Available online at
https://journal.rescollacomm.com/index.php/ijqrm/index

International Journal of Quantitative Research and Modeling

e-ISSN 2721-477X
p-ISSN 2722-5046

Vol. 2, No. 4, pp. 209-217, 2021

Do Phone and Internet Have Role to Promote Economic Development? An Empirical Evidence from Indonesia

Rika Nurlela[1], Aliasuddin[2,*], Taufiq. C. Dawood[3]

[1,2]*Faculty of Economics and Business, Syiah Kula University, Banda Aceh, Indonesia*

**Corresponding author email: aliasuddin@unsyiah.ac.id*

Abstract

As one of the developing countries in the world, Indonesia is very active in developing ICT. The dependence of the Indonesian people on ICT increases every year. The two ICT indicators experiencing rapid development are the telephone and the internet. This study aims to analyze the effects of fixed-line phone users, mobile phone users, and internet users on economic growth in Indonesia. The panel data used in this study is panel data from 33 provinces in Indonesia from 2011–2019. The results showed that mobile phone users and internet users have positive effects on economic growth. However, fixed-line phones have a negative and insignificant influence on economic growth. Advances in technology have shifted fixed-line phones to smartphones. The government is expected to control and direct mobile phones and the internet for productive activities to encourage economic improvement.

Keywords: Fixed-line phone, mobile phone, internet and economic growth.

1. Introduction

Today, information and communication technology (ICT) has grown rapidly around the world. Discoveries in technology continue to be developed to increase effectiveness and efficiency for human life. Along with the rapid innovation and development of technology, ICT has become a friend in activities, including economic activities. Many business units utilize ICT to develop their business because it facilitates the dissemination of information. ICT has removed space and time constraints that can lead to economic movement and indirectly affect economic growth.

As one of the developing countries in the world, Indonesia is very active in developing ICT. The dependence of the Indonesian people on ICT increases every year. The two ICT indicators experiencing rapid development are the telephone and the internet. The telephone is one of the communication tools used as a conversation medium useful for social activities and the economy. For economic activity, the phone disseminates business transactions, facilitates information from producers to consumers, and facilitates the delivery of goods, promotions, etc. Meanwhile, the Internet is a computer network interconnected for communication and information purposes. In economics, the internet serves as a medium for advertising, business communication, presenting price movements, financial transactions, etc.

The development of phones, internet, and economic growth in Indonesia can be explained in Figure 1. This figure shows that mobile phone users and internet users increased sharply compared to GDP per capita from 2011 to 2019. Meanwhile, fixed-line phones showed a slowdown from year to year and GDP per capita growth is still stable every year.

Previous researchers have studied the effect of phones and the internet on economic growth. Several researchers state that phones and internet have a positive and significant effect on economic growth, such as Malik et al. (2009), who concluded that the growth of mobile phones has a strong and significant impact on people's lives in Pakistan both economically and socially. Lum (2011) states that mobile subscription has a positive and significant impact on the level of real GDP per capita and GDP growth rates of countries. In addition, there are efforts to use technology to encourage global growth. Kefela (2011) found that mobile phones impacted low-income countries through increased employment, business opportunities, and productivity. Lee and Gardner (2011) discovered that mobile phones are used in 99% of the business transactions conducted by traders in Molyko. As many as 25.2% of business contacts use mobile phones to communicate, bringing trade closer to producers and consumers. Mobile phones are used for business communication by as many as 36.4% by traders.

Toader et al. (2018) found that using ICT infrastructures such as fixed-broadband subscriptions and mobile cell subscriptions has a positive and significant impact on GDP per capita at the European Union level. But the magnitude of this effect is highly dependent on the type of technology used. Through the interpretation of the IRF dimensions, it is known that broadband subscriptions and internet users will positively impact GDP for a certain lag. Lapatinas (2019) found that the internet positively influences the sophistication of exported products (measured by the improved ECI available from MIT's Observatory of Economic Complexity). Kurniawati (2021) concludes that fixed-line and mobile phone penetration can increase economic growth in middle-income Asian countries. In addition, the influence of internet penetration has a positive and significant impact on the economies of high-income Asian countries.

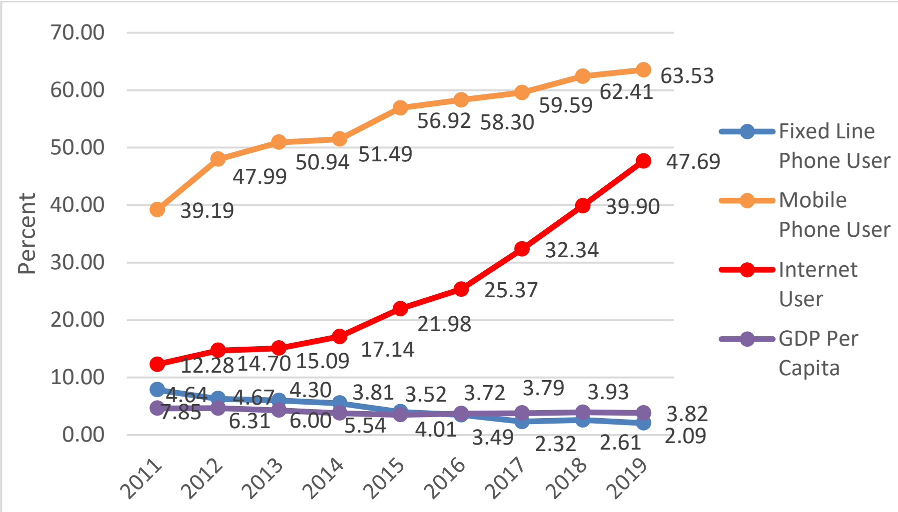

Figure 1. Development of Phone, Internet and GDP per capita Growth in Indonesia, 2011-2019
Source: BPS website, processed data

On the other hand, some studies show that phones and internet negatively impact economic growth, such as Sahrina and Anis (2019), which concludes that there is no relationship between fixed telephone users and economic growth in the five founding countries of ASEAN. Bakari and Tiba (2020) found that using the ARDL method, the internet hurts economic growth in Algeria, Egypt, Morocco, and Tunisia for the time series. Meanwhile, the panel data model shows that the internet has a significant negative impact on growth for North Africa as a whole.

Research on the effect of phones and the internet on economic growth is still interesting due to the following considerations: First, this research is mostly studied in Sub-Saharan Africa (SSA), the European Union, and other developing countries. However, on the regional scale, it is still rarely studied. Second, this study uses data from the National Socio-Economic Survey (Susenas) of the Indonesian Central Statistics Agency. This data can describe more clearly the development of telephone and internet users in Indonesia. Third, panel studies in developing countries like Indonesia can be an additional reference for future research.

2. Literature Review

2.1 Information and Communication Technology (ICT)

UNESCO Institute for Statistics defines ICT as a technological device and its resources useful in creating, transferring, and storing information.

The indicators used to measure the use of ICT in Indonesia are as follows:

1. Fixed-Line Telephone
   According to the Central Bureau of Statistics (BPS), a fixed-line phone is a telecommunications network that uses fixed-line telephone equipment and generally uses a telephone number or New Template Switched Telephone Network (NSTP).
2. Cell phones
   According to the Central Bureau of Statistics (BPS), a cellular phone is an electronic device with the same function as a fixed-line phone but is portable and wireless.
3. Internet

According to the Central Bureau of Statistics (BPS), the internet is a computer network accessed around the world by using the World Wide Web, e-mail, news, entertainment, and data files.

2.2 Economic Growth

Economic growth is the increase in the value of Gross Domestic Product (GDP), regardless of whether the increase is large or small compared to the rate of population growth or whether or not the economic structure has changed (Rao and Yan, 2020). The measurement of the progress of an economy requires the right measuring tools, several measuring tools for economic growth include (Pusra et al., 2021):

1. GDP stands for Gross Domestic Product.
   Gross Domestic Product (GDP), or Gross Regional Domestic Product (GDP) at the regional level, is the total amount of goods and services produced by an economy in one year, expressed in market prices. Either GDP or GDP is a global measure, and it is not an appropriate gauge of economic growth because it cannot yet reflect the actual well-being of the population. Indeed, welfare must be enjoyed by every resident in the country or area concerned
2. Gross Domestic Product (GDP) Per capita/Per capita Income.
   Gross Domestic Product (GDP) Per capita or Gross Regional Domestic Product (GRDP) Per capita on a regional scale can be used to gauge economic growth that more precisely reflects the well-being of a country's or region's population rather than the value of GDP or GDP alone.

3. Materials and Methods

3.1. Materials

This study aims to analyze the effects of fixed-line phone users, mobile phone users, and internet users on economic growth in Indonesia. The data structure used in this study is the panel, namely a cross-section of 33 provinces in Indonesia and a time series for 2011–2019. The independent variables are measured using the percentage of the urban and rural population owning or using fixed-line phones, the percentage of the urban and rural population owning or using cellular phones, and the percentage of the urban and rural population aged five years and over who accessed the internet in the last three months. Meanwhile, economic growth was measured by the provincial Gross Regional Domestic Product (GDP) changes based on constant prices in 2010. The data used to analyze comes from the Indonesian Telecommunication Statistics Book, 2011-2019 edition, published by BPS-Statistic Indonesia (data for ICT indicators) and BPS-Statistics Indonesia website (data for Regional GDP).

The analysis used is panel data regression analysis. Panel data regression analysis is used to see the effect of fixed-line, mobile, and internet users on economic development. The model that will be used to examine the effect of independent variables on economic growth is a model of transformation of the growth rate aimed at data stationers. Panel data regression models in this study are:

$$\mathrm{GGRDPPC_{it}} = \alpha_0 + \alpha_1\ \mathrm{GFP_{it}} + \alpha_2\ \mathrm{GMP_{it}} + \alpha_3\ \mathrm{GIU_{it}} + \mathrm{e_{it}}$$

Where GGRDPPC is economic growth (in growth); FP is fixed line phone user (in growth); MP is mobile phone users (in growth); IU is internet users (in growth), α_0 is a constant, α_{1-} α_3 is an estimated parameter, it is cross-section and time-series, and e is the error term.

3.2. Methods

In general, regression analysis of panel data can be done with three estimation models, namely the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM). To analyze the panel data, a test of model specifications must first be conducted to obtain the most appropriate model estimates used in the research. Once the correct model is selected, the next step is to do a classical assumption test to test the research hypothesis.

3.2.1. Estimation Method

There are three techniques that can be used in estimating panel data, namely pooled least square or common effect, fixed effect, and random effect (Gujarati and Porter, 2014):

1. The Pooled Least Square (PLS) or Common Effect Model (CEM)
   This method is the simplest because it does not show the dimensions of the individual or time, assuming that the behavior of individuals is the same in various periods. This approach combines time series and cross-section data into pools and estimates them using the pooled least square method.
2. Fixed Effect Model (FEM)
   For the least square method, there is difficulty in assuming interception and slope of regression equations that are considered constant both between regions and between times, which don't have a clear reason. Generalization is often achieved by entering dummy variables to allow for parameter values between cross-section units. The approach of including dummy variables is called the fixed-effect approach or the covariance model.
3. Random Effect Model (REM)
   Incorporating dummy variables in fixed-effect models impacts the reduction of degrees of freedom, ultimately decreasing the efficiency of the estimated parameters. The random effect approach assumes the effect of each individual is required as part of an unexpected error component that is not correlated with the observed explanatory variable. Effect models are also often called error component models.

3.2.2. Model Selection

The tests required in choosing the most appropriate techniques in regression of panel data, namely the Chow Test (F Statistical Test), the Hausman Test, and the Multiplier Lagrange Test (LM).

1. Chow Test (F Statistical Test)
   A test that works to choose whether the model is better between Pooled Least Squared and Fixed Effect. The hypotheses in the Chow test are as follows:
   H_0: Pooled Least Squared Model (Common Effect Model)
   H_1: Fixed Effect Model
   Where if the probability < 0.05 then reject H_0 and receive H_1
2. Hausman Test
   A test that works to choose whether the model is better between Random Effect and Fixed Effect. The hypotheses in the Hausman test are as follows:
   H_0: Random Effect Model
   H_1: Fixed Effect Model
   Where if the probability < 0.05 then reject H_0 and receive H_1
3. Lagrange Multiplier Test (LM Test)
   A test that works to choose whether the best is the pooled effect or random effect model.
   LM testing to see chi-square distributions with degrees of freedom amounting to independent variables. If the p-value is less than the chi-square value, then H_0 is rejected, which means the selected method is the Random Effect Model. If the p-value is greater than the chi-square value, then H_0 is accepted, so the estimate used in the panel data regression is the Common Effect Model.

3.2.3. Classic Assumption Test

The classical assumption test in linear regression with the ordinary least squared (OLS) approach is the multicollinearity and the heteroscedasticity test.

1. Multicollinearity Test
   The multicollinearity test aims to see whether there is a correlation between independent variables in regression models. If the correlation coefficient is greater than 0.8, it can be concluded that the model indicates multicollinearity. Conversely, if the correlation coefficient is less than 0.8, the model has not shown multicollinearity.
2. Heteroscedasticity Test
   The heteroskedasticity test aims to assess the inequality of variable distribution from residuals at each variation used in this model. To see whether or not heteroskedasticity problems can be operated using the Generalized Least Square (GLS) method. With the following hypothesis:
   H_0: If (prob > chi square) is less than $\alpha = 0.05$, then the model is indicated heteroskedasticity.
   H_1: If (prob > chi square) is greater that $\alpha = 0.05$, then the model is declared not indicated heteroskedasticity.

3.2.4. Hypotesting Test

1. Test Coefficient of Determination (Adjusted)
   The coefficient of determination describes how much all independent variables can explain the dependent variables. The coefficient value is between 0 (zero) and 1 (one), where the more significant the coefficient value, the larger the independent variables explain the variation of dependent variables.
2. Simultaneous Test (Test F)
   Statistical test F aims to find out whether independent variables simultaneously or together affect dependent variables. This test is conducted with the following criteria: If the significance level is greater than 0.05, then H_0 is accepted and if the significance level is less than 0.05, then H_1 is accepted. Where H_0 is independent variabel simultaneously does not affect dependent variable and H_1 is independent variable simultaneously affect dependent variable.
3. Partial Test (T-Test)
   The statistical t-test shows how much the effect of the independent variable has in explaining the dependent variable, where other independent variables are considered constant. This test is conducted with the following criteria: If the significance level is greater than 0.05, then H_0 is accepted, and if the significance level is less than 0.05, then H_1 is accepted. Where H_0 is the independent variable that has no significant effect on the dependent variable, and H_1 is the independent variable that has a significant effect on the dependent variable.

4. Results and Discussion

4.1 Estimation Model

There are several approaches to estimate the model with panel data, namely Pooled Least Square (PSL) or Common Effect Model (CEM), Fixed Effect Model, and Random Effect Model. The approach with a better and proper panel method can be known using the Chow, Hausman, and Lagrange Multiplier tests. The results of the estimated can be seen in Table 1.

Table 1. Model Test Results

Model	PSL/ Common Effect		Fixed Effect		Random Effect	
Variables	β	Prob	β	Prob	β	Prob
C	2.144802	0.0000	2.133434	0.0000	2.136908	0.0000
GFT	-0.007970	0.1526	-0.006744	0.1835	- 0.007098	0.1594
GMP	0.059518	0.0061	0.057721	0.0035	0.058227	0.0031
GIU	0.047441	0.0019	0.049712	0.0004	0.049049	0.0004
R^2	0.099782		0.358894		0.177702	

Sources: Eviews Output Results, 2021

Table 1 shows the results of estimates for the analysis model of the effect of phone and internet on economic growth. All models obtained the same estimate results, where the value of variable p-value from fixed-line phones (GFT) was greater than $\alpha = 0.05$. But to choose the right model from the three models above, it takes the test of Chow, Hausman, and Lagrange Multiplier.

4.2 Model Selection

To perform panel data analysis, a suitable model specification test to describe the data with several tests:

1. Chow Test

This test aims to determine the Common Effect or Fixed Effect model that is more appropriately used in estimating panel data.

Table 2. Chow Test Results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	3.296461	(32.261)	0.0000

In Table 2, the p-value obtained in Cross-section F is 0.0000 where the p-value is less than the significance level value (α=0.05), so H_0 is rejected. This means that the better model used is the Fixed Effect Model (FEM).

2. Hausman Test

This test aims to determine the Fixed Effect or Random Effect model that is more appropriately used in estimating panel data.

Table 3. Hausman Test Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.719523	3	0.8686

In Table 3, the value of prob chi square is 0.8686 > 0.05 (α = 0.05), then H_0 is accepted, so the right model is the Random Effect Model. From the hausman test results decided the best model is the Random Effect Model, so to see the most appropriate model between Common Effect and Random Effect then the Lagrange Multiplier test was carried out.

3. Lagrange Multiplier Test

This test aims to determine the most appropriate Common Effect Model or Random Effect Model that will be used in estimating panel data.

Table 4. Bruesch and Pagan Lagrange Multiplier Test Results

Null (no rand. effect) Alternative	Cross-section One-sided	Period One-sided	Both
Breusch-Pagan	46.83899	54.31118	101.1502
	(0.0000)	(0.0000)	(0.0000)
Honda	6.843902	7.369612	10.05047
	(0.0000)	(0.0000)	(0.0000)
King-Wu	6.843902	7.369612	9.652267
	(0.0000)	(0.0000)	(0.0000)
GHM	--	--	101.1502
	--	--	(0.0000)

In Table 4, the p-value in Breusch-Pagan is less than the value of α = 0.05, enough evidence to reject H_0 so that the model used is a Random Effect Model.

4.3 Hypothesis Testing

After choosing the best model is Random Effect, then the next stage of hypothesis testing is carried out as follows:

1. Simultaneous Test (F-test)

The statistical F test aims to find out whether the independent variations simultaneously or together affect dependent variables.

Table 5. F-Test Results

R-squared	0.115767	Mean dependent var	1.836677
Adjusted R-squared	0.106713	S.D. dependent var	2.580030
S.E. of regression	2.438486	Sum squared resid	1742.241
F-statistic	12.78681	Durbin-Watson stat	1.669490
Prob(F-statistic)	0.000000		

Based on Table 5, it is known that the p-value of F (0.000000) is less than the significance level value of α = 0.05, so H0 is rejected. This means that independent variables (GFP, GMP, and GUI) significantly affect dependent variables (GGRDPPC).

2. Partial Test (t-test)

The t-test is used to see how much effect independent variables have on dependent variables, where other independent variables are considered constant.

Table 6. t-Test Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.136908	0.353994	6.036560	0.0000
GFP	-0.007098	0.005032	-1.410643	0.1594
GMP	0.058227	0.019497	2.986417	0.0031
GIU	0.049049	0.013785	3.558219	0.0004

Based on Table 6, it is known that the fixed-line phone (GFP) variable has a p-value above the significance level value (α = 0.05), and the coefficient is negative. Meanwhile, mobile phone and internet user variables have p-values below the significance level value (α = 0.05) and the coefficient is positive.

3. Coefficient of Determination

The coefficient of determination, usually denoted by R^2 describes how all independent variables can explain much variation in dependent variables. Based on Table 7, the Adjusted R-squared value in the data panel using the Random Effect model is 0.115767. These results mean that the variation in economic growth (GDP per capita) can be explained by all independent variables (fixed-cord phone users, mobile phone users, and internet users) of 11.57% and the remaining 88.43% explained by other variables not used in the research model.

4.4 Classic Assumption Test

1. Multicollinearity Test

This test aims to see if there is a correlation between independent variables. The results of the model can be seen in Table 7.

Table 7. Multicollinearity Test Results

	GFP	GMP	GIU
GFP	1.000000	-0.146511	-0.182174
GMP	-0.146511	1.000000	0.349893
GIU	-0.182174	0.349893	1.000000

Table 7 shows that there is no value in this model that exceeds the number |0.8|. It can be stated that this model does not have multicollinearity.

2. Heteroskedasticity Test

The test aims to assess the inequality of the varying distribution of residuals in each variety used in this model. To see whether or not heteroskedasticity problems can be used using the Generalized Least Square (GLS) method.

Table 8. Heteroscedasticity Test Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.106716	0.279244	7.544345	0.0000
GFP	-0.003476	0.004110	-0.845709	0.3984
GMP	0.006331	0.016472	0.384374	0.7010
GIU	-0.025922	0.013712	-1.890470	0.0597

Table 8 shows that all variables have no heteroskedasticity, where the probability value is greater than the significance level value (α = 0.05), so the model is declared to have no heteroscedasticity.

4.5 Discussion

This study uses variables fixed-line phone user (GFP), mobile phone user (MP), internet (GIU) user, and economic growth (GGRDPPC) estimated by the random effect model. Based on Table 6, fixed-line phones have a negative and insignificant influence on economic growth in Indonesia. The findings are in line with Bahrini and Qaffas's (2019) research, which concluded that low-income countries in MENA and SSA do not benefit from the growth of fixed-line phones due to the high cost of infrastructure incurred for the diffusion of these fixed-line phones. In addition, these findings also support research conducted by Ariansyah (2018), which concluded that fixed-line phones negatively influence economic growth. Declining growth in fixed-line phone adoption in ASEAN countries tends to fall while GDP tends to be positive.

According to The Indonesian Telecommunication Statistics Data, from 2011-2019, the percentage of fixed-line phone users in Indonesia decreases. The high cost of phone rates with fixed-line phones compared to mobile phones caused this channel to be abandoned and switched to mobile phones. In addition, because fixed-line phone channels cannot be carried anywhere, it further minimizes the increase in benefits and will impact productivity.

Furthermore, mobile phone users, are known to have a positive and very significant effect on economic growth in Indonesia. This finding is in accordance with research conducted by Malik et al. (2009), Lum (2011), Toader et al. (2018), and Kurniawati (2021). According to the Ministry of Communication and Information data published in the Indonesian Statistics Book-2019, mobile phone customers in Indonesia by 341.28 million, with a growth rate of 6.84%. The high growth rate illustrates the high activity of Indonesian people in using mobile phones in everyday life. Suppose mobile phones are directed at productive activities such as marketing goods and services, sending price information, promoting products, etc. In that case, it will increase people's real per capita income and directly impact purchasing power and increase demand, thereby causing the economy to grow and move faster.

Lastly, internet users have a positive and significant influence on economic growth in Indonesia. The findings are in line with Yasmeen and Sadia's (2015) research, which concluded that internet use has a positive effect over the long term on economic growth. However, the use of the internet needs to be directed to activities that can affect the development of the country's economy. This study also supports the research conducted by Lubis and Febrianty (2018) Lapatinas (2019).

From 2011 to 2019, most people in Indonesia accessed the internet via mobile phone, increasing from 51.38 % to 96.95%. The aiming of access is primarily for social media activities. Because of the large internet access to social media, this media is used for marketing goods and services by business actors. this activity has added value to economic transactions that can cause an increase in income and aggregately can encourage growth in national income.

5. Conclussion

Based on the results of this study, it can be concluded that testing with the Random Effect Model shows that mobile phone users and internet users have a positive and significant influence on economic growth in Indonesia. However, fixed-line phones have a negative and insignificant effect on economic growth. This happens because the high cost of phone rates with fixed-line phones compared to mobile phones causes this channel to be abandoned and switched to mobile phones. In addition, because fixed-line phone channels cannot be carried anywhere, the benefits obtained are reduced, which will impact productivity. The government is expected to control and direct mobile phones and the internet for productive activities to encourage economic improvement.

The limitation of this study is that there is still limited data related to variables studied, which is only ten years, so it does not adequately describe conditions at the macroeconomic level. So further research needs to add years of investigation to obtain better and accurate results.

References

Ariansyah, K. (2018). Pengaruh Difusi Layanan Telekomunikasi terhadap Pertumbuhan Ekonomi Negara-Negara ASEAN pada Periode 2005-2016 [Impact of Telecommunication Service Diffusion on Economic Growth of ASEAN Countries in the Period of 2005-2016]. *Buletin Pos Dan Telekomunikasi*, *16*(1), 1-16.

Bahrini, R., and Qaffas, A. A. (2019). Impact of information and communication technology on economic growth: Evidence from developing countries. *Economies*, *7*(1), 21.

Bakari, S., and Tiba, S. (2020). *The Impact of Internet on Economic Growth : Evidence from North Africa The Impact of Internet* *on Economic Growth : Evidence from*. *96629*, 1–23.

Gujarati, D. N., & Porter, D. C. (2009). *Basics Econometrics*.5th ed. McGraw Hill Inc. New York, USA

Kefela, G. T. (2011). The impact of mobile phone and economic growth in developing countries. *African Journal of Business Management*, *5*(2), 269–275.

Kurniawati, M. A. (2021). Analysis of the impact of information communication technology on economic growth: empirical evidence from Asian countries. *Journal of Asian Business and Economic Studies*, In Press

Lapatinas, A. (2019). The effect of the Internet on economic sophistication: An empirical analysis. *Economics Letters*, *174*, 35–38.

Lee, S. H., and Gardner, L. K. (2011). Does the Spread of Mobile Phones Promote Economic Development? Empirical Evidence From South Asia and Sub-Saharan Africa Regions. *Southwestern Economic Review*, *38*, 15–26.

Lubis, N., & Febrianty, H. F. (2018, May). Internet Influencing Economic Growth: What and How Much? A Case Study of Indonesia Using Time Series Data (2001-2016). In *3rd International Conference of Integrated Intellectual Community (ICONIC)*.

Lum, T. (2011). Mobile goes global: The effect of cell phones on economic growth and development. Doctoral Thesis, Bucknell University, United States

Malik, S., Chaudhry, I. S., and Abbas, Q. (2009). Socio-economic Impact of Cellular Phones Growth in Pakistan : An Empirical Analysis. *Pakistan Joural of Social Sciences*, *29*(1), 23–37.

Pusra, C. M., Srinita, S., & Seftarita, C. (2021). Effect of Selected Economic Sectors on Poverty. *International Journal of Business, Economics, and Social Development*, *2*(1), 37-49.

Rao, C., & Yan, B. (2020). Study on the interactive influence between economic growth and environmental pollution. *Environmental Science and Pollution Research*, *27*(31), 39442-39465.

Sahrina, and Anis, A. (2019). Analisis kausalitas teknologi informasi komunikasi (tik) dan pertumbuhan ekonomi di ASEAN. *Jurnal Kajian Ekonomi Dan Pembangunan*, *1*(2), 421–434.

Toader, E., Firtescu, B. N., Roman, A., and Anton, S. G. (2018). Impact of information and communication technology infrastructure on economic growth: An empirical assessment for the EU countries. *Sustainability (Switzerland)*, *10*(10), 1–22.

Yasmeen, R., and Sadia, T. (2015). Impact of Internet Technology on Economic Growth in South Asia With Special Reference to Pakistan. *Pakistan Journal of Social Sciences*, *35*(2), 777–778.