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The Effect of Digitalization and Covid-19 Pandemic on Youth Unemployment in Indonesia

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Abstract:

The high rate of youth unemployment in Indonesia is a serious issue that needs to be addressed because it disrupts the national economic resurgence and disrupts the ongoing demographic bonus. Meanwhile, the younger generation is facing changes in the business model in the labor market due to technological advancements and digitalization. This research aims to analyze the impact of digitalization and the Covid-19 pandemic on the youth unemployment rate in Indonesia. The study uses panel data from 34 provinces in Indonesia covering the period from 2013 to 2022 and is estimated using the System Generalized Method of Moments (SysGMM) method. The results show that the development of digitalization, proxied by the Information and Communication Technology Development Index (IPTIK), has a positive and significant impact on the increase in youth unemployment. Similarly, the Covid-19 pandemic also has a positive and significant impact on the youth unemployment rate. Digitalization and the Covid-19 pandemic together indicate that the younger generation in Indonesia is vulnerable to economic and technological changes. Therefore, appropriate policies are needed to manage technological developments and address the impact of the pandemic so that the younger generation can be actively involved in the labor market. The results also show that control variables such as economic growth, inflation, and investment have varied effects on youth unemployment. Economic growth has a negative impact, in line with Okun's Law, while inflation does not significantly affect the youth unemployment rate. Investment has a negative and significant impact, indicating that increased investment can reduce youth unemployment in Indonesia.

Keywords: *Youth unemployment, digitalization, ICT development index, demographic bonus*

1. Introduction

The composition of Indonesia's population according to the result of the 2020 population census consists of 10.88% post Gen Z (aged 7 years and under), 27.94% Gen Z (aged 8-23 years), 25.87% millennials (aged 24-39 years), 21.88% Gen X (aged 40-55 years), 11.56% Baby Boomer (aged 56-74 years), and 1.87% Pre-boomer (aged 75 years and above). Based on the composition, it is clear that Indonesia is dominated by young people (53.81%) and productive age people (70.72%) (BPS, 2021). This indicates that Indonesia is currently in the demographic bonus era.

The ongoing demographic bonus in Indonesia can be used as a moment for the revival of the national economy in the future because on the supply side, the workforce of productive age is very abundant (Maryati et al., 2021). However, if there are no policies that favor labor absorption, the number of unemployed will continue to

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increase (Umar, 2018). Increasing unemployment will hamper economic development and can give rise to social problems such as poverty and crime (Antipova, 2021). This could get worse with the economic shock caused by the Covid-19 pandemic (Pantjoro, 2021).

The International Labor Organization (ILO), in 2020, reported that almost half of the world's unemployment was formed by the youth population (15-24 years), namely 71 million people. Furthermore, in 2021 the number increased to 75.1 million people due to the effect of the Covid-19 pandemic. According to ILO, had the youth unemployment in the world reduced by half, global economic growth would have been increased by 4 percent (ILO, 2017). In Indonesia, the youth unemployment rate was 19.55% in 2021 and escalated to 20.63% in August 2022. Meanwhile, the share of youth unemployment in total unemployment in Indonesia reached 52.18% (BPS, 2022). This figure is quite worrying because out of 100 people who are unemployed, 52 of them are youth. This critical issue of youth unemployment is stated in the 8th goal of the Sustainable Development Goals (SDGs) that is realizing full and productive employment opportunities and the realization of decent work for all, including young people.

Solow states that output growth is influenced by the interaction between capital accumulation, labor and technology (Mankiw, 2016). Technology has played an important role in accelerating growth by making the production process easier, more efficient, and effective. Additionally, it encourages labor productivity; therefore, it requires a skilled workforce, especially among young workers (Riniati et al., 2022). One form of technology that is developing rapidly is information and communication technology (ICT). The rapid development and diffusion of ICT has formed a digital market that brings together service providers and users in various aspects of life, such as trade, transportation, health, education, finance, and so on (Chen et al., 2010). The International Telecommunication Union (ITU) reported that Indonesia's ICT development was ranked 114th out of 175 countries in 2016 and 111th in 2017. Nevertheless, internet users, dominated by young people, in Indonesia grew 54 percent in the past two years. This growth is the largest in the world because it exceeded the global average growth of only 10 percent per year. This high growth represents good potential to support community empowerment by utilizing information and communication technology (APJII, 2022). However, this potential is not utilized properly by young people; hence, the problem of youth unemployment is still not resolved in Indonesia.

Study on the impact of digitization or the development of ICT on unemployment has been extensively conducted before. In the context of the relationship between ICT and unemployment, a study by Amiri & Woodside (2017) found a negative relationship between ICT and the unemployment in Brazil, Russia, India, and China from 2007 to 2015. Supporting this research, Shabbir et al. (2021) during the period 1994-2016, discovered a negative and significant impact of ICT on unemployment in South Asian.

Meanwhile, a study by Lobo et al. (2020) found that the impact of ICT, specifically broadband speed, in reducing unemployment in rural areas was higher than in urban areas in the state of Tennessee, USA, during the period 2011-2015. In contrast, a study by Abbasabadi & Soleimani (2021) covering 163 countries in the year 2016 concluded that in the early stages, the development of digital technology would increase unemployment. Then, at a certain level, the development of digital technology would reduce the unemployment.

In Indonesia, Siregar (2022) found that the development ICT has been proven to increase unemployment in the short and long term during the period 2012-2020. Similarly, Sintha et al. (2021) found that technological development (ICT) has a significant positive impact on unemployment in Indonesia during the period 2015-2019. Technological development can create new unemployment because it tends to save labor. Slightly different results were obtained by Sumanto et al. (2020), who found that ICT development has a positive and significant effect on unemployment. However, the interaction between the dummy variable for islands (Sumatra, Java, and Bali) and ICT has a significant negative impact on unemployment during the period 2015-2017. This is because only human resources in these three islands are ready to face technological developments. Meanwhile, a study by Salsabila & Oktora (2022) shows that internet access has a significant and negative impact on the unemployment during the period 2016-2019. Conversely, the research findings by Muin (2020) indicate that IT competence is not significantly related to the unemployment. An increase in IT skills within the population does not guarantee that they will get a job.

In the context of the impact of between ICT and youth unemployment, Ogbonna et al. (2022) found that youth unemployment can be reduced with the diffusion and use of ICT in 41 African countries between 2003 and 2018. Meanwhile, Metu et al. (2020) found that ICT (the broadband internet, mobilephones subscriptions (MPS), and internet acces) had a negative and significant impact on youth unemployment in 48 sub-Saharan African (SSA) countries, but the number of households with computers was not. On the other hand, Ebaidalla's study (2016) found that mbps had a significant negative impact on youth unemployment in 30 SSA countries, while the impact of the number of internet users was found to be not significant. This is in contrast to Ebaidalla's other research (2015) in the Middle East-North Africa (MENA) countries, where fixed telephone subscribers and internet users had a significantly negative effect on youth unemployment. However, the impact of MPS was found to be not significant.

In Indonesia, research related to the impact of ICT on youth unemployment is still challenging to find. Therefore, this study is conducted to fill this gap. Additionally, the differences in findings from previous research create another gap that can be further examined, especially in the Indonesian context. ICT proxies commonly used in previous studies include mbps, internet diffusion and penetration, and fixed broadband subscriptions. Richmond & Triplett (2018) state that different

characteristics of technological development among countries will result in varying effects on the economy. Hence, this research will use the IPTIK variable as a digitalization proxy since IPTIK represents a more comprehensive indicator of technological development that is rarely used due to its relative novelty (Nurarifin & Ridena, 2020).

This research is generally expected to contribute by providing information on the impact of digitalization and the Covid-19 pandemic on youth unemployment in Indonesia. Specifically, this study is anticipated to benefit various stakeholders by offering new insights for further research and serving as input and consideration in determining government policies.

2. Theoretical Background

Youth Unemployment

Youth unemployment is defined by the ILO as people aged 15-24 years who are not working but are looking for work, or preparing for a business, or feel it is impossible to get a job (desperate), or have been accepted for work but have not yet started working. The youth unemployment rate (YU) is measured by the percentage value of the number of unemployed in the 15-24 age group (PP) to the total workforce in the 15-24 age group (AK), can be written as follows (BPS, 2022):

$$YU = \frac{PP}{AK} \times 100\%$$

Digitalization

Digitalization is the phenomenon of transforming analog data into digital form (Reis et al., 2020) which facilitates accessibility, availability and transparency (Hagberg et al., 2016) which enhancing business connections between consumers and companies can consequently boost economic value. The scope of digitalization, in this concept, includes the use of ICT in e-business and e-commerce, algorithmic decision making in business, and also the use of automated digital technology in production processes. The application of digital technology can create new business models, more efficient production methods, and digital markets that change the way producers and consumers interact (Chen et al., 2010).

The important role of digitalization and its rapid development has encouraged various studies on digitalization. Various studies have also been conducted to measure the degree of digitalization of a region. In 2009, ITU measured the digital degree of a region with the ICT Development Index (IDI) which was adopted by BPS (National Statistics Bureau) to compile an IPTIK index to compare ICT achievements between provinces in Indonesia. This index is built from three sub-indices, namely ICT access and infrastructure (Acces); ICT use subindex (Use); and the ICT skills sub-index (Skills), with the measurement method namely (BPS, 2023):

$$IPTIK = 0{,}4\ Access + 0{,}4\ Use + 0{,}2\ Skill$$

Okun's Law

Arthur Okun's research in 1962 in the United States explained the relationship between economic growth and unemployment. Okun's Law stated that, in the short term, an economic growth increase of 3% or more will lead to a reduction of 1% in the unemployment rate (Ssebulime & Joseph, 2019). Mathematically, the relationship between economic growth and unemployment can be written as follows (Mankiw, 2016):

$$U_t - U_{t-1} = -\beta(g_{yt} - g_y)$$

U_t represents open unemployment rate in year t, U_{t-1} represents open unemployment rate in the previous year, g_{yt} is output growth rate, and g_y is normal output growth rate.

3. Methodology

This study uses a dynamic panel data regression method to examine the impact of digitalization (proxied by IPTIK) and the influence of the Covid-19 pandemic on youth unemployment in Indonesia with economic growth, inflation and investment as control variables. The Generalized Method of Moments (GMM) method with data processing using STATA 16 software was applied to analyze the model. The data type was secondary data, a panel of 34 provinces in Indonesia with the time period 2013 to 2022. All data used in this research was collected from macroeconomic indicators produced by the National Statistics Bureau (BPS).

The model used in this study is based on the research conducted by Ogbonna et al.(2022) and Metu et al.(2020). However, slightly different from past research, the ICT variable in this research used IPTIK to proxy for digitalization in Indonesia. This research also used the Covid-19 dummy variable to see the impact of the Covid-19 pandemic that occurred in Indonesia. The analysis model used in this research is:

$$YU_{i,t} = \alpha_0 + \beta_1 YU_{i,t-1} + \beta_2 IPTIK_{i,t} + \beta_3 Covid19_{i,t} + \sum_{j=1}^{3} \delta_j X_{j,i,t-\tau} + u_{i,t}$$

YU means youth unemployment rate; YU_{t-1}: is *YU* lag variable; *IPTIK*: digitalization proxy; *Covid19*: Covid-19 dummy variable; X_j: control variables (economic growth, inflation, and investment).

Table 1. Variable Description

Variable	Symbol	Measurement	Sources
Dependent			
Youth unemployment	*YU*	Percent, number of youth unemployed divided by number of youth labor force	National Statistics Bureau (BPS)
Independent			
Digitalization	*IPTIK*	ICT Devepment Index	BPS
Covid-19 pandemic	*Covid19*	Dummy, 1 for the occurrence of Covid-19, 0 for the non-occurrence of Covid-19	Processed by researchers
Control			
Economic growth	*PE*	Percent, rate of economic growth	BPS
Infation rate	*INF*	Percent, inflation rate	BPS
Investment	*PMTB*	Million Rupiah, Gross Capital Formation	BPS

Note: PMTB values are transformed using natural logarithms (Ln)

There are two approaches that are often used to estimate dynamic panel data regression models, namely First Difference GMM and System GMM. Both are general estimators designed for situations in the form of: panel data with N>T, independent variables that are not strictly exogenous, the existence of dynamic relationships because they depend on past realizations, individual effects, heteroscedasticity issues, and individual autocorrelation (Roodman, 2009).

The criteria for determining the best GMM estimator are the validity of the instrument variable (Sargan Test), consistent estimator (AR Test), and unbiased (Arellano & Bond, 1991). The instrument is valid if the Sargan test p-value is > 5% significance level. The model is admitted to be consistent if the first order p-value of the Arellano-Bond Test (AR-1) < 5% significance level, while the second order p-value (AR-2) > 5% significance level. The GMM model will be unbiased if the lag coefficient is between the PLS and FEM estimates (FEM lag < GMM lag < PLS lag).

4. Empirical Findings/Result

The results of dynamic panel model testing with GMM estimation to analyze the influence of digitalization and the Covid 19 pandemic towards youth unemployment are presented in the following Table 2. According to Table 2, the best model chosen and used in this research is the Two Step System GMM model. This is because this estimator meets the criteria for selecting the best model. The instrument used is valid, because the Sargan test p-value (0.908) > significance level (5%). Meanwhile, p-value AR-1 (0.009) < significance level (5%) and p-value AR-2 (0.065) > significance level (5%). In terms of model's unbiasedness, only the System GMM (one step and two step) estimates have a YU_{t-1} variable lag coefficient that is between the FEM and PLS estimates (0.2504< 0.319< 0.354< 0.8332) (Table 3). Therefore, the System GMM estimation model is not biased.

Table 2. Estimation Results of the GMM Model with Dependent Variable YU

Independen Variable	First GMM		System GMM	
	One step	Two Step	One Step	Two Step
(1)	(2)	(3)	(4)	(5)
YU_{t-1}	**-0,1066****	**-0,0991*****	**0,319*****	**0,3541*****
	(0,026)	(0,000)	(0,000)	(0,000)
IPTIK	0,3226	**0,6448*****	0,3952	**0,4878*****
	(0,447)	(0,001)	(0,283)	(0,000)
Covid19	0,0517	0,0486	0,5303	**0,501*****
	(0,902)	(0,785)	(0,288)	(0,005)
PE	**0,0252****	**0,0070*****	**-0,1201****	**-0,1312*****
	(0,636)	(0,687)	(0,046)	(0,000)
INF	0,1465	0,0942	0,2065	0,2299
	(0,613)	(0,271)	(0,182)	(0,220)
PMTB	**-0,9422*****	**-0,3917*****	-0,6488	**-0,9085*****
	(0,000)	0,000	(0,219)	0,001
Constant	**47,5828*****	**51,2421*****	**12,2243*****	**11,8856*****
	(0,000)	(0,000)	(0,000)	(0,000)
Sargan p-value	0,000	**0,815**	0,000	**0,908**
AR(1) p-value	**0,000**	0,150	**0,000**	**0,009**
AR(2) p-value	0,009	**0,277**	0,007	**0,065**
Wald chi2 p-value	**0,000**	**0,000**	**0,000**	**0,000**

Note: * siginificant at 10% level, ** significant at 5% level, *** significant at 1% level.
Source: Data Processing Results (2023)

Based on the estimation results of the Two step System GMM model (column 5 of Table 2), it can be seen the influence of each independent variable on youth unemployment in Indonesia can be partially determined.

1) The digitalization variable proxied by IPTIK has a significant positive influence with a coefficient of 0.4878, which shows that an increase of digitalization in Indonesia will increase youth unemployment in Indonesia by 0.4878 percent, *ceteris paribus*.
2) The Covid19 variable also has a significant positive influence with a coefficient of 0.501, which shows that the youth unemployment rate in Indonesia became higher by 0.501 percent when the Covid-19 pandemic occurred, *ceteris paribus*.

Table 3. Comparison of YU_{t-1} Coefficients Estimated by FEM, GMM, and PLS

Estimator	FEM	First GMM		System GMM		PLS
		One Step	Two Step	One Step	Two Step	
YU_{t-1} coefficient	0,2504	-0,1066	-0,0991	0,319	0,3541	0,8332
p-value	(0,000)	(0,026)	(0,000)	(0,000)	(0,000)	(0,000)

Meanwhile, the control variables used also have different influences. The economic growth (PE) variable has a significant negative influence with a coefficient of -0.1312, which shows that when economic growth increases by 1 percent it will reduce the youth unemployment rate in Indonesia by 0.1312 percent. The inflation (INF) variable has not a significant influence, which means that an increase in the inflation rate will not affect youth unemployment. Investment (PMTB) variable has a significant negative influence with a coefficient of -0.9085, which shows that when invesment increases by 1 percent it will reduce the youth unemployment rate in Indonesia by 0.9085 percent.

Based on the Two step System GMM model estimation results (column 5 of Table 2), also can be seen that the p-value of Wald $chi^2 = 0.000 <$ significance level (5%). This shows that the independent variables simultaneously influence youth unemployment in Indonesia.

5. Discussion

The Influence of Digitalization towards Youth Unemployment in Indonesia
The model estimation results, Two Step System GMM (column 5 of Table 2) show that the IPTIK variable has significant positive with a coefficient of 0.4878, which shows that the development of digitalization in Indonesia is able to increase youth unemployment in Indonesia. This means that youth unemployment rate will increase along with the development of digitalization in Indonesia. This result is in accordance with the findings of Siregar (2022) that the development of ICT in Indonesia has been proven to increase unemployment in the short term and long term. On the one hand, technological advancement can increase productivity and economic growth, but on the other, it actually causes inequality and unemployment due to replacing jobs with technology. Sintha et al. (2021) also supports that development in technology can actually create new unemployment because technological developments are created to aim for labor saving.

However, the results of this study are in contrast to a similar study by Ogbonna et al. (2022) in 41 African countries, who found that youth unemployment can be reduced by the spread and use of ICT. The increased use of ICT can significantly reduce youth unemployment and promote long-term economic growth. Investing in ICT infrastructure to expand access and usage among the larger population can help alleviate youth unemployment in Africa. This is because individuals with better ICT skills are better positioned to take advantage of job opportunities in the rapidly growing service sector. Likewise with Metu et al. (2020) who found that ICT had a significant negative impact on youth unemployment in 48 sub-Saharan Africa (SSA) countries. In the same vein, Ebaidalla (2016) also found that mobile subscribers had a negative and significant influence toward youth unemployment in 30 SSA countries and in Middle East-North Africa (MENA) countries.

The development of digital technology actually creates technological unemployment. such as the findings of Sumanto et al. (2020) that the Indonesian workforce is not ready to face technological development except on the islands of Sumatra, Java and Bali. This is because only human resources on these three islands are ready to face technological developments. Meanwhile, Yunita (2021) found that the higher internet users in a region, the higher the unemployment in that region. This is because internet use in Indonesia has not been fully used to increase productivity such as looking for work or improving skills. The internet is mostly used for consumer purposes.

Technological shocks can affect the number of workers in several periods. This happens because of the substitution effect between innovation and labor so that workers are replaced by technology (Emara, 2021). Orji et al. (2016) also supports this finding that ICT developments are able to create employment opportunities, but the nature of this work is different from traditional work which prioritizes skills and expertise as evidenced by the large number of workers in Nigeria who have lost their jobs in banks and other sectors due to being replaced by computers and other technological innovations.

Bestari (2021) also stating that the impact of technology on the workforce is expected to continue to increase in the coming years with the implementation of advanced technologies such as artificial intelligence (AI), nano-technology, big data, and computerization. This situation is particularly challenging for young people who have only basic education and digital skills, as they may have difficulty transitioning from informal or temporary employment to more stable, formal employment. Lack of experience in the job market due to their short work history also makes it more difficult for them to find work.

Indonesian Youth Unemployment due to the Covid-19 Pandemic

The model estimation results also show that The Covid19 variable has a positive and significant effect with a coefficient of 0.501, which shows that the youth unemployment rate in Indonesia became higher when the Covid-19 pandemic occurred. This result is in accordance with the findings Gould & Kassa (2020) that the Covid-19 pandemic has had a significant impact on youth unemployment, where young workers are the group most affected in terms of economic impact. Barford et al. (2021) also supports that the Covid-19 pandemic has caused an increase in unemployment for the youth group with a much higher impact compared to the age group 25 years and over. The implementation of the Large-Scale Social Restrictions (PSBB) during the outbreak of pandemic led to the closure of economic sectors, such as transportation, hotels, restaurants and restaurants, entertainment venues and recreational services, which resulted in the escalation of unemployment rate (Saragih & Usman, 2021).

This research also aligns with Maguire (2020) findings that the labor market shocks caused by the pandemic dominantly influenced young workers compared to adult workers because the former is the most vulnerable group. The youth group is in a

disadvantaged position because they are vulnerable to being fired and laid off and thus become unemployed. Their limited work experience and inadequate skills make them less likely to be employed when the pandemic occured. The high number of layoffs of young workers and weak intensity of recruitment during the pandemic have resulted in an increase in youth unemployment.

Furthermore, it is also necessary to review the influence of the control variables used in this research. The economic growth (PE) variable has a negative and significant influence. This shows that the Okun Law phenomenon applies in Indonesia which is in accordance with research by Bayrak & Tatli (2018) in OECD, Hasan & Sasana (2020) in ASEAN countries, Michael & Geetha (2020) in Malaysia, and Ebaidalla (2016) in Sub-Saharan Africa (SSA) countries. The youth unemployment rate can be reduced with higher economic growth (Ogbonna et al., 2022). The inflation rate has a positive but not significant effect, which means that an increase in the inflation rate will not affect youth unemployment (Metu et al., 2020). Meanwhile, investment has a negative and significant influence. The greater the investment, the greater the availability of infrastructure through development (Orji et al., 2016). Moreover, the development of physical infrastructure such as roads and good electricity networks will be able to reduce youth unemployment (Baah-Boateng, 2016).

6. Conclusions

Based on the estimated model results and the preceding discussion, several conclusions emerge regarding the impact of digitalization and the Covid-19 pandemic on youth unemployment in Indonesia. Firstly, it is evident that digitalization has significantly contributed to the rise in youth unemployment. Despite the widespread presence of Information and Communication Technology (ICT) in Indonesia, its utilization by youth tends to prioritize consumer activities rather than job-seeking, productivity enhancement, or skill improvement, thereby failing to alleviate unemployment rates among the younger demographic. Secondly, the Covid-19 pandemic has exacerbated economic uncertainty and directly affected certain sectors, leading to a surge in unemployment rates among the youth. Lastly, both digitalization and the pandemic underscore the susceptibility of youth to economic and technological shifts, highlighting their increased vulnerability to unemployment due to skill deficiencies and the precarious nature of their employment positions in the face of such changes.

However, it is important to acknowledge certain limitations within this research. Firstly, the study does not account for interaction variables, thus future research should explore the interplay between various factors to enrich the analytical depth. Secondly, given Indonesia's archipelagic nature, ICT development is unevenly distributed across different islands, leading to significant disparities. Therefore, there is a need to investigate the impact of this inter-island disparity on youth unemployment rates to provide a comprehensive understanding of the issue.

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