

Conference Paper

Technological Changes, Investments, and Unemployment in Indonesia

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Abstract

The vicious circle of poverty in a country could stop if the government was able to solve the problem of unemployment. One way to reduce unemployment is to boost investment. In addition, in the era of the industrial revolution the role of technological development also needs to be considered as a means of reducing unemployment. This study is aiming to analyze the effect of physical investment, educational investment, and technological changes on unemployment in Indonesia. The data used in this study are obtained from Indonesian Central Statistics Agency (BPS). The technological development is proxied by Index of Technology and Communication. The regression method is used to reach the aim of the study. The result of the analysis indicates that the physical investment and technological development have a negative and significant effect on unemployment. Moreover, the findings suggest that the reduction in unemployment in Indonesia is caused by many people who become online motorcycle taxi drivers in the informal sector.

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1. Introduction

Technology will always develop. Every development of a technology, it will also change economic patterns and result in changing work patterns and acceleration of processes from initially only relying on the strength and power of human labor, now it has used a variety of sophisticated machines [1]. Technology also makes the human role replaced because the technology already has the ability as humans do, it can even be better and faster when doing certain activities. This has an impact on the workforce that will be used little by companies because of the assistance of technology that makes work or production more effective and efficient so that the company's profits become greater.

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Indonesia is one of the 5 countries with the largest population in the world. As a developing country, Indonesia is still not free from the snares of poverty. According to the Indonesian Central Statistics Agency (BPS), the number of Indonesians living below the poverty line (until November 2018) is \pm 25.67 million. In addition, unemployment is also one of the problems that is still a strategic issue to be resolved by the Indonesian government. Data from the Indonesian Central Statistics Agency (BPS) shows that the open unemployment rate in Indonesia is now 5.13 percent.

One of the causes of poverty is unemployment and income inequality [2–4]. Theoretically, one way to break the cycle of poverty is to open investment or capital taps with an intention to open new jobs that will gradually reduce poverty [5]. Responding to this, it can be seen now that the current priority program of the Indonesian government is channeling large capital in the form of infrastructure development as investment.

Now, the Indonesian government is flowing much capital to build transportation infrastructure as the main support for the economy related to connectivity between regions. Infrastructure development aims to encourage smooth inter-regional economic activity. Infrastructure development is also intended to reduce economic disparities between regions [6]. However, during these five years the incessant development of transportation infrastructure has not significantly raised the Indonesian economy. This is indicated by economic growth that is still stagnant at 5 percent per year. The income gap is also still felt between people from different regions.

Investment is indeed a key component to break the chain of poverty and unemployment [7]. However, the intended investment should not only be based on physical investment such as infrastructure. The government's program to boost infrastructure has not been able to significantly increase economic growth. Other investment in the form of investment for human development is also important to be considered by the government in order to break the chain of poverty [8]. Human capital is improved by investing capital in education and training [9]. In addition to investing in human capital, investment that is no less important is the flow of capital for technological development. As we all know, the current era, known as the industrial era 4.0 requires every country in the world to transform following the development of information technology [10].

The rise of the development of the digital economy in Indonesia lately is destabilizing the current conventional economic structure. If seen from the number of start-up companies that grow to tens of thousands each year, the level of employment by this sector is also increasing every year. According to data from the Indonesian FinTech Association report that the digital economy sector managed to absorb 1,078 workforces in 2014,

then 2,040 in 2015, and 1074 in the first quarter of 2016. However, it only managed to reduce the number of unemployed less than 0.5% per year.

Indonesia, with full support from President Jokowi, is currently focusing on the use of increasingly rapid technological developments, particularly in the utilization of the digital economy. However, Indonesia's readiness in facing the digital economy is still considered lacking because there are emerging issues related to unclear laws governing the digital economy. In addition, the development of digital technology can actually be a boomerang for the Indonesian economy. Industry in Indonesia has been filled with labor-intensive industries. Thus, if the industrial world has done a lot of transformation in its production inputs, from labor to new machines, then there could be massive job separations and cause more unemployment in Indonesia.

Research on how the influence of physical capital investment and education on a country's economy has been carried out by many. Song & Van Geenhuizen [11] examined how the influence of port infrastructure development on economic growth in the provinces and areas that ports have built in China. Ekpong [12], Kumo [13] and Pradhan & Bagchi [14] examine how the effects of transportation infrastructure development on economic growth. In addition, some researchers also examined how the influence of the development of internet technology on the economic performance of a region or country [15, 16]. The study of Eitha & Asiphala [17] concluded that factor affecting unemployment in Namibia is investments. Riddel & Song [18] in their study found that unemployment in US can be reduced by focusing the development of education sector. The previous studies had not included the technological changes in the model. So, we will look the effect of technological changes on unemployment in our study.

This study aims to analyze the effect of investment and technological change on unemployment in Indonesia. Investments that will be used in this research are physical investment and education investment, while technological development is measured by the index of information technology development. This study is important to be conducted in order to explore the effect of technological development on Unemployment. As a part of the changing world, Indonesia has also faced the massive development of technology. It is said that technology could be the good for economy. On the other hand, it would affect economy in worst condition if certain conditions not fulfilled.

2. Methods

In this study, the research design is arranged systematically and logically by considering, the method used and the research strategy that is considered to be the most effective. This study is an explanatory study, a research that intends to examine and explain the effect of physical investment, investment in education, and inflation on unemployment in Indonesia. This study is a quantitative study, which is an approach in which to draw conclusions and test hypotheses based on the results of statistical analysis. A lengthy discussion of the results of research is needed to explain the meaning behind the statistical figures and compare it with the results of previous studies or conformity with the theory used. The study uses the data of physical investment per capita, investment in education per capita, technology index, inflation, and unemployment of all provinces in Indonesia ranging from 2016 to 2018. The data of physical investment and education investment are transformed into investment per capita to accommodate the demographical aspect of each region.

Statistical analysis technique used in this study is panel data regression analysis. The equation is as follow:

$$U_{it} = \alpha + \beta_1 PI_{it} + \beta_2 EI_{it} + \beta_3 TI_{it} + \beta_4 INF_{it} + \varepsilon_{it} \quad (1)$$

Whereby,

α = constant

$\beta_{1,2,3,4}$ = coefficients

U = Unemployment rate

PI = Physical Investment

EI = Educational Investment

TI = Index of Technology and Communication

INF = Inflation

ε = Errors

i = time series

t = cross section

The expected signs of each independent variable are shown in table below:

TABLE 1: Expected Sign of Independent Variables

Variable	Expected Sign
Physical Investment	(-) Investment in physical building will create new jobs, unemployment falls [17].
Educational Investment	(-) Investment in education will make workforces have better expertise, unemployment is reduced [18].
Index of Technology	(-/+) Technological developments have two possible effects to unemployment [19].
Inflation	(-) According to Philip's curve, Inflation has negative effect on unemployment [20].

3. Results

As mentioned above, we use five variables which are obtained from Indonesian Central Statistics Agency (BPS), namely unemployment (U), index of technology (TI), physical investment (PI), educational investment (EI), and inflation (INF). To capture the difference demographic condition, we transform the variable PI and EI into per-capita investment. Those new variables were generated by dividing the two investments by the number of people over the age of 15 years. Because of the transformation, the descriptive statistics of variables used in this study is shown in table 2:

TABLE 2: Descriptive Statistics

Variable	Obs	Mean	Std. Deviation
U	102	5.36	1.94
TI	102	4.23	1.02
PI	102	4930115	5906306
EI	102	288607.3	369241.6
INF	102	3.32	1.21

The data of each variable contain 102 observation. The number were generated from 34 provinces in Indonesia and 3 year time series from 2016 to 2018 which is the research limitation. According to table 2, it is shown that the mean of unemployment in Indonesia is 5.36 from all provinces in 3 years. TI's mean indicates that the technological literacy of the Indonesian is still not good. The average level of per-capita physical investment is IDR 4,930,115.00 and educational investment is IDR 288,607.00 which seems very low.

3.1. Panel Data Regression Analysis

3.1.1. Normality Test

The normality test conducted in this study is the skewness-kurtosis test. The result of the test is shown in the table below:

TABLE 3: Skewness-Kurtosis Normality Test

Variable	Obs.	Pr(Skewness)	Pr(Kurtosis)	Prob>Chi2 *
Unemployment (U)	102	0.0364	0.3970	0.0802
Technology Index (TI)	102	0.0005	0.0220	0.0009
Physical Investment (PI)	102	0.0000	0.0000	0.0000
Educational Investment (EI)	102	0.0000	0.0002	0.0000
Inflation (INF)	102	0.1620	0.4562	0.3234

* H0: The data are not significantly different than the normal population

H1: The data are significantly different than the normal population

Table 3 indicates that the data of Technology Index, Physical Investment, and Educational Investment are not normally distributed. It can be seen in the probability column that the three are valued below the alpha 5%. To normalize the three data, we transform them into their natural logarithm. The result of the new normality test with transformed data is as follow:

TABLE 4: Skewness-Kurtosis Normality Test with Transformed Data

Variable	Obs.	Pr(Skewness)	Pr(Kurtosis)	Prob>Chi2 *
U	102	0.0364	0.3970	0.0802
ln_TI	102	0.7945	0.2783	0.5298
ln_PI	102	0.4496	0.3129	0.4432
ln_EI	102	0.1472	0.2163	0.1549
INF	102	0.1620	0.4562	0.3234

* H0: The data are not significantly different than the normal population

H1: The data are significantly different than the normal population

Because of the transformation, we can see in table 4 that all of our data are now normally distributed.

3.1.2. Multicollinearity Test

The result of the multicollinearity test is shown in table 5:

TABLE 5: Multicollinearity Test: Correlation Matrix

	In_TI	In_PI	In_EI	INF
In_TI	1.0000			
In_PI	0.2334	1.0000		
In_EI	0.2075	0.5710	1.0000	
INF	0.1319	0.0381	-0.0141	1.0000

From table 5 we can conclude that there are no variables are correlated. It can be seen from the value of correlation matrix between variables which are not close from value 1.

3.1.3. Heteroscedasticity Test

The heteroscedasticity test used in this study is the modified Wald-Test for groupwise heteroskedasticity. The result of the test is that the probability of chi-square is 0.000 which is below alpha 5% meaning that the data are statistically heteroscedastic.

3.2. Regression Result

The normality test indicates that three variables are not normally distributed, the Physical Investment (PI), Educational Investment (EI), and Technological Development Index (TI). To normalize them, we transform the three to their natural logarithmic value. The equation 1 becomes:

$$U_{it} = \alpha + \beta_1 \ln_PI_{it} + \beta_2 \ln_EI_{it} + \beta_3 \ln_TI_{it} + \beta_4 INF_{it} + \varepsilon_{it} \tag{2}$$

To estimate the parameters of panel data regression analysis, there are three models of estimation, pooled least square, fixed effect, and random effect. The best model is decided by conducting the Chow Test and Hausman Test. The result of the tests is as follow:

TABLE 6: Chow and Hausman Test

Test	Chi-Square	P-Value	Decision
Chow	20.27	0.0000	Fixed Effect
Hausman	18.41	0.0010	Fixed Effect

Table 6 means that the best model for the analysis is Fixed Effect model. The result of regression analysis with fixed effect model is shown in table 7.

Table 7 shows that with fixed effect method, we get R-squared valued 0.342 meaning that variance of independent variables is only able to explain the variance of dependent

TABLE 7: Fixed-Effect Regression Analysis

Variables	Coefficient	t-stat	P-Value
In_TI	-0.4125467	-3.32	0.001*
In_PI	-0.4344007	-2.45	0.017*
In_EI	-0.1167468	-1.28	0.206
INF	-0.1605104	-2.42	0.018*
Constant	15.79713	6.06	0.000
Adj. R-Square F-test	0.3472 8.51*		

*significant at alpha 5%

variable by 34,2 percent while the rest is explained by other variables outside the model. The result of F-test also indicates that all variables simultaneously affect unemployment.

Partially, table 7 informs that technological development (proxied by natural logarithm of technology index) is significantly and negatively affecting unemployment with a coefficient of -0.4125467. The coefficient means that a 1 percent change of Technology Index will bring unemployment down by 0.4 percent. The physical investment also has a negative and significant effect on unemployment. If the physical investment rises by 1 percent, the unemployment rate will decrease by 0.4 percent. Investment on education is also has a negative effect on unemployment rate, but the effect is not significant. The effect of inflation on unemployment rate is also negative and significant. Its coefficient value means that 1 percent change of inflation will reduce the unemployment rate by 0.16 percent.

4. Discussion

4.1. Investment and Unemployment

The regression result is confirming the result of the previous study [17-20]. As Keynes said that the level of economic activity is determined by aggregate spending. In general, aggregate expenditure in a given period is less than the aggregate expenditure needed to achieve full employment. This is because the investments made by employers are less than savings when the level of employment is full. To achieve this situation, government policy is needed to increase aggregate expenditure, the most important of which is fiscal policy. This policy regulates government expenditure and revenue budgets. If there is a lot of unemployment, the government can implement an expansionary fiscal policy by enlarging labor-intensive projects. Some workers who are unemployed will work thereby increasing the income of the community. When prices rise, the government

can implement fiscal policy by increasing taxes, so that higher inflation will not occur [21]. There is a relationship between government spending (G) and investment (I), where changes in government spending and investment will affect labor demand in a country / region, because labor is a complementary input and substitution of capital. According to Keynes, the greater the national income, the greater the volume of work it produces, and vice versa. National income depends on aggregate demand consisting of consumption, investment and government spending.

4.2. Does technological development really reduce unemployment

Revolution of technology will definitely happen and this should not be avoided, but how to anticipate in order to avoid the adverse effects that will occur. In the history of human civilization, we note that there have been at least four technological revolutions. First is the invention of the steam engine. Second is electrification, third is the use of computers, and the fourth is the current digital revolution. There have been many studies aimed at anticipating the adverse effects of the development of digital technology. The purpose of the study is to prevent the digital era from increasing the level of unemployment which is currently, in Indonesia, in the range of 7 million people. Especially in the upcoming years, there will be a demographic bonus with a productive age number that requires increased employment. If we see to the regression result, the analysis describes that for now, Indonesian's technological development is able to suppress the unemployment rate. However, we still have to look much deeper about the facts in the field. According to BPS data, from 100% of job vacancies in Indonesia, as of February 2019, as much as 57.27% was contributed by the informal sector. Former Indonesian Minister of Finance, Chatib Basri, also questioned the unemployment rate did go down, but the unemployment rate with high school level up or up to Bachelor actually rose.

What distinguishes formal and informal workers is related to tax payments to the government. Formal worker is worker that pays taxes to the government. Usually, formal workers are professionals such as teachers, lecturers, doctors, journalists, and the State Civil Apparatus. Meanwhile, informal workers are workers who do not pay taxes to the government, even though their income is actually included in the category subject to income tax (PPH). Informal workers are usually associated with workers who rely heavily on physical strength (blue collar) such as street vendors (street vendors), construction workers, and Online motorcycle-taxi drivers.

Based on Gojek's presentation material obtained by CNBC Indonesia, it was stated that the company currently has more than two million driver partners spread across four

countries, Indonesia, Thailand, Vietnam, and Singapore. However, given that Indonesia is the largest market for Gojek, it can be said that the majority of the two million driver partners are in Indonesia [22]. At first glance, there's nothing wrong with being an online motorcycle taxi driver. However, the government must be really wary of this phenomenon. Because, instead of entering into formal employment, Indonesian people instead rely on informal employment to support themselves and their families. As mentioned above, informal workers are workers who do not pay taxes to the government, even though their income is actually included in the category subject to income tax. In the end, government ammunition to boost development was limited.

5. Conclusion

In this study, we focus on the effect of investment and technological development on employment in Indonesia. The investment referred to in this study is investment in physical development and investment in human resources, namely education. The results of the regression analysis concluded that investment and technological development had a negative effect on unemployment in Indonesia. That means investment and technological development can absorb labor in Indonesia. Associated with the positive effect of technological developments on employment, this can be attributed to the rise of online motorcycle taxi drivers who are informal workers. It must be recognized that the rapid progress experienced by digital startups such as Go-Jek and Grab is capable of absorbing a large workforce. But if we look deeper, the decline in the unemployment rate in general is accompanied by an increase in the unemployment rate for the educated workforce. This has an impact on the low government tax revenue because motorcycle taxi drivers are informal work. From this it can also be said that the government has not been able to utilize well-educated workers. If only informal workers did not dominate the Indonesian labor market in Indonesia, surely the realization of tax revenue could be even better and government ammunition to encourage development would increase.

To anticipate the negative impact of the online motorcycle taxi drivers, the government of Indonesia must focus on developing the real sector, or known as the tradable sector. Apart from absorbing a lot of workers with low educational level qualifications, this sector is included in the formal sector which will provide fresh funds to the government to boost development (through tax payments from workers).

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Conflict of Interest

The authors have no conflict of interest to declare.

References

- [1] Brynjolfsson, E. and McAfee, A. (2011). *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*. Brynjolfsson.
- [2] Paramita, A. I. D. and Purbadharmaja, I. P. (2015). Pengaruh Investasi dan Pengangguran terhadap Pertumbuhan Ekonomi serta Kemiskinan di Provinsi Bali. *E-Jurnal Ekonomi Pembangunan Universitas Udayana*, vol. 4, issue 10.
- [3] Jonnadi, A., Amar, S. and Aimon, H. (2012). Analisis pertumbuhan ekonomi dan kemiskinan di Indonesia. *Jurnal Kajian Ekonomi*, vol. 1, issue 1.
- [4] Asrol, A. and Ahmad, H. (2018). Analysis of Factors that Affect Poverty in Indonesia. *Analysis*, vol. 39, issue 45, pp. 14.
- [5] Mekahsari, I. (2012). Pengaruh Investasi Melalui Pertumbuhan Ekonomi Terhadap Kemiskinan di Sulawesi Selatan. In *Skripsi tidak diterbitkan. Makassar: Fakultas Ekonomi dan Bisnis, Universitas Hasanuddin Makassar*.
- [6] Delis, A., Mustika, C. and Umiyati, E. (2015). Pengaruh Fdi terhadap Kemiskinan dan Pengangguran di Indonesia 1993-2013. *Jurnal Paradigma Ekonomika*, vol. 10, issue 1, pp. 231-245.
- [7] Kristyanto, V. S. and Wahyudi, T. (2017, October). Human Capital Investment and Its Role in Encouraging Inclusivity in East Java. In *Mulawarman International*

- Conference on Economics and Business (MICEB 2017)*. Atlantis Press.
- [8] Wahyuni, I. G. A. P., Sukarsa, M. and Yuliarmi, N. (2014). Pengaruh Pengeluaran Pemerintah dan Investasi terhadap Pertumbuhan Ekonomi dan Kesenjangan Pendapatan Kabupaten/Kota di Provinsi Bali. *E-Jurnal Ekonomi dan Bisnis Universitas Udayana*.
- [9] Syera, I. A. (2017). The Effect of Unemployment Rate, Human Development Index, Gross Domestic Product against Level of Poverty in Indonesia. *Proceedings of AICS-Social Sciences*, vol. 7, pp. 62-68.
- [10] Goos, M. (2018). The Impact of Technological Progress on Labour Markets: Policy Challenges. *Oxford Review of Economic Policy*, vol. 34, issue 3, pp. 362-375.
- [11] Song, L. and Van Geenhuizen, M. (2014). Port Infrastructure Investment and Regional Economic Growth in China: Panel Evidence in Port Regions and Provinces. *Transport Policy*, vol. 36, pp. 173-183.
- [12] Ekpung, E. G. (2014). Public Infrastructure Spending and Economic Growth in Nigeria: An Error Correction Mechanism (ECM) approach. *Journal of Social Economics Research*, vol. 1, issue 7, pp. 129-140.
- [13] Kumo, W. L. (2012). Infrastructure Investment and Economic Growth in South Africa: A Granger Causality Analysis. *African development Bank Group Working Paper Series*, issue 160.
- [14] Pradhan, R. P. and Bagchi, T. P. (2013). Effect of Transportation Infrastructure on Economic Growth in India: the VECM Approach. *Research in Transportation Economics*, vol. 38, issue 1, pp. 139-148.
- [15] Manyika, J. and Roxburgh, C. (2011). The Great Transformer: The Impact of the Internet on Economic Growth and Prosperity. *McKinsey Global Institute*, vol. 1.
- [16] Bertschek, I., et al. (2015). The Economic Impacts of Broadband Internet: A Survey. *Review of Network Economics*, vol. 14, issue 4, pp. 201-227.
- [17] Eita, J. H. and Ashipala, J. M. (2010). Determinants of Unemployment in Namibia. *International Journal of Business and Management*, vol. 5, issue 10, pp. 92.
- [18] Riddell, W. C. and Song, X. (2011). The Impact of Education on Unemployment Incidence and Re- Employment Success: Evidence from the US Labour Market. *Labour Economics*, vol. 18, issue 4, pp. 453-463.
- [19] McClure, P. K. (2018). "You're fired," Says the Robot: The Rise of Automation in the Workplace, Technophobes, and Fears of Unemployment. *Social Science Computer Review*, vol. 36, issue 2, pp. 139-156.
- [20] Kaur, K. (2014). An Empirical Study of Inflation, Unemployment, Exchange Rate and Growth in India. *Asian Journal of Multidisciplinary Studies*, vol. 2, issue 10, pp. 20.

- [21] Deliarnov. (2005). *Perkembangan Pemikiran Ekonomi*. Jakarta: PT Raja Grafindo Persada.
- [22] cnbcindonesia.com. (2019, October). Retrieved from.