Regional Economic Growth in Indonesia, Information and Communication Technology Perspectives

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Abstract: This paper aims to investigate the contribution of information and communication technology (ICT) to local economic growth in Indonesia in the period 2008-2017, as it provided a critical backbone to the development of the data industry in Indonesia, especially mobile data. This study tested a cross-section instrument on 33 provinces in Indonesia. The simultaneous equation model is employed to analyze the effect of ICT on regional economic growth. This study assessed two policy settings, namely direct contribution to access and availability for economic growth, and the indirect impact on labor productivity. The results revealed an increase in the role of ICTs in encouraging regional economic growth in Indonesia, although most provincial areas have limited ICT infrastructure. This paper opens an extended solution to the improvement of ICT infrastructure and emphasizes a better in-depth analysis of ICTs on regional economic growth.

1 INTRODUCTION

The idea of long-term economic growth followed the theoretical framework of Solow-Swan (Solow, 1957; Swan, 1956). This model makes technology the main ingredient in long-term growth and economic development. Over the past few years, growth was a process of increasing capital and labor to achieve higher returns. This Solow-Swan model shows that because of fewer profits, there are limits to the increase in the amount of money and energy to achieve sustainable growth. Improved technology can offset this declining profit and provide an opportunity for a country to experience productivity growth.

Technology has always been at the forefront of economic growth and productivity. Increasing capital and labor input in the production process alone is not enough to maintain sustainable growth. Productivity is the primary driver of growth after a country reaches its capital and labor use limits. Recognizing the importance of technology in industrial growth, more and more countries and companies are allocating their resources for investment in technology.

Furthermore, technological advances have contributed to human well-being, including in terms of new jobs, goods, health services, travel, and communication. At the same time, technology also has a disturbing power. Technology can influence how labor is employed, and companies operate. Technological changes in the fourth industrial revolution at the moment may not be as drastic as they have been in the past, but the acceleration of technological improvements and adoptions is happening even faster. The previous industrial revolution took decades to truly change so that the adjustment time was longer, especially in the labor market.

Information and Communication Technology (ICT) is one form of technology that is snowballing today and can be an indicator in determining the economy of a country. The high demand and penetration of digital devices in various aspects of human life has directly created a significant industry in the field of technology and involves almost all major nations in the world, with business value increasing day by day (Indrajit, 2011). ICT has become a new resource for economic growth. It is observable from the impact of the use of ICTs in a broad manner, which enables the implementation of more efficient ways to produce, distribute, and consume goods and services.

Several previous studies have shown that ICTs can drive economic growth. The higher the development of a country's information technology, the higher the economic growth. There is a tendency that countries with rapid ICT growth have fast economic growth as

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well. In the United States, in the period 1995-1998, ICTs were able to contribute to the economic growth of 4.73% (Jorgenson, Dale and Stiroh, 2000). Also, some European Union member countries (notably Ireland, the Netherlands, and Finland) and some OECD countries (for example, US, Australia, and Canada) have recorded increases in economic growth and productivity, stable inflation, and reduced unemployment through the application of ICT.

In the Asia Pacific region, a country like Indonesia provided evidence that ICT diffusion is positively correlated with the level of economic growth. The role of communication equipment calculates research in Asia regarding ICT's role in economic growth. The results showed that the accumulation of capital of communication equipment had a positive impact on all Asian countries during the 1990s, and positive side measures were similar in Asian countries (Kanamori, Fujiwara, and Mitomo, 2004). This study provides the first step in understanding the impact of using ICT in Asia.

Recently, the rise of the information society in Indonesia exhibits the continuous development of ICT, especially telecommunication firms, as magnified by the transition from fixed-line phones to the mobile cellular phone. Besides, due to the rapid growth of telecommunications in Indonesia, the term "Digital Economy" has penetrated the urban and even rural areas in Indonesia. Telecommunication has eliminated the distance and reduced the differences between communities. Information is no longer constrained by time, location, or demographics, providing a great value to society.

A study from the International Telecommunication Union revealed 25 percent of Indonesia's population had accessed the internet in 2016, showing the climate of information disclosure and public acceptance of technological developments and changes towards the information society. The high number of internet users in Indonesia is inseparable from the rapid growth of cellular phones (Batunanggar, 2019). In 2017 there was 88.13 percent of households in Indonesia having/controlled at least one mobile telephone number. This figure is much higher when compared to the conditions in 2012, which only reached 83.52 percent.

This paper examines the causal relationship of ICTs to growth, using panel data from 33 provinces in Indonesia for the ten years 2008-2017, where ICTs are multiplying in various regions in Indonesia. The data compiled from three primary sources are the dataset of the Statistics Indonesia (for regional economic indicators), the International Telecommunication Union (ITU) database (for ICT penetration indicators), the Indonesian Ministry of Communication and Information.

2 LITERATUR REVIEW

The contribution of Romer (1986; 1990) and Lucas (1988), had provided a stimulus to investigate endogenous factors that determine economic growth. It centered on the central question or idea of which "the main engine of growth."

One of the engines of growth is human capital. It is static, instead of being static, it is very dynamic and possessed abundant productive capabilities. Every step of development would yield to the stock of knowledge obtained. Therefore, this kind of improvement would boost economic growth. Quah emphasizes the demand for supply, argues that the Information and Communication Technology (ICT) revolution encourages the advancement of workforce skills, consumer sophistication, and broad-based education level improvement; furthermore, it urges increased use of technology and increases the productivity of labor, leading to the increase of economic growth (Quah, 2002). Levine argues that a lesser barrier to information, essential driver of ICT, would promote increased investment (1997).

Even before the advent of ICTs, the imminent impact of the increased access and participation on information and effective communication yielded economic growth, as evidenced in Japan, Korea, Hong Kong, and Taiwan. The extraordinary economic growth in the late 80th as a result of how companies and people had better access to market information. Besides, they benefit from more effective communication with foreign partners and each other.

The slow development of productivity had been observed as a critical inhibitor of economic growth in many developing countries (Cirera, 2016). One of the answers to the previous problem was the advancement use of ICT (Cirera, Lage, and Sabetti, 2016), as it could facilitate a more efficient approach to factors of production utilization and promoting the application of and to other technologies. Its potentiality as a productivity driver in areas with lower ICT adoption or underdeveloped infrastructure, such as Sub-Saharan Africa.

Although the magnitude of ICT contributions to the growth of productivity still sparked heated conversation and debate, various study findings such as Pilat (2004); Draca, Sadun, and Reenen (2006); Litan and Rivlin (2001) revealed that ICT positively affected the productivity growth. Polak found a low elasticity, despite being positive of 0.3% (2014). This low elasticity could be explained by the fact that ICTs are integral parts of many production and capital

technologies, which makes it difficult to separate the effects of ICT investments on the impact of other production factors. The debate over the contributions of ICT remains an open question of whether ICT could potentially become an important driver of productivity growth and subsequently increase economic growth.

The rapid application of ICTs raises essential questions about the possible impacts on the company's operations. For example, Bloom, Sadun, and Reenen (2012) investigate how ICTs affect worker autonomy, differentiating between cost reduction in the information, or even communication. They found that as the independence of workers increased would provide freedom, despite shrinking for the first time, while in the future, decisions were decentralized, and worker autonomy increased.

Several studies have empirically analyzed the relationship between ICT and productivity. At the sectoral level, Basu et al. (2004) examined ICT could differentiated the US and UK productivity performance. Focusing on the reduced ICT costs, cheap ICT investments are likely to create significant changes only if companies can radically apply their other inputs and increase productivity. They concluded that the different productivity patterns was the result of unmeasured investments in intangible organizational capital of these two countries after 1995.

Among all types of ICT investments that have an impact on productivity, internet adoption is the main application that triggers many kinds of research. Sánchez, Gallego-Álvarez, and Rodríguez-Domínguez (2011) investigated the effect of the internet on productivity as evidenced in Spanish-based corporations. They reported three channels where the internet can affect productivity: (i) the reduced transaction costs in the production and distribution of goods and services; (ii) the increased management efficiency, by a more effective management of supply chains, and a more effective communication within the company as well as customers and partners; (iii) the increasing competition provided the platform of a more transparent prices with a more expansive market potentiality for buyers and sellers, who put pressure on suppliers to implement techniques that translate into cost savings. The important conclusions of this study indicate a positive impact on the productivity of internet adoption but it would decline as a certain level of usage is reached.

Although ICTs cover a variety of applications, internet adoption is in the frontrow driver of how it developed rapidly inside the firms. Loundes (2002) shows that the percentage of businesses using the internet in Australia has doubled in three years. In 1998, 29 percent of Australian companies used the internet, while it increased to 69 percent in 2001. Recent data shows that internet penetration reaches almost all companies in developed countries; 97.9 percent of businesses with ten or more employees in OECD countries have internet connections (Cirera, 2016). Even developing countries have a high percentage of companies using ICT (Cirera, 2016). For example, the rate of Turkish and Mexican companies that use the internet is more than 90 percent (OECD, 2012). However, ICT adoption is not evenly across all types of companies. Walczuch, Braven, and Lundgren (2000) have shown that small companies in the Netherlands do not adopt the internet at the same speed as their larger counterparts.

Bresnahan et al., using company-level data, suggest that the reduction in ICT prices will increase investment in work organizations and product and service innovations, which in turn increases the demand for skilled workers to increase productivity growth (Bresnahan, Brynjolfsson, and Hitt (2002). The Bresnahan study, using US-level company data from 1987 to 1994, found evidence of complementarity among the three types of innovations (ICTs, workplace reorganization, and complementary new products and services). In other words, companies that adopt innovation tend to use more skilled labor, and the impact of ICT on labor demand is more significant when combined with organizational investment. In short, they highlight the importance of ICT as an enabler of organizational change, which leads to productivity growth.

Furthermore, using the same company-level data, Brynjolfsson and Hitt specifically investigate the influence of computerization on productivity and output growth (Brynjolfsson and Hitt, 2003). According to them, ICTs affect productivity because companies change their production processes and produce complementary innovations in and throughout the company. Their main conclusion is that the estimation of computerized contributions to output growth continues to increase in the long run. In the short term, the output contribution measured from computerization is roughly the same as the computer capital cost, but in the long run, their participation is significantly more significant than their expenses.

Furthermore, Polder et al. (2010) investigated the impact of ICT on productivity using data for more than 5,000 Dutch companies from 2002 to 2006. Polder, including ICT investment as an input to innovation similar to investment treatment in R & D within the framework proposed by Crépon, Duguet, and Mairessec (1998). Their central hypothesis is that ICTs affect productivity through an innovation process. Thus, ICT is input to the innovation process, such as the input of other knowledge for R & D. In other words, ICTs enable higher levels of productivity through an innovation process because this is an input of innovation to increase output and ultimately leads to higher company performance. The findings of

Polder et al. show that investment and use of ICTs are essential drivers of innovation output in manufacturing and services. Besides, they found that the strong effect of ICT on productivity is through organizational innovation.

Internet penetration in Indonesia is increasing, from 25.37 percent in 2016 to 32.34 percent in 2017. One indicator illustrating this phenomenon is the correlation between the percentage indicator of the population using the internet and per capita GRDP, which shows a positive relationship of 0.723 (Statistics Indonesia, 2017. Judging from the growth of research conducted by Nata found that ICT investment in Indonesia both in telecommunications and hardware and software has a strong influence on the growth of the Indonesian economy, and the high growth rate of ICT investment has triggered high economic growth in Indonesia (Nata, 2007). Hardware has an active role if viewed in terms of it's physical, whereas software has a high contribution in terms of service services.

3 METHOD

The analytical method used in this study is the panel data method with quantitative analysis and strengthened by qualitative analysis. This study will conduct a simultaneous modeling framework of ICT, human capital, labor productivity, and regional economic growth in a model that explicitly connects all variables is the most appropriate equipment to see, both directly and indirectly, the impact of ICT on regional economic growth. Therefore, in this study, a simultaneous equation regression model will be used using the two-stage least square (TSLS) regression technique to see the relationship between ICT, human capital, labor productivity, and regional economic growth. Thus, the general specifications of the structural equation system used in this study are:

$$P = f(\text{ICT, HC}) \quad (1)$$

$$Y = f(\text{P, ICT, HC}) \quad (2)$$

Where P is labor productivity; Y is regional economic growth; ICT is information and communication technology which is proxied by the ICT Development Index, and HC is human capital proxied by the Human Development Index.

Given the size of regional economic growth seen from ICT, human capital, and labor productivity, structural equations (1) and (2) become:

$$P_{it} = \alpha_0 + \alpha_1 ICT_{it} + \alpha_2 HC_{it} + \varepsilon_{it} \quad (3)$$

$$Y_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 ICT_{it} + \beta_3 HC_{it} + \varepsilon_{it} \quad (4)$$

Next equation (3) is substituted to equation (4):

$$Y_{it} = \beta_0+\beta_1(\alpha_0+\alpha_1 ICT_{it}+\alpha_2 HC_{it})+\beta_2 ICT_{it}+\beta_3 HC_{it}+\varepsilon_{it}$$

$$Y_{it} = \beta_0+\alpha_0\beta_1+\alpha_1\beta_1 ICT_{it}+\alpha_2\beta_1 HC_{it}+\beta_2 ICT_{it}+\beta_3 HC_{it}+\varepsilon_{it}$$

$$Y_{it} = \beta_0+\alpha_0\beta_1+(\alpha_1\beta_1+\beta_2)ICT_{it}+(\alpha_2\beta_1+\beta_3)HC_{it}+\varepsilon_{it} \quad (5)$$

Where P_{it} is labor productivity; Y_{it} is regional economic growth; ICT is Information and Communication Technology proxied by the ICT Development Indeks; HC_{it} is Human Capital proxied by the Human Development Index; i is the province I, where i = 33 provinces in Indonesia; t is year t, where t = 2008-2017; α, β is estimated parameters; α_0, β_0 is intercepting; and ε is error term.

The Two-Stage Least Square (TSLS) method can work on a simultaneous equation system that is over-identified and exactly-identified. For an exactly-identified equation, besides being estimated by the TSLS method, it can also be assessed by the indirect least square (ILS) method to produce parameter values that meet the best linear unbiased estimator (BLUE) criteria.

Then through equation (5), brought to the reduced form equation. The reduced form equation in question is as follows:

$$Y_{it} = \pi_0 + \pi_1 ICT_{it} + \pi_2 HC_{it} + \mu_{it} \quad (6)$$

Where:

Y_{it} = regional economic growth
$\pi_0 = (\beta_0 + \alpha_0\beta_1)$
$\pi_1 = (\alpha_1\beta_1 + \beta_2)$
$\pi_2 = (\alpha_2\beta_1 + \beta_3)$
μ_{it} = composite term error

4 RESULTS AND DISCUSSION

Based on the estimation results using 33 districts/ cities, it shows that the direct effect of ICT on Productivity (P) is 0.386, which means that an increase of 1 point ICT Index will result in an increase in labor productivity of 0.386 percent with a significance level of 1% (0.01). This means that the effect of ICT on P is significant, presented in table 1. These results are in line with Quah's view, which states that ICT penetration will encourage skill improvement and increase the education level of the workforce, thus increased labor productivity and, finally, economic growth (Quah, 2002). Likewise, Levine (1997) argues that ease of accessing ICTs is believed to be an important driver of increasing productivity faster, which in turn increases economic growth.

Based on the estimation results in Table 1, it shows that the direct effect of Productivity (P) on regional economic growth (Y) is 0.173, which means an increase of 1 percent labor productivity will

increase the economic growth of 0.173 percent with a significance level of 0.013. These results are consistent with Cirera's opinion that states that low productivity growth is one of the main factors that inhibit economic growth in many developing countries. One potential for productivity growth is the adoption and use of ICT. Information technology can facilitate productivity growth by utilizing production factors more efficiently and promoting the application of other technologies. The potential of ICT as a productivity enabler is even more enormous in areas far from the availability of technology, especially in developing countries, which until now have tended to have lower rates of ICT adoption and underdeveloped ICT infrastructure (Cirera, Lage and Sabetti (2016).

Based on the estimation results in Table 1, it shows that the direct effect of ICT on Y is 0.331, which means that an increase of 1 point ICT Index will result in a rise in regional economic growth (Y) of 0.331percent with a significance level of 1%. These results support Nata's study, which found that ICT investment in Indonesia in both telecommunications and hardware and software has a strong influence on Indonesia's economic growth, and the high level of ICT investment has triggered high growth in Indonesia (Nata, 2007). Hardware has an active role when viewed in terms of its physical, while software has a high contribution in terms of service. The fact is that internet penetration in Indonesia is multiplying, from 25.37 percent in 2016 to 32.34 percent in 2017; moreover, it encourages the development of internet usage in economic activities or digital economy phenomena. One indicator that can illustrate this phenomenon is the correlation between the percentage of the population using the internet and the GDP per capita which shows a positive relationship of 0.723 (Statistics Indonesia, 2018).

Table 1: The Estimate Results.

Directions of Effect	Estimate	t-statistic	Prob.
P <---- ICT	0.386***	3.804	0.000
Y <---- ICT	0.331***	7.139	0.000
P <---- HC	0.076**	2.100	0.036
Y <---- HC	0.015	0.917	0.359
Y <---- P	0.173*	2.491	0.013

***p<0.01;
**p<0.05;
*p<0.1

5 CONCLUSIONS

An important finding in this study is that ICTs have a significant relationship to regional economic growth in Indonesia. This relationship begins with the influence of ICT penetration on labor productivity. Information and communication technology can facilitate productivity growth by utilizing production factors more efficiently and promoting the application of other technologies, which in turn, encourages increased use of technology and increases labor productivity and, as a result, encourages economic growth.

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