardast, 2020).

When the world economy is sluggish, you can take advantage of digital technology as a means to increase economic activity. The incorporation of information and communication technology (ICT) can significantly influence the economy by enhancing resource allocation efficiency, reducing production costs, and increasing investment and demand across all sectors (Khan et al., 2015). The rapid adoption of digital technologies facilitated by connected devices and services has accelerated both economic growth and the creation of job opportunities. However, the impact of this adoption varies across different countries (Khan et al., 2015). The benefits of digitalization, such as higher economic growth and productivity, may be more

pronounced in developed countries compared to developing countries, which may experience fewer employment opportunities due to disparities in their economic structures (Sabbagh et al., 2013). According to Booz & Company, digitalization resulted in a US$193 billion increase in worldwide economic output and generated six million jobs globally in 2011, despite the unfavorable global economic conditions at the time (Sabbagh et al., 2013).

In today's fast-paced digital world, the internet has become an essential requirement for people to easily access a vast range of information from different parts of the world. Furthermore, the internet is permanent, and internet users can access it 24 hours a day. Individual internet users around the world have increased every year. In 2021 internet users will increase by 7.7% to 4.76 billion, whereas in 2020, internet users were 4.42 billion. Based on data for 2022, the largest internet user region in the world is Northern Europe, with 98% of the total population (Pahlevi, 2022). Meanwhile, in 7 ASEAN countries, the average internet user is only 31.78% of the total population, with Singapore in 2020 as the most significant internet user country, with a percentage of 92% of the total population. ASEAN countries have a digital divide due to uneven access to digitalization development (Mubah et al., 2017).

Figure 1. Percentage of Internet Users in 7 ASEAN Countries (% of Total Population)



Source: *World Bank*, 2020

According to Figure 1, in 2020, Malaysia had the second-highest number of internet users among ASEAN countries, with 89.55% of the total population accessing the internet. Thailand ranked third in terms of internet users, with 77.84% of the total population accessing the internetIndonesia has the most significant internet users after Thailand, with 53.72% of the total population. Meanwhile, Cambodia has internet users of 33.8% of its total population, which is the lowest figure compared to other ASEAN countries. According to *the Speedtest*

Global Index 2021, as the country with the highest number of internet users, Singapore has adequate internet facilities using *fixed broadband*, judging from the average download speed of 262.20 *Mega Bytes per Second (MBps)* and an average upload speed of 236. 81 Mbps. Singapore is a developed country with a much higher index than other ASEAN countries. Besides, Singapore is in a solid political and regulatory area and is very supportive of innovation and business (Mubah et al., 2017). Singapore applies internet quota rates at low prices so that Singaporeans can access the internet quickly and without obstacles (Mubah et al., 2017). Meanwhile, Cambodia has the lowest number of internet users due to weak regulations that provide the foundation for the spread of the telecommunications market; international bandwidth is felt to be lacking where the Cambodian state refuses a competitive market for ISPs (Mubah et al., 2017). In addition, the Government of Cambodia, in 2021, determined to form a *National Internet Gateway (NIG),* which will give control over the flow of information on the internet and the power to block harmful content and sites.

The emergence of digitalization with the ease of accessing the internet not only affects economic growth in a country but can also affect developments in the field of education. Education plays a critical role in driving technological innovation and long-term economic growth in society (Habibi & Zabardast, 2020). Education serves as a life chain that can enhance the human capital of the workforce and create a pool of educated leaders who can fill various roles in government services, public companies, domestic and foreign private businesses, and professions. As a consequence, this can result in a rise in labor productivity and economic growth rates (Habibi & Zabardast, 2020). The breadth of access to digital technology is expected to be carried out by transferring and updating globally by utilizing information technology in educational activities. Apart from that, with the ease of accessing the internet, education can be accessed through Zoom Online Meetings, Google Meetings, Google Classroom, Google Form, and other platforms that can increase the efficiency of the learning process (Sardiana & Moekti, 2022).

The development of science and technology in the global economy has given rise to the notion of a digital economy, which refers to economic and business activities that utilize internet-based markets. The development of the digital economy is an opportunity for local and foreign investment in developed and developing countries. According to the OECD, foreign direct investment is a cross-border investment made directly by an actor *(direct investor)* who will invest in one of the other actors *(direct investment enterprise)* to obtain long-term profits. In *the ASEAN Investment Report* for 2022, the ASEAN Secretariat said that foreign direct

investment in 2020 has decreased in ASEAN countries due to Covid-19, but in 2021 it experienced a rapid increase. In 2021, ASEAN member countries are expected to receive foreign direct investment (FDI) with a combined value of US$174 billion (Ahdiat, 2022). According to the Ministry of Investment/Investment Coordinating Board (BKPM) in 2021, one of the most significant foreign investments in ASEAN was Singapore to Indonesia in the third quarter of 2021, which was recorded at US$ 2.6 billion; this investment value is equivalent to 36.2% of the total capital realization in the previous quarter. The capital is provided through 5,145 projects in the country (Jayani, 2021). Many essential benefits are generated by foreign direct investment. Foreign direct investment is important in achieving sustainable development targets and increasing economic growth for all countries (Todaro, 2006).

Advances in digital technology are very fast affecting the improvement of the world economy. Digitalization can facilitate access to various information using the internet. There is evidence to support that digitalization has a substantial and favorable influence not only on economic growth but also on education and international trade. Digital technology is a significant factor in economic and social activities in both developing and developed countries. The key factors that influence the impact of digitalization on economic growth include the use of electronic commerce and online business transactions, which provide greater convenience and flexibility in banking operations, as well as improved communication, all of which ultimately drive productivity and economic growth (Habibi & Zabardast, 2020).

The objective of this study is to analyze the impact of advancements in digitalization technology on economic growth, specifically how the ease of internet access can influence the development of education and science, as well as the creation of a digital economy that has a significant positive impact on economic growth.

LITERATURE REVIEW

Education and Economic Growth

In the Neo-classical growth theory, education is considered as a significant form of human capital that is essential in determining long-term economic growth and has a crucial role in promoting technological advancement (Samuelson & Solow, 1956). Education is a significant factor in a country's development and success as it molds individuals, equipping them with skills and knowledge that make them valuable contributors capable of providing sustainable benefits (Salsabila et al., 2021). Theoretical literature related to education and economic growth highlights the significance of education in boosting economic growth. Habibi

& Zabardast (2020) found that The Middle Eastern countries experience a positive impact from education; an increase of 10% in primary school gross enrollment leads to a growth of approximately 0.035% in per capita GDP. Another research study conducted by Nugroho (2014) on the effect of education on economic growth from 2004 to 2012 found that education in the proxy with Literacy Rate (AMH) positively and significantly affects economic growth. The government should continue to promote initiatives that enhance the quality and fairness of education, which are the primary issues faced by Indonesia's educational system. Doing so would ensure that education's contribution to both economic growth and fairness can be maximized (Nugroho, 2014).

Mobile Phone Use and Economic Growth

Advances in digitalization technology have been carried out in various fields that have changed various forms of daily life in business, government, and social life in society. One of the conveniences of digital technology is the widespread use of cellular phones. The rapid growth of digital technology has made cellular phones available to access the internet in various parts of the world. A survey conducted by the Indonesian Telematics Society (MASTEL) with the University of Indonesia's Economic and Social Research Institute (LPEM UI) found that using cell phones in Indonesia can improve the national economy's GDP. Kurniawati (2022) found that telephone line penetration and mobile phones can drive economic growth in middle-income Asian countries. Habibi & Zabardast (2020) also found that using mobile phones significantly contributed to economic growth in the Middle East and OECD countries.

Individual Internet use and economic growth

With the development of today's era, almost all aspects of human life can be connected to the internet, which can facilitate human work. The internet is a medium in every sector of today's life, from the political sector and education to defence. In contrast, the biggest impact of internet users is the sector trade and the economic sector has all been digitized. According to Weriemmi et al. (2020), digitalization using individual internet users significantly positively affects economic growth in 10 Asian countries. Digitalization is an important capability that underpins all other national economic endeavours. Digitalization can generate significant economic and social benefits for people and communities (Weriemmi et al., n.d.).

Foreign Direct Investment and Economic Growth

The advancement of technology and science results in rapid changes that are crucial for sustaining long-term economic growth. One of the drivers of economic development in a country can be carried out by foreign direct investment. As one of the drivers of increasing a country's economic performance, the investment must be distributed optimally so that economic added value can encourage increased economic growth (Jufrida et al., 2017). Foreign Direct Investment (FDI) can lead to higher productivity levels and provide access to technology transfer. Besides, FDI can increase competitiveness so that domestic products become superior products. FDI is essential to economic growth (Jufrida et al., 2017). Kurniawati (2022) found that financial development, trade openness, and foreign direct investment (FDI) have a substantial impact on the growth of an economy. Although financial development and trade openness are crucial elements in fostering economic growth, foreign direct investment (FDI) has a more pronounced effect on promoting economic growth in middle-income countries than in high-income countries, underscoring the significant role foreign investment plays in stimulating growth in middle-income nations (Kurniawati, 2022).

Inflation and Economic Growth

Inflation is characterized by a persistent rise in the overall price level of goods and services within an economy, leading to a reduction in the buying power of currency. Inflation occurs continuously. In a country, inflation can affect the stability of the economy. However, judging from the principle of inflation, not all inflation negatively impacts a country's economy; if mild inflation occurs, it can encourage economic growth (Indriyani, 2016).

This study modified the research conducted by Weriemmi et al. (2020), Habibi & Zabardast (2020) and Kurniawati (2022), which employed measures of cellular subscriptions per 100 people, the percentage of the population that are individual internet users, and foreign direct investment (FDI). The research modifies the research objects, years and research methods. This study modified the research method using panel data analysis because it can show heterogeneity between individuals. Furthermore, the combination of cross-sectional and time-series data increases the model's informativeness and diversity, reduces collinearity, increases degrees of freedom, and improves efficiency.

RESEARCH METHODS

Data

This study examines the independent variables in the form of government spending on education, cell phone users, individual Internet users, foreign direct investment and consumer price inflation. The dependent variable is economic growth. We use secondary data obtained from the official website of the World Bank, from 2001 to 2020, with a cross-section of 7 ASEAN countries (Indonesia, Malaysia, Thailand, Laos, Singapore, Philippines, and Cambodia). This study employs the methodology of panel data analysis. Panel data regression in this study is used to determine whether the variables of government spending on education, cell phone users, individual Internet users, foreign direct investment and consumer price inflation affect economic growth in 7 ASEAN countries. Statistical data processing and analysis are done with the program and E-Views 10.

Method of Analysis

Panel Data Regression Analysis

Panel data is a type of data that has more than one individual dimension (cross-section) and more than one-time dimension (time series). One of the advantages of the panel data model is that it can show heterogeneity between individuals. In addition, the combination of cross-section and time series data makes panel data a type of model that is more informative, more varied, can reduce collinearity, increasing degrees of freedom and is more efficient.

Panel data model form for one independent variable, namely :

$$Y_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it}$$

The form of the equation of the panel data regression in this study is as follows:

$$\text{Pertumbuhan Ekonomi} = \alpha_i + \beta 1\text{Education} + \beta 2\text{Mobile} + \beta 3\text{Internet} + \beta 4\text{Investment} + \beta 4\text{Inflation} + \varepsilon_{it}$$

Where α_i is a constant, while β1 β2 coefficient and ε is the standard error in the panel data regression equation, variable Economic growth refers to GDP per capita (%). The Neo-classical growth model explains long-term economic growth as a result of exogenous factors such as capital accumulation, population growth, or technological progress (Samuelson & Solow, 1956). To investigate how educational variables affect economic growth from an empirical research perspective, this study considers government spending on education as the education variable, which is supported by the modern human capital theory. (Mahmudah & Prasojo, 2016). Whereas in digitization, this research adopts the study of Habibi & Zabardast (2020), where this research includes cellular variables (cell phone users) and Internet variables

(individual internet users). The Solow model suggests that the steady rise in living standards can only be attributed to technological advancements. (Mankiw & Scarth, 2010). Economic openness is explained by the investment variable, which refers to foreign direct investment and the inflation variable, which refers to consumer price inflation which this research adopts from Kurniawati's (2022) research study.

Normality test

To conform to the classical linear regression model, one of the requirements is that the residuals/errors should follow a normal distribution. Error normality can be tested using the JarqueBera test. Testing hypothesis:

H0 = normally distributed error

H1 = errors are not normally distributed

In making a decision, the normality test is if the Jarque-Bera probability <0.05, then H0 is rejected, which means that the errors are not normally distributed. So that when the data is declared not normally distributed, it must need a normality handler. By looking at outlier/outlier data (data values that come out of the average). If the Outliner value is more than one, then normality is handled by removing the data affected by the outliner and selecting normal data

Table 1: Variable Definitions and Summary of Data Sources

No	Variables	Definition of Variables	Source
1	Growth	GDP growth per capita (annual %)	WDI, World Bank
2	Education	Government spending on education, total (% of GDP)	WDI, World Bank
3	Mobile	Cell Phone Users (per 100 people)	WDI, World Bank
4	Internet	Individual Internet Users (% of the population)	WDI, World Bank
5	Investment	Foreign Direct Investment (% of GDP	WDI, World Bank
6	Inflation	Consumer Price Inflation (% Annual)	WDI, World Bank

Source: Built by the Author

Results and Discussion

Based on Table 2, the economic growth in ASEAN countries rapidly grows. The maximum growth rate is 4.94, while some economies are performing poorly because the minimum value is only -3.10, with an average of 3.57, where there is a downward slope left because of the

negative skewness value. The minimum value of education (government spending on education) is 2.46, and the maximum value is 3.58, with an average of 3.04.

Table 2: Descriptive Statistics

	Y_GROWTH_...	C	X1_EDUCATI...	X2_MOBILE_...	X3INTERNET...	X4_INVESTM...	X5_INFLATIO...
Mean	3.570730	1.000000	3.047372	81.03582	16.45492	1.498619	6.511397
Median	3.856879	1.000000	2.979267	94.64155	11.60000	1.820309	6.213591
Maximum	4.946468	1.000000	3.583600	164.4406	53.72649	2.916115	13.10867
Minimum	-3.102652	1.000000	2.460030	3.041098	2.018614	-1.855686	1.920968
Std. Dev.	1.667432	0.000000	0.314818	52.97811	15.41197	1.156117	3.175363
Skewness	-3.166524	NA	0.119755	-0.189422	1.131944	-1.276726	0.684674
Kurtosis	13.10518	NA	2.000698	1.534165	3.137994	4.307083	2.336717
Jarque-Bera	829.6291	NA	6.159823	13.37113	30.00800	48.00005	13.50449
Probability	0.000000	NA	0.045963	0.001249	0.000000	0.000000	0.001168
Sum	499.9022	140.0000	426.6320	11345.01	2303.688	209.8067	911.5956
Sum Sq. Dev.	386.4657	0.000000	13.77630	390128.5	33016.51	185.7883	1401.527
Observations	140	140	140	140	140	140	140

Source: Processed Data E-Views 10

While other variables such as mobile (cellular phone users) have an average of 81.03, Internet (Individual Internet users) have an average of 16.45 per 100 people, Investment (foreign direct investment) and inflation (inflation, consumer prices) show an average of 1.49 and 5.51.

Table 3: Panel Regression Results

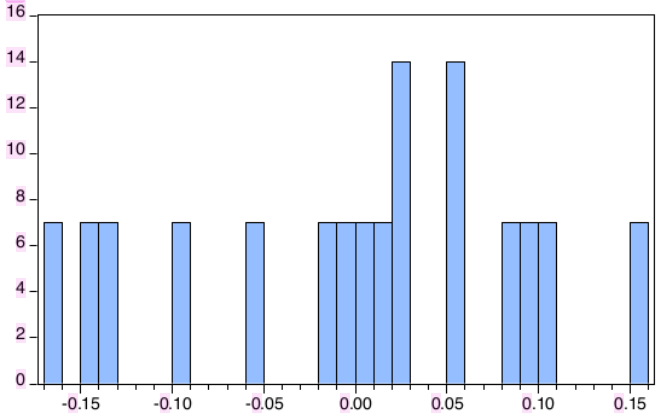
	Model 1	Model 2
Variables	Chow test	Hausman test
growth		
Education	0.0321	0.0362
Mobile	0.0001	0.0001
Internet	0.0000	0.0000
Investments	0.0001	0.0001
inflation	0.2868	0.2979
Cross-section F (Prob)	1.0000	1.0000

Source: Processed Data E-Views 10

Table 3 illustrates the application of three models: common effect, fixed effect, and random effect, using different approaches. Model 1 presents the findings of the Chow test or Likelihood ratio test, which helps determine the superior model between the fixed effect model and the common effect model by examining the F-Statistic probability. Model 2 involves a Hausman test, which is performed to determine the optimal model between the fixed effect and random effect models under the same assumptions as the Chow test. The results suggest that the random effect model is more suitable than the fixed effect model. Model 3 shows the Breusch-Pagan

LM test, which aims to determine the best-fit model between the common effect model or the random effect model. This test is carried out under similar conditions as Model 1, indicating that the common effect model is more suitable for use than the random effect model.Cross section with the criterion H0 is rejected if the probability <; (α=0.05), where the common effect or CE model is more appropriate.

Table 4: Normality Test



Series: Standardized Residuals	
Sample 2002 2019	
Observations 119	
Mean	-2.09e-16
Median	0.019002
Maximum	0.159662
Minimum	-0.160946
Std. Dev.	0.090575
Skewness	-0.333586
Kurtosis	2.228245
Jarque-Bera	5.160260
Probability	0.075764

Source: Processed Data E-Views 10

The normality test determines whether the errors are normally distributed; it can be tested using the Jarque-Bera Test. Table 4 on the normality test shows that the p-value of the jarque-bera test statistic is 0.075764; the value is > 0.05. Thus, the error/residual normality assumption is fulfilled (data is normally distributed).

Table 5: Common Effect Model Hypothesis Test

Variables	coefficient	std. Error	t-Statistics	Prob.
C	1.887905	0.137353	13.74487	0.0000
X1_EDUCATION____	-0.218313	0.040815	-5.348792	0.0000
LOGMOBILE	0.079518	0.024149	3.292786	0.0013
X3INTERNET____	-0.007112	0.001235	-5.760311	0.0000
LOGINVESTMENT	0.078073	0.014744	5.295152	0.0000
LOGINFLATION	-0.039673	0.033993	-1.167081	0.2456

R-squared	0.546289	Mean dependent var	1.390636
Adjusted R-squared	0.526213	SD dependent var	0.134468
SE of regression	0.092557	Akaike info criterion	-1.872876
Sum squared residue	0.968052	Schwarz criterion	-1.732752
Likelihood logs	117.4361	Hannan-Quinn criter.	-1.815976
F-statistics	27.21146	Durbin-Watson stat	2.238172
Prob(F-statistic)	0.000000		

Source: Processed Data E-Views 10

Table 5 shows that four of the five variables have a significant positive effect, and only one variable, namely inflation, does not have a statistically significant effect.

Education is a critical contributor to long-term growth and plays a fundamental role in promoting economic development. The findings indicate that education has a positive and significant impact on economic growth. These results are consistent with the research conducted by Habibi & Zabardast (2020), which demonstrates that Education has a notable and favorable impact on economic growth. Moreover, nations that have greater access to education and digital technology experience a positive effect on economic growth. Moreover, Nugroho (2014) also confirms that education has a positive and significant effect on economic growth.

The utilization of cellular phones, as digital devices, enables the access to information and communication, which can enhance the economic activities of individuals and ultimately lead to economic growth. The findings of the study indicate that the number of cellular phone users has a significant positive impact on economic growth in seven ASEAN countries. This is consistent with the research conducted by Kurniawati (2022), who found that The prevalence of mobile phone users has a significant and positive impact on economic growth. Hence, the expansion of mobile phone usage is essential in driving economic growth in Central Asian countries. Furthermore, Vickers (2017) also affirmed that mobile phones have a favorable and statistically significant impact on economic growth.

The hypothesis test conducted on the variable for individual internet users, referred to as the internet variable, indicates that it has a significant positive impact on economic growth. This is because internet access connects people's lives, and the various digital applications and services that use the internet make it easier for them to carry out product promotions, marketing, and transactions, thereby promoting economic growth. These findings are consistent with the research by Weriemmi et al., n.d.(2020), which shows that digitalization, represented by individual internet users, has a positive impact on economic growth. Additionally, Kurniawati (2022) found that tshe high-income Asian countries have achieved significant and favorable economic growth attributed to their high rate of internet penetration.

Investment has a positive and significant impact on economic growth, with foreign direct investment (FDI) providing long-term benefits that can help a country achieve development targets and boost economic growth. These findings are consistent with Kurniawati (2022) research, which demonstrates the significant positive effect of FDI on economic growth in ASIA countries. Similarly, Maslukhah (2019) reports that FDI has a positive and significant

effect on economic growth in ASEAN both simultaneously and partially. However, based on the hypothetical test conducted on the inflation variable, which refers to consumer price inflation, it is observed that it does not significantly impact economic growth in the 7 ASEAN countries. Therefore, an increase in the inflation variable will result in a decrease in economic growth.

Conclusion

The development of digitalization not only increases economic growth but also facilitates activities in education and trade economic activities globally. With the existence of the Sustainable Development Goals (SDGs) Program, this research study empirically examines the impact of digitalization on economic growth in ASEAN countries using panel data in 7 ASEAN countries (Indonesia, Malaysia, Thailand, Laos, Singapore, Philippines, Cambodia). The results can be concluded that education significantly positively affects economic growth. Second, digitalization, as measured by the variables of cellular phone users and individual internet users, has a positive and significant effect on economic growth. Third, trade openness, as measured by the variable foreign direct investment and consumer price inflation, has different results where the foreign direct investment variable has a significant positive effect on economic growth. In contrast, consumer price inflation does not significantly influence economic growth in ASEAN.

Suggestion

Digitalization is a driving force for developments in education, trade openness, and economic growth. It is hoped that the government will develop digital technology that every community can obtain to compete in the digital era. In addition, the government must strengthen digital infrastructure, develop digital competencies, and enact appropriate laws to complement primary regulations, so that digital discrepancies do not occur.

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