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The Effect of Educational Technology Development and Economic Growth on Open Unemployment in Indonesia

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Keywords
unemployment; technology; education; gross domestic product

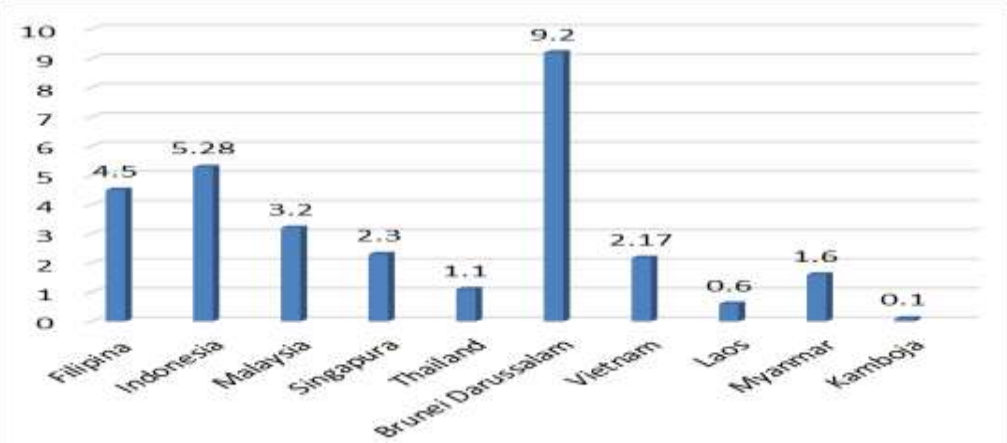
Abstract
This study aims to examine and analyze the determinants of the unemployment rate in Indonesia. This study uses secondary data from the Indonesian Central Statistics Agency (BPS). This study uses the panel data method which is a combination of cross section data covering 34 provinces and time series for 5 years from 2015-2019. Based on the Chow test and Hausman test, the most appropriate model in this study is the Fixed Effect Model (FEM). Based on the simultaneous test, the development of technology, education, and economic growth simultaneously have a significant effect on the open unemployment rate of 87.38 percent and the remaining 12.62 percent is influenced by other variables not included in this research model. Based on the validity test, technological developments have a significant positive effect on the open unemployment rate, while education and economic growth have a significant negative effect on the open unemployment rate in Indonesia.

I. Introduction

Unemployment is currently one of the problems in the economy caused by an imbalance in the number of workers supplied exceeds the number of workers demanded. So that the labor market is not able to absorb the available labor force. The high unemployment rate that occurs reflects the economic condition of a country or region, whether it is developing, slow or even experiencing a decline. According to the Central Statistics Agency (2011) unemployment is a term for those who are looking for work, preparing for a business, not looking for work because they feel it is impossible to get a job, and who already have a job but have not started working and at the same time they are not working (jobless). .

Unemployment is often a separate problem that must be faced in various countries, including Indonesia. Indonesia has experienced several major crises after its independence in 1945 which led to an increase in unemployment and even poverty. First, in the 1960s, high inflation rates caused a fall in people's purchasing power and increased poverty. Second, in 1997-1998 there was an economic crisis, where people experienced the same fate, namely an increase in the number of unemployment and poverty and a fairly heavy economic life. In 2020 the world again experienced a crisis due to the pandemic, where countries in the world tried to save their people by reducing various social and economic activities. As a result, The economic sector has slumped due to reduced demand for goods and services from the public. The real sector is the sector that has suffered the most from this crisis. The closure of economic activity has led to increased unemployment and poverty.

The unemployment rate in Indonesia among ASEAN countries is high. Indonesia in 2019 was ranked the second highest with the highest unemployment rate, which was 5.28% below 1 rank from Brunei Darussalam with an unemployment rate of 9.2%.



Source: Trading Economics, 2019 (processed).
Figure 1. *Graph of Open Unemployment Rate (%) ASEAN Countries.*

Indonesia is a country that wants unemployment to be as low as possible. But keep in mind, unemployment is impossible to completely eliminate because of the time it takes job seekers to find new jobs or move from old jobs so that workers have to be unemployed for a while. To create a low unemployment rate, the government is required to formulate appropriate policies. For this reason, it is necessary to analyze factors with several economic and non-economic indicators that can affect the magnitude of the unemployment rate, including technological developments, education levels, and economic growth.

The development of technology that is growing from time to time makes all sectors, especially the economic sector, really need technology. The condition of technological development can be seen from the Information and Communication Technology Development Index (IP-TIK), which is a standard measure of describing the level of development of information and communication technology in a region, the digital divide and the potential for ICT development.(Central Bureau of Statistics, 2018).

Table 1. Information and Communication Technology (IP-ICT) Development Index in Several Countries 2015-2016

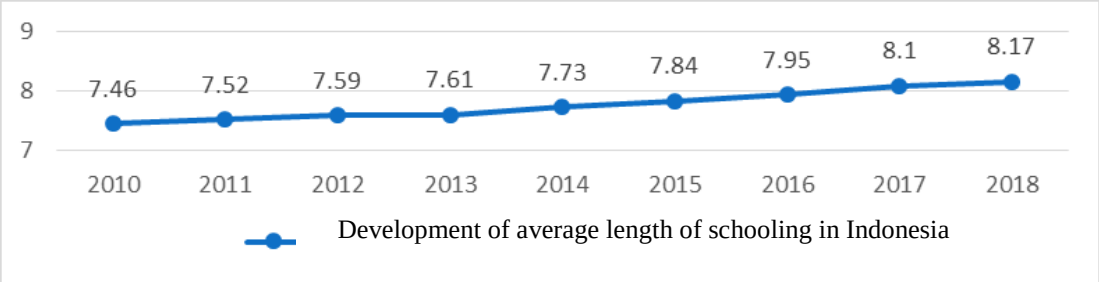
Country	2015		2016	
	IP-ICT	*Rank*	IP-ICT	*Rank*
Korean (Rep.)	8.80	1	8.85	2
Iceland	8.78	2	8.98	1
Denmark	8.68	3	8.71	4
Switzerland	8.66	4	8.74	3
English	8.53	5	8.65	5
Japan	8.32	11	8.43	10
Australia	8.08	16	8.24	14
Singapore	7.85	20	8.05	18
Malaysia	6.22	62	6.38	63
Brunei	6.56	54	6.75	53
Thailand	5.31	79	5.67	78

Vietnamese	4.18	108	4.43	108
Philippines	4.52	100	4.67	101
Indonesia	3.85	114	4.33	111
Cambodia	3.24	128	3.28	128
Timor Leste	3.11	127	3.57	122
Myanmar	2.59	140	3.00	135
Total Countries	**175 Countries**		**176 Countries**	

Source: Central Bureau of Statistics, 2017 (processed).

Table 1. shows the position of Indonesia's Information and Communication Technology Development Index (IP-ICT) in the world. In 2015 Indonesia was ranked 114th and rose in 2016 to 111th position, this shows that there is a good improvement in Indonesia's technological development. According to Ferdinan (2013), technological developments have a major impact on welfare because they can reduce a country's unemployment. However, technology also has a dilemma where in addition to reducing unemployment, technology can also increase unemployment if it is not accompanied by quality skills and human resources. With technological conditions that are increasingly developing, human resource skills are required to be of higher quality, this can be created through education.

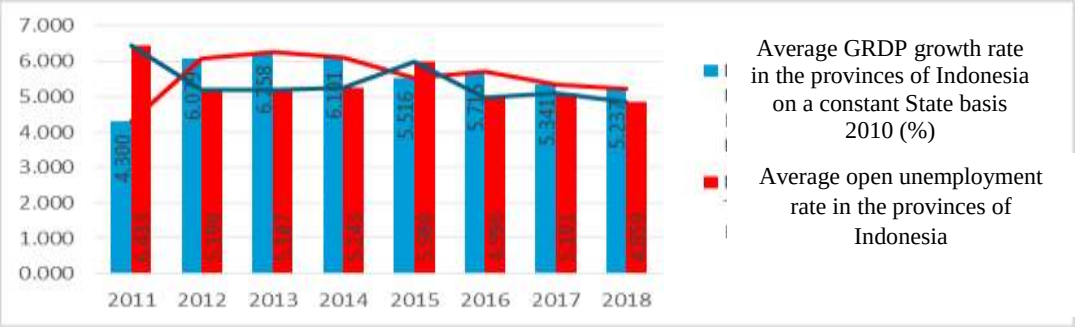
Education is a process of training, developing knowledge, skills, thoughts, character through formal education (Sagala, 2013:42). according toKamaludin in Hartanto & Masjkuri (2017) The higher a person's education, the higher the ability and opportunity to work. To see the level of education, it can be seen from the average length of schooling. The average length of schooling is the number of years of study for the population aged 15 years and over completed in formal education (Central Bureau of Statistics, 2019). The condition of the average length of schooling in Indonesia has increased every year. This condition is expected to increase job opportunities and reduce unemployment problems, because an educated person tends to have a variety of skills(Hartanto & Masjkuri, 2017).



Source: Central Bureau of Statistics, 2019a (processed)

Figure 2. *Graph of Average Length of School*

Economic growth is usually described by Gross Regional Domestic Product (GDP). according toHartanto & Masjkuri (2017) The relationship between the unemployment rate and the GDP of a country or region is explained through Okun's law, namely if there is an increase in GDP in a region, there will also be an increase in energy absorption, so that unemployment decreases.



Source: Central Bureau of Statistics, 2019b (processed).

Figure 3. *Average Growth Rate of GRDP at Constant Prices (2010) and the Open Unemployment Rate in the Provinces of Indonesia in 2011-2018*

Based on table 1 the condition of the relationship between GRDP and unemployment in Indonesia in 2011-2018 in accordance with Okun's law where if there is an increase in GRDP, employment will increase which causes unemployment to fall.

Previous research such as Ferdinand (2013) which examines the growth of technology, labor force, labor, wages on economic growth, unemployment and poverty. Muslim (2014) which examines the rate of economic growth, labor force, education, government spending on the open unemployment rate. Hartanto & Masjkuri (2017) examines the population, education level, minimum wage, and GRDP to the number of unemployed. Based on the economic phenomena and previous research described above, this research focuses on technological developments (proxied by IP-TIK), education (proxied by the average length of schooling), and economic growth (proxied by GRDP) and the data are analyzed with panel data regression. Based on the background that has been described, the research is entitled "The Effect of Educational Technology Development and Economic Growth on Open Unemployment in Indonesia".

II. Review of Literature

2.1. Unemployment

Unemployment by Central Bureau of Statistics (2011)also known as open unemployment, namely those who are looking for work, preparing for a business, not looking for work because they feel it is impossible to get a job, and who already have a job but have not started working and at the same time they are not working (jobless). So the indicator to describe the number of unemployed is the open unemployment rate.

2.2. Technological Development

Technological developments are described by the Information and Communication Technology Development Index (IP-ICT). The Information and Communication Technology Development Index (IP-ICT) is a standard measure that can describe the level of development of information and communication technology in a region, the digital divide and the potential for ICT development (Central Bureau of Statistics, 2018).

2.3. Education

The level of education is described by the average length of schooling, namely the number of years of study for the population aged 15 years and over who have completed formal education (Central Bureau of Statistics, 2019a). Learning is an effort which is done by the teacher or others to teach students (Hasanah, 2012, p. 85). Indonesian language learning is

in accordance with the current curriculum, is text-based learning. The text is a complete expression of the human mind in which there are situations and contexts. The text is not just the development of grammatical structures or a collection of sentences, but it is a realization of a value system, social norms, social processes with their social goals (Ramadiana in Rahmanisa, A. et al. 2018)

2.4. Economic Growth

Economic growth is described by Gross Regional Domestic Product (GRDP). According to the Central Statistics Agency inPriastiwi & Handayani (2019) Gross Regional Domestic Product (GRDP) is statistical data that summarizes the value added gain from all economic activities in the province in a certain period.

Economic growth is generally defined as the development of activities in the economy that causes goods and services produced in society to increase and the prosperity of society increases. (Sukirno, 2015). Economic growth is a continuous process of increasing per capita output in the long run. (Hakim, M. et al. 2021)

III. Research Methods

This study is an analysis of secondary data on the influence of technological developments, education, and economic growth on open unemployment in Indonesia for the 2015-2019 period. The research locations selected were in 34 provinces of Indonesia. The data is sourced from the Central Statistics Agency for each province in Indonesia. Secondary data is data obtained based on information that has been compiled and published by certain agencies. This study uses panel data. According to Gujarati & Porter (2015) panel data is a combination of time series data and data between units (cross section). The time series data in this study is the 2015-2019 period and the cross section data in this study is data from 34 provinces in Indonesia.

This study is a descriptive quantitative study that provides an overview of open unemployment in 34 provinces of Indonesia which resulted in 170 observations. Quantitative research is a method based on the philosophy of positivism used to examine certain populations or samples by using statistical or quantitative data analysis with the aim of testing predetermined hypotheses. Descriptive method is a research method that aims to determine the nature and deep relationship between two or more variables by observing certain aspects more specifically to obtain data that is in accordance with the problem (Sugiyono, 2017). This study uses three independent variables (X) and one dependent variable (Y), namely:

1. X_1 = ICT, technological developments that are sourced from data Information and Communication Technology Development Index (IP-TIK) in 34 provinces of Indonesia in 2015-2019.
2. X_2 = PDDK, education sourced from data on the average length of schooling in 34 provinces in Indonesia in 2015-2019.
3. X_3 = GRDP, economic growth sourced from Gross Regional Domestic Product (GRDP) data in 34 provinces in Indonesia in 2015-2019.
4. Y = TPT, unemployment sourced from data on the open unemployment rate in 34 provinces of Indonesia in 2015-2019.

Open unemployment is influenced by technological developments, education, and economic growth, so that when described as a function, it is as follows:

Information:
= Constant
β1,2,3 = Multiple Regression Coefficient Each Independent Variable
TPT= Open Unemployment Rate
ICT= Development of Information and Communication Technology
PDDK= Education Level
GRDP= Gross Regional Domestic Product
i= Cross Section
t= Time Series
e= Random Error

There are 3 approaches in panel data regression, namely Common Effect Model (CEM) which is the simplest approach in model parameters, Fixed Effect Model (FEM) approach, each of which has its own characteristics, Random Effect Model (REM) approach with estimate disturbance variables that can be interconnected over time and between individuals that are accommodated through errors (Utomo, 2013).

Selection of the most appropriate model for managing panel data can use several tests, namely the Chow test test between the Common Effect Model (CEM) and Fixed Effect Model (FEM). The Lagrange Multiplier test is a test between the Coomon Effect Model (CEM) and Random Effect Model (RAM), the Hausman test is a test between the Fixed Effect Model (FEM) and Random Effect Model (REM) (Utomo, 2013).

The classical assumption test according to Basuki & Prawoto (2017: 297) in linear regression on the Ordinary Least Square (OLS) method includes linearity test, autocorrelation test, heteroscedasticity test, multicollinearity test, and normative test. However, in panel data regression, not all classical assumption tests in the Ordinary Least Square (OLS) method are used, only multicollinearity and heteroscedasticity tests are used. According to Ghozali (2011:105). Multicollinearity test is a test of whether the regression model found a correlation between the independent variables (independent). Heteroscedasticity test according to Priyatno (2012:93) is a state test where the residual variance is not the same for all observations in the regression model.

Test Statistics according to Nachrowi & Usman (2006)testing for hypothesis testing with regression coefficient significance which includes F test, coefficient of determination test (R-square) and t test. F test to determine the effect of all independent variables on the dependent variable, test the coefficient of determination (R-square) to measure the variation of the dependent variable, t test to determine the influence of individual independent variables on the dependent variable(Rahmadeni & Wulandari, 2017).

IV. Result and Discussion

4.1. Panel Regression Model Selection Results

a. Chow Test

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistics	df	Prob.
Cross-section F	25.853023	(33,122)	0.0000
Cross-section Chi-square	330.492630	33	0.0000

Cross-section fixed effects test equation:
Dependent Variable: TPT
Method: Least Squares Panel
Date: 07/25/21 Time: 14:44
Sample: 2015 2019
Periods included: 5
Cross-sections included: 34
Total panel (unbalanced) observations: 170

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.368052	1.159658	-2.042026	0.0428
ICT	-0.373842	0.184666	-2.024424	0.0446
PDDK	1.080407	0.186470	5.794004	0.0000
GDP	9.73E-07	4.82E-07	2.018532	0.0453

R-squared	0.220815	Mean dependent var	4.919937
Adjusted R-squared	0.205734	SD dependent var	1.836908
SE of regression	1.637082	Akaike info criterion	3.848543
Sum squared resid	415.4059	Schwarz criterion	3.925749
Likelihood logs	-301.9592	Hannan Quinn Criter.	3.879896
F-statistics	14,64190	Durbin-Watson stat	0.303544
Prob(F-statistic)	0.000000		

The Chow test was used to select the model between CEM and FEM. H0 is rejected if the probability value is > (0.05), then the CEM model is more appropriate than FEM. H0 is accepted if the probability value is < (0.05), then the FEM model is more appropriate than CEM. The E-Views output shows Prob. F or Prob. Chi Square 0.0000 < 0.005. H0 is accepted, meaning that the FEM model is correct.

b. Lagrange Multiplier Test

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Hypothesis Test		
	Cross-section	Time	Both
Breusch-Pagan	196.8023 (0.0000)	0.598753 (0.4391)	197.4010 (0.0000)
Honda	14.02862 (0.0000)	-0.773792 --	9.372582 (0.0000)
King-Wu	14.02862 (0.0000)	-0.773792 --	3.835301 (0.0001)
Standardized Honda	14.71672 (0.0000)	-0.395414 --	6.308784 (0.0000)
Standardized King-Wu	14.71672 (0.0000)	-0.395414 --	1.664225 (0.0480)
Gourierioux, et al.*	--	--	196.8023 (< 0.01)

*Mixed chi-square asymptotic critical values:

1%	7.289
5%	4.321
10%	2,952

The Lagrange Multiplier test is used to select the model between CEM and REM. H0 is rejected if the probability value is > (0.05), then the CEM model is more appropriate than REM. H0 is accepted if the probability value is < (0.05), then the REM model is more appropriate than CEM. The E-Views output shows Prob. F or Prob. Chi Square 0.0000 < 0.005. H0 is accepted, meaning that the REM model is correct.

c. Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistics	Chi-Sq. df	Prob.
Cross-section random	13.259529	3	0.0041

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
ICT	0.073020	-0.264966	0.017154	0.0099
PDDK	-0.635676	0.701846	0.251644	0.0077
GDP	-0.000000	-0.000000	0.000000	0.7908

Cross-section random effects test equation:
Dependent Variable: TPT
Method: Least Squares Panel
Date: 07/25/21 Time: 15:27
Sample: 2015 2019
Periods included: 5
Cross-sections included: 34
Total panel (unbalanced) observations: 170

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.831694	4.040257	2.433433	0.0164
ICT	0.073020	0.184102	0.396626	0.0423
PDDK	-0.635676	0.577274	-1.101169	0.0000
GDP	-1.87E-07	2.31E-07	-0.811883	0.0184

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.902517	Mean dependent var	4.919937
Adjusted R-squared	0.873751	SD dependent var	1.836908
SE of regression	0.652681	Akaike info criterion	2.185068
Sum squared resid	51.97101	Schwarz criterion	2.899215
Likelihood logs	-136.7129	Hannan Quinn Criter.	2.475076
F-statistics	31.37497	Durbin-Watson stat	2.133652
Prob(F-statistic)	0.000000		

Hausman test is used to select the model between REM and FEM. H0 is rejected if the Cross Section Probability value is > (0.05) and the correct model is the REM model. H0 is accepted if the Cross Section Probability value < α (0.05) and the right model is the FEM model. The E-Views output shows a random cross-section probability value in the Hausman test of 0.0041 < 0.05. H0 is accepted, meaning that the FEM model is correct.

The results of the Chow test and Hausman test show that the most appropriate model is the Fixed Effect Model (FEM).

4.2. Classic Assumption Test Results

a. Multicollinearity Test

	ICT	PDDK	GDP
ICT	1	0.6598684441963718	0.3672142317061058
PDDK	0.6598684441963718	1	0.1178821166241417
GDP	0.3672142317061058	0.1178821166241417	1

Multicollinearity test to test whether the regression model found a correlation between independent variables. If the value of r < 0.8 means that there is no correlation between the independent variables, so there is a multicollinearity problem. Conversely, if the value of r> 0.8 means that there is a correlation between the independent variables, so there is no multicollinearity problem.*Output E-Views*shows the coefficient value between the independent variables < 0.80. This means that the regression model does not occur multicollinearity and is free from multicollinearity disorders.

b. Heteroscedastic Test

Dependent Variable: TPT
Method: Least Squares Panel
Date: 07/25/21 Time: 16:12
Sample: 2015 2019
Periods included: 5
Cross-sections included: 34
Total panel (unbalanced) observations: 170
White diagonal standard errors & covariance (df corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.831694	4.341472	2.264599	0.0253
ICT	0.073020	0.210737	0.346498	0.7296
PDDK	-0.635676	0.628693	-1.011107	0.3140
GDP	-1.87E-07	1.53E-07	-1.222837	0.2237

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.902517	Mean dependent var	4.919937
Adjusted R-squared	0.873751	SD dependent var	1.836908
SE of regression	0.652681	Akaike info criterion	2.185068
Sum squared resid	51.97101	Schwarz criterion	2.899215
Likelihood logs	-136.7129	Hannan Quinn Criter.	2.475076
F-statistics	31.37497	Durbin-Watson stat	2.133652
Prob(F-statistic)	0.000000		

Heteroscedasticity test is a condition where the residual variance is not the same in all observations in the regression model. The probability value of t-statistics > (0.05), then H0 is accepted, which means that there is no heteroscedasticity problem. The probability value of t-statistics < (0.05), then H0 rejects which means there is a heteroscedasticity problem.*Output E-Views* shows the results of the white test on the heteroscedasticity test which states

probability value ICT (0.7296), PDDK (0.03140) and PDRB (0.2237) > (0.05), meaning that H0 is accepted and the variables of ICT, PDDK, and GRDP do not cause heteroscedasticity problems.

4.3. Statistical Test Results

Based on the method that has been chosen, namely the Fixed Effect Model, then to test the hypothesis using the output of the Fixed Effect Model.

Dependent Variable: TPT
Method: Least Squares Panel
Date: 07/25/21 Time: 16:24
Sample: 2015 2019
Periods included: 5
Cross-sections included: 34
Total panel (unbalanced) observations: 170

Variable	Coefficient	Std. Error
C	9.831694	4.040257
ICT	0.073020	0.184102
PDDK	-0.635676	0.577274
GDP	-1.87E-07	2.31E-07

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.902517	Mean dependent var	
Adjusted R-squared	0.873751	SD dependent var	
SE of regression	0.652681	Akaike info criterion	
Sum squared resid	51.97101	Schwarz criterion	
Likelihood logs	-136.7129	Hannan Quinn Criter.	
F-statistics	31.37497	Durbin-Watson stat	
Prob(F-statistic)	0.000000		

a. F Uji Test

F-statistical probability value < (0.05), then H0 is rejected, which means that the independent variable simultaneously affects the dependent variable. F-statistical probability value > (0.05), then H0 is accepted, which means that the independent variable simultaneously does not affect the dependent variable. The E-Views output shows an F-statistical probability value of 0.000000 < (0.05), then H0 is rejected which means that the variables of technological development (ICT), education (PDDK), and economic growth (GRDP) simultaneously have a significant effect on variable open unemployment rate (TPT).

b. Coefficient of Determination (R-Square)

Output E-Views shows that the adjusted R2 value is 0.873751. This figure shows that the variables of technological development (ICT), education (PDDK), and economic growth (GRDP) are simultaneously able to influence the open unemployment rate of 87.38 percent and the remaining 12.62 percent is influenced by other variables outside this research model.

c. t Test

Output E-Views partially shows that ICT has a coefficient value of 0.073020 and a probability value of 0.0423 <0.05, meaning that technological developments (ICT) have a significant positive effect on the open unemployment rate (TPT). This means that the increase

in information and communication technology will increase the open unemployment rate. This study has similarities with Ferdinand (2013) in his study showing the results that technological developments have a positive and significant effect. According to Ferdinand (2013) technological developments in Indonesia tend to save labor. Where companies cannot consider it cost effective to train certain types of jobs in order to keep up with changes, especially employees who are less educated and older. Maybe the workers will be unemployed for a long time that may not work anymore.

Output E-Views shows partially PDDK has a coefficient value of -0.635676 and a probability value of 0.0000 <0.05 means that the level of education (PDDK) has a significant negative effect on the open unemployment rate (TPT). This means that an increase in the level of education will reduce the open unemployment rate. This study has the same opinion withHartanto & Masjkuri (2017), where education has an important role in the progress of economic development in reducing the unemployment rate. Agreeing with this, Muslim (2014) also explained that at least people who spend more time getting an education, the higher or dignified they are in their work and the more they avoid unemployment problems.

Output E-Views show partially GRDP has a coefficient value of -1.87E-07 and the probability value is 0.0184 <0.05 means that economic growth (GRDP) has a significant negative effect on the open unemployment rate (TPT). This means that an increase in economic growth will reduce the open unemployment rate. This study is in accordance with the legal theory of Okun (Okun's Law), where if there is an increase in GRDP, the absorption of labor increases which causes unemployment to fall.

V. Conclusion

The conclusion of the calculation results with panel data to analyze the determinants of the unemployment rate in Indonesia are as follows: First, the model testing using the chow test, the Langrange multiplier test and the Hausman test shows the Fixed Effect Model (FEM) model that is more appropriate. Second, Based on the simultaneous test, the development of technology, education, and economic growth simultaneously have a significant effect on the open unemployment rate. Based on the validity test, technological developments have a significant positive effect on the open unemployment rate, while education and economic growth have a significant negative effect on the open unemployment rate in Indonesia.

Based on the results of the study above, suggestions are given to the Indonesian government in suppressing the high level of unemployment that occurs, namely that it should be responsive to unemployment problems properly. In terms of technology, the government can play an active role in making policies that support the development of domestic technology, for example reducing dependence on imports by making new innovations to utilize domestic resources. The government can also allocate more resources in research and research and development development by training workers. In terms of education, the government can continue to encourage conscious participation in education by providing scholarships and building infrastructure. The government is also expected to create education with an entrepreneurial spirit in order to reduce people's dependence on looking for work and to increase employment opportunities. In terms of economic growth, the government can open up labor-intensive investments rather than capital-intensive ones.

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