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The Role of Information and Communication Technology (ICT) and Tourism on Economic Growth in Indonesia

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Abstract: This study aims to analyze the influence of ICT and the tourism sector on economic growth in Indonesia from 2015 to 2021 using panel data regression analysis on a total of 238 data with the Feasible Generalized Least Square-Seemingly Unrelated Regression (FGLS-SUR) estimation method. The results of the study show that the proportion of individuals who use the internet, the number of fixed broadband subscribers, the room occupancy rate of star hotels, foreign investment, labour, and government spending have a positive and significant effect on economic growth in Indonesia. In this regard, it is hoped that each province will have equal access to the internet and further enhance hotel services, especially for star-rated hotels. The positive impact of this research in Indonesia is that it can help enhance the Gross Regional Domestic Product (GRDP) in each province, thereby influencing overall economic growth through the fields of ICT and tourism.

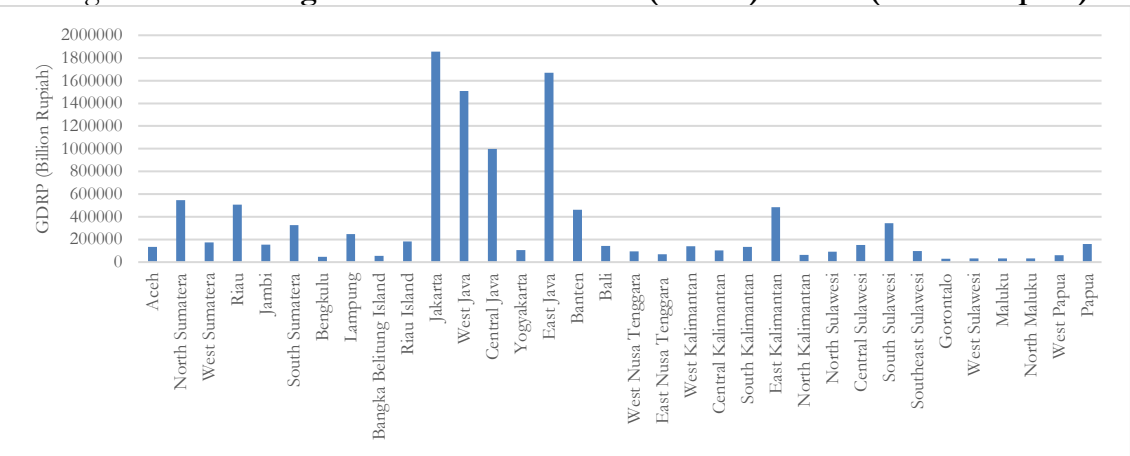
Keywords: Broadband, Internet, Tourism, Economic Growth, Hotels

Introduction

One way to gauge economic growth is to look at the gross domestic product (GDP) (Fatmawati & Syafitri, 2015). GDP can be used to measure community prosperity and evaluate economic growth accomplishments. The national medium-term development plan (RJPMN) for 2015-2019 has a target of 6–8% economic growth, although actual growth in Indonesia from 2015–2019 is only predicted to be in the range of 5–6%. This number is still well behind the 5.02 percent economic growth recorded in 2019. The average economic growth in Indonesia in 2020 – 2024 is also targeted to be between 5.7 and 6.0 percent per year, but in 2021, the actual economic growth in Indonesia was only at 3.69 percent. This indicates that from 2015 to 2021, there hasn't been any realization of economic growth that has reached the target (BPS, 2021). Furthermore, when viewed overall, economic growth in 2021 actually had

a lower value compared to 2015. This indicates that, on average, the growth rate in 2021 was slower than in 2015. Figure 1 depicts the GRDP of each province in 2021. It reveals rather significant variances in each province, with the island of Java having the greatest GRDP overall.

Figure 1. **Gross Regional Domestic Product (GRDP) in 2021 (Billion Rupiah)**



Source: BPS-Statistics Indonesia (2021)

In RPJMN, specifically the National Development Strategy on the development dimensions of leading sectors with priority, includes the tourism industry as one of the sectors for development. The potential of distinctive natural beauty and cultural diversity is used by leading tourism priority sectors as capital for the growth of national tourism (Bappenas, 2015). Through tourism-related activities including the selling of goods and services through hotels, restaurants, transportation services, and other such venues, the development of tourism has an impact on the socioeconomic circumstances of the local community. Due to its potential to spur economic growth, the tourism industry has attracted the attention of numerous nations worldwide (Hakim et al., 2021). The problem with the tourism sector is that several targets set by the Ministry of Tourism and Creative Economy in the 2015–2019 strategic plan have not yet been achieved, as shown in Table 1 below.

Table 1. **Target and Realization of Tourism in Indonesia**

Year	**Target dan Realization**	**Indicators**			
		Contribution to GDP (%)	Foreign Exchange (Trilion Rupiah)	Total Labor (Million people)	Tourist (Million visits)
(1)	(2)	(3)	(4)	(5)	(6)
2015	Target	4,32	144,00	11,40	10,00
	Realization	4,25	175,71	10,36	10,41
2016	Target	4,50	172,00	11,80	12,00
	Realization	4,13	176,23	12,28	12,02
2017	Target	5,00	200,00	12,00	15,00
	Realization	5,00	202,13	12,60	15,04
2018	Target	5,25	223,00	12,60	17,00
	Realization	5,25	224,00	12,70	15,81
2019	Target	5,50	280,00	13,00	20,00
	Realization	4,80	197,00	12,90	16,10

Source: RPJMN (2019)

According to Li et al.(2018) where they critically analyzed hundreds of papers on tourism from 2010 to 2014, one of the findings noted that, albeit occasionally, tourism has a significant impact on the economy. The tourism sector also benefits from technological advancements (Dewi & Wulansari, 2020). To learn more about popular tourist destinations, many individuals use mobile devices and online services. Information, communication, and technology are a source of economic progress, claims (Pradana, 2021). According to Solow's theory, which he added technological factors to, economic progress in a nation is affected by a combination of capital and labor accumulation (Mankiw, 2021). The World Bank reports that the number of people utilizing the Internet is growing quickly, giving Indonesia's digital economy the highest growth in Southeast Asia. Cellular phones and fixed broadband are the most common ways that locals access the internet. Even so, not all Indonesian residents can access the internet easily. Research conducted by Kurniawati (2022) shows that there are three indicators of information and communication technology that have a positive and significant contribution to economic growth in Asia. The three indicators are internet penetration, telephone infrastructure, and cellular telephone subscribers.

The relationship between tourism and ICT and economic growth has in fact been the subject of numerous studies, however, prior research has distinguished between the two relationships. A number of earlier research that looked at how the tourist industry affected economic growth in different nations (Aratuo & Etienne, 2019; Inchausti-Sintes, 2015; Jayaraman & Makun, 2022; Nchake & Shuaibu, 2022). There are also earlier studies that explain how ICT variables have an impact on economic growth in various nations (Adeleye, 2023; Nguyen & Doytch, 2022). Several earlier studies simply looked at the impact of ICT and tourism separately, such as the study by Adeola & Evans, 2020; Anser et al., 2022; Gössling, 2021; N. Kumar & Kumar, 2020; Lee et al., 2021; Zhu et al., 2021. Research on the relationship between ICT and tourism and how it affects economic growth is still scarce or nonexistent in Indonesia. There is research that includes these two characteristics, however, that research was carried out in 10 ASEAN nations (Haini, 2022), whereas our research was only carried out in Indonesia.

Given Indonesia's enormous tourism potential and the fast-paced development of information technology, these two factors may offer an alternate means of boosting Indonesia's economic growth and raising its share of the global GDP or Gross Regional Domestic Product (GRDP). This study used the panel data regression analysis method to capture changes between provinces because of the uneven distribution of ICT development in each province and the diverse natural potentials. In Indonesia, the scope of digital inequality goes beyond problems with infrastructure and encompasses a deficiency in media and content-related skills (Hadi, 2018). The study on the digital gap between rural and urban areas in Indonesia reveals that the fundamental cause of digital inequality (level one) lies in a lack of motivation and restricted access to material or ownership due to social disparities. This is further compounded (level two) by a deficit in skills and variations in the frequency or accessibility of digital use, intensifying the existing digital disparity (Jayanthi & Dinaseviani, 2022). As a result, the purpose of this study is to gain a general understanding of Indonesia's economic growth, the state of information, communication, and technology as well as the tourism industry, and analyze the impact of information, communication, and technology and the tourism sector on economic growth in Indonesia using variable based on theory and literature review.

Literature Review

A nation's ability to thrive economically depends on three factors: accumulation of capital, growth in labor and population, and technical advancement Todaro & Smith (2015). The Gross Regional Domestic Product (GRDP), or on a national scale also known as the GDP, is one of the metrics used to explain economic growth (Hawari & Kartiasih, 2017; Kartiasih, 2019; Kusumasari & Kartiasih, 2017). A nation's economy is expanding if the total real compensation for its production-related inputs is higher than it was the year before (Adwendi & Kartiasih, 2016; Haryanto, 2013). By including a third independent variable, technology, and a second element, labor, into the equation for economic growth, Solow economic growth is a development of Harrod Domar's theory (Todaro & Smith, 2015). This theory explains that savings, population growth, and technological growth affect the level of economic output and economic growth (Mankiw, 2021).

According to a number of earlier research, factors related to the tourism sector could increase economic growth (Aliansyah & Hermawan, 2021; Hakim et al., 2021; Min et al., 2016; Saputra, 2022; Saputra & Sukmawati, 2021). According to Law Number 10 of 2009, increasing economic growth and enhancing human welfare are two goals of tourism. As a result, one of the pillars of Indonesia's increasing economic growth is the travel and tourist industry. The law also specifies the various tourism-related business kinds. Tourist attractions, tourist destinations, tourist transportation services, food and beverage services, accommodation provision, planning entertainment and recreational activities, planning meetings, incentive travel, conferences, and exhibitions, tourism information services, tourism consulting services, tour guide services, water tourism, and spa are examples of the different types of tourism businesses. If these many forms of tourism are used to their full potential, Indonesia's economy or income will grow.

ICT includes the internet, telecommunications, information technology equipment, media and broadcasting, libraries, and document centers, as well as a variety of other tools used in communication activities. The Information Communication and Technology Development indicator, which ranges from zero to ten, is a composite indicator that may be used to describe the state of ICT development in a particular area (Fernández-Portillo et al., 2020; Kartiasih et al., 2023, 2023a, 2023b; UN, 2009). According to BPS-Statistics Indonesia, ICT development index (IDI) is a common measurement of the degree of information and communication technology development, gauging the digital divide, and measuring the potential for ICT development in an area when compared over time and between areas. Eleven indicators make up IDI, which is then broken down into three sub-indices: the information communication and technology infrastructure sub-index, the information communication and technology development sub-index, and the information communication and technology expertise sub-index. Internet users and fixed broadband users are included in the IDI's component parts, specifically the usage sub-index. The Solow growth hypothesis, which contends that capital accumulation, population and labor expansion, and technical advancements all have an impact on a region's overall output of goods and services, demonstrates the significance of information and communication technology in the economy. Additionally, a number of earlier research have shown that ICT-related factors can increase economic growth (Agustina & Pramana, 2019; Kurniawati, 2022; Wardhana et al., 2020). In addition, there are several other studies which can explain that ICT does have an influence or relationship to economic growth. For instance, research by

Appiah-Otoo & Song (2021); Awad & Albaity (2022); Hussain et al. (2021); Sawng et al. (2021). From this study, variables related to ICT were used, such as internet penetration, fixed broadband subscribers, then there were also those who used mobile phone celuller. The results of this research study explain that ICT does have a significant influence on economic growth in various countries. Even though the effects of ICT and the tourism industry on economic growth have both been extensively studied, it is still uncommon to discover research that combines the effects of ICT and the tourism industry on economic growth.

Even though the effects of ICT and the tourism industry on economic growth have both been extensively studied, it is still uncommon to discover research that combines the effects of ICT and the tourism industry on economic growth. The positive impact or benefit of this research in Indonesia is that it can help enhance the Gross Regional Domestic Product (GRDP) in each province, thereby influencing the overall economic growth through the fields of Information and Communication Technology (ICT) and tourism.

Methods

The basic data were collected from national accounts statistics published by the Indonesia BPS-Statistics Indonesia, available through the web portal (BPS, bps.go.id). The publications that were downloaded from the BPS website and then imported into Excel contain the data that was collected from BPS. Additionally, there is already available data that may be downloaded straight from the BPS website. The time span considered for this study is 2015–2021 with observation units drawn from 34 Indonesian provinces. So, panel data is used in this study.

The dependent variable in this study is economic growth by proxy for Gross Regional Domestic Product (GRDP) in billion rupiahs. The independent variables used come from information, communication, and technology (ICT), by proxy namely the proportion of individuals who use the internet in percent and the number of fixed broadband subscribers in person, as well as the independent variables from the tourism sector, by proxy namely the room occupancy rate in percent and, number of tourist by proxy, the number of tourists staying at hotels in person. As well as other independent variables that are thought to influence economic growth, namely investment, labor, and government expenditure.

Descriptive analysis and inferential analysis are the analytical techniques used in this study. The dependent and independent variables have been assessed using descriptive analysis. The software used are Microsoft Excel 2013, Eviews 12, and QGIS 3.16, while inferential analysis is performed to determine the impact of the independent factors on the dependent variable.

Descriptive analysis is used to get an overview of economic growth in Indonesia and to get an overview of the independent variables that will be used, namely the ROR-star hotels, the number of tourists, the proportion of individuals who use the internet, and the number of fixed broadband subscribers. Descriptive analysis uses graphs and bar charts processed in Microsoft Excel 2013 and thematic maps processed using QGIS 3.16 for easy understanding. Thematic maps are used to see the distribution of each variable in each province.

The inferential analysis used in this study is panel data regression with a total of 34 observations of cross-sections, and the period used is from 2015 to 2021. The panel data

regression is used to estimate and analyze the influence of tourism sector variables and information and communication technology on the economic growth of provinces in Indonesia. Panel data is a combination of cross-sectional and time-series data. Panel data regression has three models, including the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). In general, the model specifications that are formed are as follows (Baltagi, 2021):

$$Growth_{1it} = \alpha + \beta_1 Internet_{it} + \beta_2 ROR_{it} + \beta_3 LnFDI + \beta_4 LnLabor + \beta_5 LnGov + u_{it} \quad (1)$$

$$Growth_{2it} = \alpha + \beta_1 Internet_{it} + \beta_2 LnTourist_{it} + \beta_3 LnFDI + \beta_4 LnLabor + \beta_5 LnGov + u_{it} \quad (2)$$

$$Growth_{3it} = \alpha + \beta_1 LnBroadband_{it} + \beta_2 ROR_{it} + \beta_3 LnFDI + \beta_4 LnLabor + \beta_5 LnGov + u_{it} \quad (3)$$

$$Growth_{4it} = \alpha + \beta_1 LnBroadband_{it} + \beta_2 LnTourist_{it} + \beta_3 LnFDI + \beta_4 LnLabo + \beta_5 LnGov + u_{it} \quad (4)$$

Equation (1) is the basic model that formed in this paper where, α, is the intercept. β, is the slope that refers how much the output changes due to addition of one unit of input. u_{it}, is the error component. And then the variables that used in this research, such as $Growth_{i,t}$ is the natural logarithm of GRDP in Indonesia in the *i-th* province and *t*-period; $Internet_{i,t}$ is the proportion of individuals who use internet in Indonesia in the *i-th* province and *t*-period; $LnBroadband_{i,t}$ is the natural logarithm of number of fixed broadband subsribers in Indonesia in the *i-th* province and *t*-period; $ROR_{i,t}$ is the room occupacy rate in Indonesia in the *i-th* province and *t*-period; $LnTourist_{i,t}$ is the natural logarithm of number of tourist staying at hotels in Indonesia in the *i-th* province and *t*-period. Addition, the variable control such as $LnFDI_{i,t}$ is the natural logarithm of foreign investment in Indonesia in the *i-th* province and *t*-period; $LnLabor_{i,t}$ is the natural logarithm of people who works in Indonesia in the *i-th* province and *t*-period; and $LnGov_{i,t}$ is the natural logarithm of goverment expenditure in Indonesia in the *i-th* province and *t*-period. Natural logarithms are applied to the GRDP, the dependent variable, to get a regression coefficient that displays the elasticity value's degree (Bashir et al., 2012). The use of the four equations above aims to observe the consistency in how each independent variable influences the dependent variable, which is economic growth. ICT variable (Information and Communication Technology) utilizes an approach with individual proportion variables based on internet usage and the number of fixed broadband subscribers (Kurniawati, 2022). On the other hand, the tourism variable employs the approach of room occupancy rates and the number of tourists staying in hotels, as per studies conducted by Hakim et al. (2021) and Saputra (2022). Furthermore, Haini (2022) provides evidence that tourism and internet penetration directly and indirectly influence economic growth. Tourism, internet penetration, and their interaction positively and significantly impact economic growth. This underpins the utilization of these four variables in the above-mentioned equations.

There are several steps taken to perform panel data regression, including (Baltagi, 2021):

1. Selection of the Best Model. There are three estimation models in panel data regression: CEM, FEM and REM. Of the three models, the best model was selected for estimation. The tests that must be carried out include the Chow test, the Hausman test, and the Breusch-Pagan Lagrange Multiplier test.

2. Testing the residual variance-covariance structure. Testing the variance-covariance structure is carried out if the best model chosen is the FEM, which aims to see symptoms of heteroscedasticity and correlation between individuals. If there are symptoms of heteroscedasticity and correlation between individuals, the estimation method used is "seemingly unrelated regression" (SUR). If there are heteroscedastic symptoms but no correlation between individuals, then the estimation method used is weighted least squares (WLS). If there are no heteroscedastic symptoms and no correlation between individuals, the estimation method used is Ordinary Least Squares (OLS) with the FEM model.
3. Estimating the panel data regression model.
4. Classical Assumption Test (Normality, Nonmulticollinearity, Non-autocorrelation, Homoscedasticity)
5. Test the suitability of the model (Goodness of fit)
6. Interpretation and analysis.

Findings

Given, five summaries of the each variable in Indonesia's 34 provinces from 2015 to 2021, as follows:

Table 2. **Five number summary**

Variables	**Mean**	**Minimum**	**Maximum**	**Std. Deviation**
(1)	(2)	(3)	(4)	(5)
GRDP	303,378	20,380	1,856,301	429,515
ROR	47.02%	13.08%	71.12%	9.93%
Tourist staying at hotel	3,178,317	53,305	20,935,626	4,505,957
Internet	38.11%	8.98%	85.55%	16.24%
Fixed Broadband	231,044	24	2,685,022	452,123
FDI	872	2	5,881	1,202
Labor	3,650,402	267,023	22,313,481	5,168,320
Gov. Expenditure	10,362,590	1,473,750	78,671,228	13,057,214

Source: BPS (processed)

Based on Table 2, the mean of the GRDP value is 303378 billion rupiahs, with the lowest (minimum) GRDP value is 20,380 billion rupiahs and the highest (maximum) GRDP value is 1,856,301 billion rupiahs. Then the standard deviation for GRDP value is 429,515 billion rupiahs. For the tourism data. First, the mean of the ROR is 47.02%, with the lowest (minimum) ROR is 13.08% and the highest (maximum) ROR is 71.12%. Then the standard deviation of ROR is 9.93%. Second, the mean of the number of tourist staying at hotels is 3,178,317 people, with the lowest (minimum) number of tourist staying at hotels is 53,305 people and the highest (maximum) number of tourist staying at hotels is 20,935,626 people. Then the standard deviation of tourist staying at hotels is 4,505,957 people.

For the ICT data. First, the mean of the proportion of individuals who use internet is 38.11%, with the lowest (minimum) proportion of individuals who use internet is 8.98% and the highest (maximum) proportion of individuals who use internet is 85.55%. Then the standard deviation of proportion of individuals who use internet is 16.24%. Second, the mean of the fixed broadband subscribers is 231,044 households, with the lowest (minimum) fixed broadband subscribers is 24 households and the highest (maximum) fixed broadband

subscribers is 2,685,022 households. Then the standard deviation of fixed broadband subsribers is 452,123 households. And last for the other variable that theoritical have an impact to economic growth. First variable, the mean of FDI is 872 million US$, with the lowest (minimum) FDI is 2 million US$ and the highest (maximum) FDI is 5,881 million US$. Then the standard deviation of FDI is 1,202 million US$. Second variable, the mean of labor is 3,650,402 people, with the lowest (minimum) labor is 267,023 people and the highest (maximum) labor is 5,168,320 people. Then the standard deviation of labor is 5,168,320 people. Last, the mean of goverment expenditure is 10,362,590 million rupiahs, with the lowest (minimum) goverment expenditure is 1,473,750 million rupiahs and the highest (maximum) goverment expenditure is 78,671,228 million rupiahs. Then the standard deviation of goverment expenditure is 13,057,214 million rupiahs.

The Gross Regional Domestic Product (GRDP) is defined by the BPS-Statistics Indonesia as the total value of final goods and services or the total added value produced by various production units in a certain area in a certain period. An area that has a high GRDP indicates that the region has a high income as well. Based on data from BPS-Statistics Indonesia, the province that has the highest average GRDP value from 2015–2021 is Jakarta, which is 1,692,856.223 billion rupiah, followed by East Java with 1,530,457.332 billion rupiah, and Central Java with 1,385,460.666 billion rupiah. The GRDP on the island of Java is relatively higher than the GRDP outside Java. This can be caused by the fact that the center of government is currently in the province of Jakarta, and many economic centers are still focused on the Java Island. Thus, economic development in Java tends to be faster than in provinces outside Java. Meanwhile, the province that has the lowest average GRDP from 2015–2021 is North Maluku Province, which is 25,345.04 billion rupiahs. Then the second and third lowest ranks are the provinces of Gorontalo and Maluku, with a GRDP of 26,192.94 billion rupiah and 28,847.155 billion rupiah, respectively.

The sum of the gross regional domestic product in each province will produce Indonesia's gross domestic product. From the GDP and GRDP, the growth rate can be calculated by subtracting the GDP value in the t-period and the previous period and then dividing it by the GDP in the previous period. This rate of economic growth can show the development of the economy in a country from one period to another. It can be known that the rate of economic growth in Indonesia in 2015–2019 tends to increase but is stagnant at 5 percent. In 2020, the rate of economic growth decreased drastically, namely by -2.07 percent. This was due to the COVID-19 virus, which started to enter Indonesia in March 2020 and resulted in all people's movements being restricted and the economy in Indonesia also declining. However, in 2021, the Indonesian economy will be recovering, as indicated by the economic growth rate of 3.69 percent in 2021. Even though this number has not returned to what it was before the pandemic, it is hoped that it will continue to increase in the following years.

Hotel Room Occupancy Rate (ROR) is the ratio between the number of rooms occupied and the number of rooms available. TPK hotel can find out how much an accommodation is in demand by tourists, both foreign and domestic tourists. If the ROR of a hotel in an area is high, then it can be said that the area is one of the areas with high interest among tourists. This means that hotel ROR can be an indicator of how many tourists visit a region or area. An area is expected to have good hotel management. Data from BPS-statistics Indonesia shows the average of ROR-star hotels in Indonesia from 2015 to 2021. It can be known that the distribution of ROR-star hotels is not unequal from one province to another. The province with the highest average ROR-star hotels was North Sulawesi at 57.78 percent,

Jakarta at 57.25 percent, and Bengkulu at 53.38 percent. Meanwhile, the province with the lowest average ROR-star hotels was the Bangka Belitung Islands, which was 34.44 percent, followed by Maluku, which was 38.02 percent, and Southeast Sulawesi, which was 39.53 percent.

The thematic map is created in Figure 5, where the color grouping is based on natural breaks. Classification using natural breaks is used to minimize the average deviation from the class average while at the same time maximizing the deviation from the average of other groups. In addition, this method minimizes the variance within classes and maximizes the variance between classes. The increasing intensity of the purple color indicates higher Gross Regional Domestic Product (GRDP) values in each province, while the deepening blue color signifies higher values for each independent variable. When both variables are high, it results in a blend of purple and blue colors.

Figure 5a shows the trend of the relationship between ROR and GRDP value. It can be seen that the map is dominated by provinces with a moderate average ROR and a low average GRDP value, there are six provinces. Then there is one province with a high average ROR and a high average GRDP value, which is Jakarta province. And there are two provinces with a moderate average ROR and a high average GRDP value, there are West Java and East Java.

Figure 5b illustrates the trend of the relationship between the number of tourists and the number of hotel guests using the GRDP approach. It can be seen that the map is dominated by provinces with very low average hotel guests and a low average GRDP value, such as eight provinces. However, there is also a positive relationship between the two variables, there are the province with the highest average hotel guests and the highest average GRDP value, namely West Java. The provinces of Jakarta and East Java have a high average number of hotel guests and a moderate average GRDP value.

Figure 5a. **Thematic map of relationship between average of ROR and GRDP value in 2015-2021**

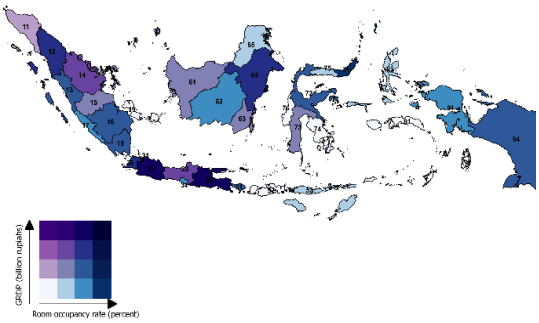
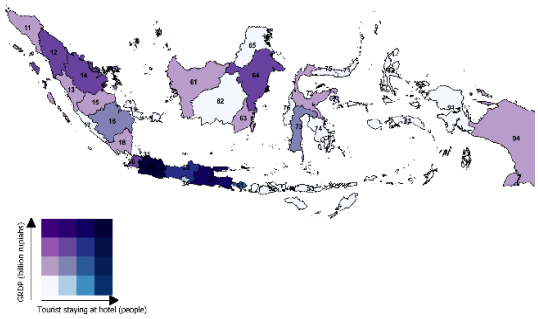


Figure 5b. **Thematic map of relationship between average of tourist stay at hotel and GRDP value in 2015-2021**



Source: BPS-Statistics Indonesia

The use of the Internet in Indonesia has started to grow. Almost all people are familiar with the internet. The proportion of individuals who use the internet is the number of people over the age of 5 who use the internet. The use of the internet is very helpful in various ways; therefore, the use of the internet should always increase every year. It can be seen in Figure 6a that there is a relationship between the proportion of individuals who use the Internet and the GRDP value in each province. From this map, it can be seen that the island of Java tends to have a deep blue colour, which means it has an average or high proportion of

internet users and an average or high GRDP value as well. However, there are six provinces with a low average proportion of internet users and a low average GRDP value.

Apart from internet usage, the number of fixed broadband subscribers is one of the components of IDI. A real example of telecommunications infrastructure growth is the availability of fixed broadband subscriptions. Its existence increases accessibility to effective telecommunications networks, especially the internet (Aini, 2020). Figure 6b illustrates, in the form of a thematic map, the trend between fixed broadband subscriber relationships and GRDP. The thematic map is dominated by provinces with a very low average fixed broadband subscriber and a low average GRDP value, namely 10 provinces. However, there is one province with a high average fixed broadband subscriber and a high average GRDP value, namely the Jakarta province, and there are two provinces with a moderate average fixed broadband subscriber and a moderate average GRDP value, consist of the provinces of West Java and East Java.

Figure 6a. **Thematic map of the relationship between the average internet and GRDP value in 2015-2021**

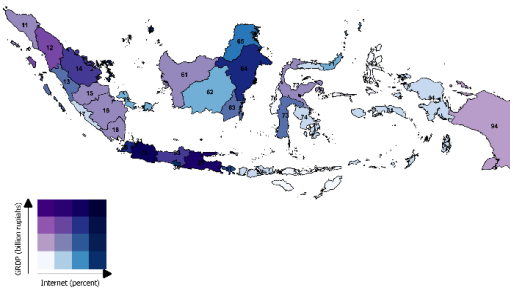
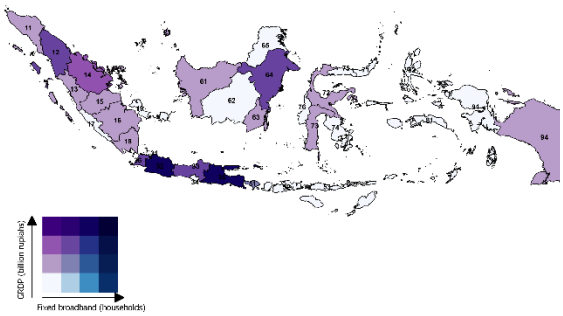


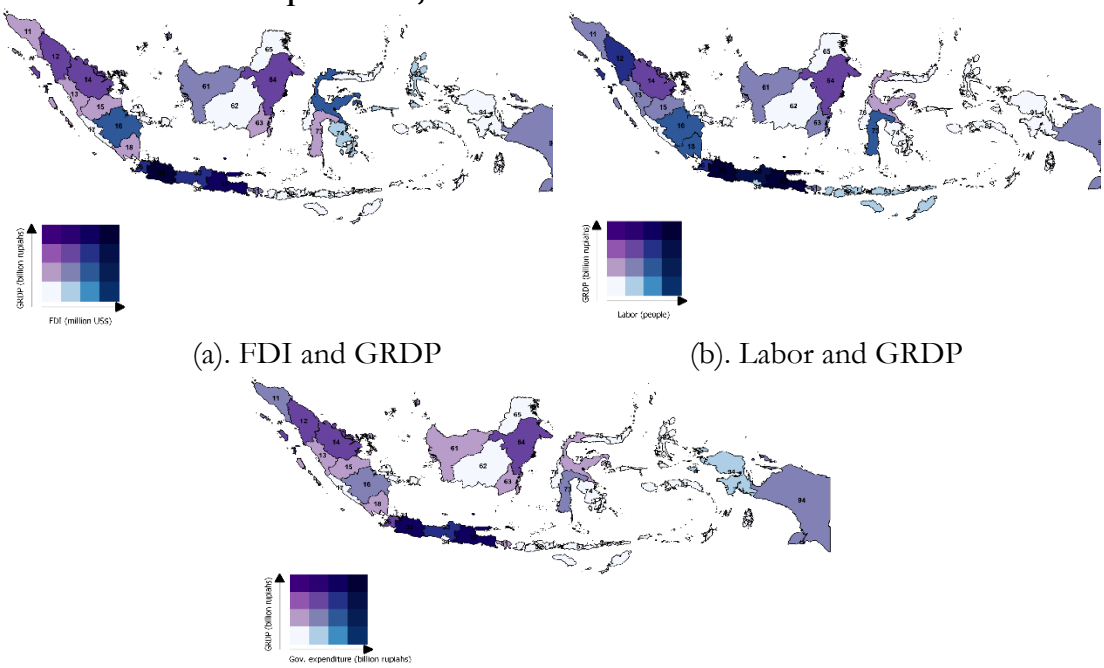
Figure 6b. **Thematic map of the relationship between the average of fixed broadband and GRDP value in 2015-2021.**



Source: BPS-Statistics Indonesia

Figure 7a shows the trend of the relationship between FDI and GRDP in each province. It can be seen on the map, there are 12 provinces with a very low average FDI and a very low average GRDP value. Meanwhile, Java island, the exception for Yogyakarta, has a moderate or high average FDI and a moderate or high GRDP value. Figure 7b shows the trend of the relationship between the average workforce and the average GRDP in each province. It can be seen that the map is dominated by provinces with a very low average labor force and very low GRDP values, namely 11 provinces spread outside Java Island. Meanwhile, the island of Java still dominates the blue color, which is quite dense, which means that several provinces on the island of Java have an average or high average workforce and a medium or high GRDP value as well.

Figure 7. **Thematic map of the relationship between investment, iabor, government expenditure, and GRDP value in 2015-2021**



(a). FDI and GRDP (b). Labor and GRDP

(c). Government expenditure and GRDP

Source: BPS-Statistics Indonesia, 2021

Figure 7c shows the trend of the relationship between the average government expenditure and the average GRDP value in each province. It can be seen that the map there are 13 provinces with the very low average government spending and very low GRDP values that spread outside Java Island, and only Yogyakarta is on the island of Java. Meanwhile, on the island of Java, exclude for Yogyakarta, has a moderate or high average government expenditure and a moderate or high GRDP value.

This study used panel data regression analysis to see whether there is an influence of information and communication technology and the tourism sector on economic growth in Indonesia. In panel data regression, there are three model approaches to be estimated: the common effect model, the fixed effect model, and the random effect model. After estimating the three models, the best model is then selected using statistical tests including the Chow test, Hausman test, and Lagrange multiplier test. This study uses two variables in information and communication technology as well as two variables in the tourism sector. The total estimation that will be carried out is as many as 4 models, namely, each ICT and tourism variable will be estimated together with the control variable.

Before conducting the estimation, a panel unit root test was performed to examine whether each variable used is stationary. The panel unit root test has a null hypothesis stating that each individual has a unit root or is non-stationary, while the alternative hypothesis suggests that each individual unit does not have a unit root or is stationary. All variable are tested in level and first difference. The result is shown at Table 3.

Table 3. **Unit Root Test**

Variable	LLC (0)	LLC (1)	IPS (0)	IPS (1)
(1)	(2)	(3)	(4)	(5)
GRDP	0.0000**	0.0000**	0.3379	0.1583
Internet	1.0000	0.0000**	1.0000	0.0062**
Broadband	0.0000**	0.0000**	0.0000**	0.5281
ROR	0.0011**	0.0000**	0.8880	0.0002**
Tourist	0.0000**	0.0000**	0.0143*	0.0000**
FDI	0.0000**	0.0000**	0.0117*	0.0000**
Labor	0.0000**	0.0000**	0.3464	0.0000**
Gov. Expenditure	0.0000**	0.0000**	0.0049**	0.0069**

Source: processed

Notes: *, ** denote statistical significance at the 5%, and 1% levels, respectively.

The first step is to do the Chow test, namely, to choose a better model to use between CEM and FEM. The null hypothesis of the Chow test is that CEM is better than FEM. From the calculation results, all p-values are lower than 0.05, so it can be concluded that with a significance level of 5 percent, FEM is better than CEM in all models. Then the Hausman test was carried out to see which one was better used between REM and FEM. The null hypothesis of the Hausman test is that REM is better than FEM. From the calculation results, all p-values are smaller than 0.05, so it can be concluded that with a significance level of 5 percent, FEM is better than REM in all models. So it can be concluded that the best model chosen is the Fixed Effect Model (FEM).

In selecting the best model, the best model for estimating is FEM, which means that this model is the most suitable compared to the other two models for completing the panel data regression model. Because the best model chosen was FEM, the next step was to examine the residual variance-covariance structure, namely to see whether there were symptoms of heteroscedasticity in the model using the Lagrange multiplier and to test whether there was cross-sectional correlation in the residuals using the LM test. The first test is to check whether there is heteroscedasticity in the residuals. The null hypothesis in this test is that there are no symptoms of heteroscedasticity or that the residual variance-covariance is homoscedastic. Based on the statistical value of the LM test, it was found that all models had a value greater than the chi-square table, which was 47.3999. This means that the null hypothesis is rejected, and it can be concluded that the residual variance-covariance in all models is heteroscedastic. Furthermore, because the residual variance-covariance in all models is heteroscedastic, the next step is to test whether there is a symptom of cross-sectional correlation in the model. The test used is the LM test. Based on the statistical value of the LM test, it was found that all models had a value greater than the chi-square table, which was 671.2098. This means that the null hypothesis is rejected, and it can be concluded that there is a cross-sectional correlation in the model. From the two tests that have been carried out, it can be concluded that the appropriate estimation method used is the Seemingly Unrelated Correlation (SUR).

After determining the appropriate model for estimation, it is necessary to test the classical assumptions. In this study, the model chosen was the Fixed Effect Model (FEM) with the Feasible Generalized Least Square-Seemingly Unrelated Regression (FGLS-SUR) estimation method, where the symptoms of autocorrelation and heteroscedasticity have been accommodated so that the assumption test that needs to be carried out is only the

assumption of normality and non-multicollinearity. The normality test was carried out using the Jarque-Bera test statistic to see whether the residuals in the model were normally distributed. The null hypothesis in the normality test is that the residuals are normally distributed. From the results of testing the statistical value of the Jarque-Bera test, it was found that all models had a p-value of more than the 5 percent test level. This means that the decision failed to reject the null hypothesis so that it can be concluded that the residuals in each model are normally distributed and that the assumption of normality can be fulfilled. Furthermore, the fulfillment of the multicollinearity assumption uses the variance inflation factor (VIF) to identify a strong relationship between the independent variables. From the test results, it was found that there were no variables that had a VIF value of more than 10. So it can be concluded that the non-multicollinearity test has been fulfilled. Based on the cross-sectional dependence test using 4 methods, with a significance level of 5%, there is sufficient evidence to suggest that there is correlation among individuals in each equation.

In equations 1 to 4, the probability value of the F test statistic is 0.0000, which is less than 0.05, so the decision is to reject the null hypothesis. So, it can be concluded that the ICT and tourism variables together have a significant effect on economic growth in Indonesia. Technology contributes to accelerating economic growth, in line with Solow's theory. This is consistent with the outcomes displayed in Table 4, where the ICT elements, specifically the internet and fixed broadband, have notable and favorable outcomes. Based on the t-test statistics, it was found that the proportion of individuals who use the Internet has a positive and significant effect on economic growth in Indonesia. This is in line with Kumar et al. (2019), which found that internet penetration has a significant and positive effect on economic growth in high-income Asian countries. Then, the number of fixed broadband subscribers also has a positive and significant effect on economic growth in Indonesia.

Table 4. **Fixed Effect Model SUR Coefficient**

Variable	Model 1	Model 2	Model 3	Model 4
(1)	(2)	(3)	(4)	(5)
C	6.8821*	6.4676*	3.6070*	3.5425*
	(0.7734)	(0.9624)	(0.7393)	(0.6010)
Internet	0.0038*	0.0031*	-	-
	(0.0003)	(0.0004)		
Broadband	-	-	0.0306*	0.0326*
			(0.0025)	(0.0026)
ROR	0.0016*	-	0.0003	-
	(0.0004)		(0.0004)	
Tourist	-	0.0116*	-	0.0069*
		(0.0046)		(0.0028)
FDI	0.0072*	0.0070*	0.0043	0.0042*
	(0.0024)	(0.0022)	(0.0028)	(0.0026)
Labor	0.2309*	0.2448*	0.4341*	0.4341*
	(0.0541)	(0.0660)	(0.0506)	(0.0401)
Gov. Expenditure	0.1629*	0.1802*	0.1876*	0.1829*
	(0.0198)	(0.0236)	(0.0172)	(0.0153)
F-Statistics	22245.90	20777.45	17445.09	19181.56
Prob. (F-Statistics)	0.0000	0.0000	0.0000	0.0000
Adjusted R-Squared	0.9997	0.9997	0.9997	0.9997

Classical Assumption				
Normality Test	0.1041	0.0479	0.1799	0.3707
Variance Inflation Factor (VIF)	Internet	Broadband	ROR	Tourist
	2.7145	1.5395	1.6394	1.4584
	FDI	Labor	Gov. Expenditure	
	1.4185	1.3657	1.6394	
Cross-sectional dependence	Breusch Pagan-LM	Pesaran scaled LM	Bias-corected scaled LM	Pesaran CD
	0.0000	0.0000	0.0000	0.0000

Source: processed

Notes: N=238 observations. Definition of variables are in Table 6. Variable GRDP, Broadband, Tourist, FDI, Labor, and Goverment Expenditure are log-transformed. *, ** denote statistical significance at the 5%, and 1% levels, respectively. Standard errors are in parenthesis.

$$Growth_{1it} = (6.8821 + \hat{\mu}_{it}) + 0.0038Internet_{it} + 0.0016ROR_{it} + 0.0072LnFDI + 0.2309LnLabor + 0.1629LnGov \quad (1)$$

$$Growth_{2it} = (6.4676 + \hat{\mu}_{it}) + 0.0031Internet_{it} + 0.0016LnTourist_{it} + 0.0070LnFDI + 0.2448LnLabor + 0.1802LnGov \quad (2)$$

$$Growth_{3it} = (3.0670 + \hat{\mu}_{it}) + 0.0306LnBroadband_{it} + 0.0003ROR_{it} + 0.0043LnFDI + 0.4341LnLabor + 0.1876LnGov \quad (3)$$

$$Growth_{4it} = (3.5425 + \hat{\mu}_{it}) + 0.0326LnBroadband_{it} + 0.0069LnTourist_{it} + 0.0042LnFDI + 0.4341LnLabor + 0.1829LnGov \quad (4)$$

As for the tourism industry, it has already been said that it is believed to be able to increase economic growth through its tourist-related enterprises. In this study, ROR and the number of tourists staying in hotels are used as proxies for tourism, one of the numerous sectors within the tourism sector. This is consistent with Table 4's findings, which suggest that the tourism sector's proxy variable may increase economic growth in Indonesia. The ROR variable for star hotels has a positive and significant effect on economic growth in Indonesia, which is in line with research by Saputra (2022) and Saputra & Sukmawati (2021), which states that the ROR has a positive and significant effect on economic growth. The high ROR in star-rated hotels indicates a strong demand in the tourism sector, which will contribute to tourism revenue. Tourists staying in star-rated hotels also tend to spend more money on accommodation, food, transportation, and various tourism activities, which will have a positive impact on the local economy.

The variable number of tourists as a proxy for the number of hotel guests has a positive and significant effect on economic growth in Indonesia. These results are in line with research conducted by Hakim et al. (2021), which states that the number of tourists visiting accommodations has a positive and significant effect on economic growth in the province of West Java. It similar to ROR, a high number of tourists indicate a high income received by the local area. The longer tourists stay in the area, the more they will spend their money there. This will increase the local revenue received from the local taxes.

The following additional variables that, in theory, might increase economic growth are then used in this research, including: foreign direct investment (FDI), labour, and government spending. This is consistent with the findings in table 2, which show that FDI, labour, and

government expenditures all have a positive and significant impact on Indonesia's economic growth. These results are in line with the research by (Haryanto, 2013; Sari et al., 2016; Setijawan et al., 2021), which states that investment, labour, and government spending have a positive and significant effect on economic growth.

The results of the goodness of fit using adjusted R-squared show that all four models have an adjusted R-squared of 0.9997. This indicates that each variable contributes to economic growth, explaining 99.97% of the variation in the dependent variable by the independent variables. This result shows that, across the four models, each variable related to ICT and tourism—such as internet usage, fixed broadband subscribers, tourists, labour, and government expenditure—consistently influences economic growth, as all are significant contributors to economic growth.

Individual Effects

The intercept of each province varies because each province has different individual effects. Thus, it can indicate the economic growth conditions of each province, assuming its independent variables are constant. The individual effects indicate variations in economic growth conditions among each individual, where in this study, it pertains to the 34 provinces in Indonesia. From the results of FEM, the individual effects for each observation are obtained, as shown in the table below.

Table 5. **Individual Effects of Fixed Effect Model**

No.	Province	Individual Effects	No.	Province	Individual Effects
(1)	(2)	(3)	(4)	(5)	(6)
1.	Aceh	-0,2550	18.	West Nusa Tenggara	-0,4561
2.	North Sumatera	0,9149	19.	East Nusa Tenggara	-0,7852
3.	West Sumatera	0,0459	20.	West Kalimantan	-0,1530
4.	Riau	1,0407	21.	Central Kalimantan	-0,3614
5.	Jambi	0,0420	22.	South Kalimantan	-0,1939
6.	South Sumatera	0,5252	23.	East Kalimantan	1,0381
7.	Bengkulu	-0,9966	24.	North Kalimantan	-0,5465
8.	Lampung	0,2987	25.	North Sulawesi	-0,4506
9.	Bangka Belitung Islands	-0,7418	26.	Central Sulawesi	-0,1198
10.	Riau Islands	0,2663	27.	South Sulawesi	0,5478
11.	Jakarta	1,8585	28.	Southeast Sulawesi	-0,3661
12.	West Java	1,5429	29.	Gorontalo	-1,3245
13.	Central Java	1,2557	30.	West Sulawesi	-1,1395
14.	Yogyakarta	-0,4784	31.	Maluku	-1,3251
15.	East Java	1,6858	32.	North Maluku	-1,2903
16.	Banten	0,7562	33.	West Papua	-0,6868
17.	Bali	-0,1066	34.	Papua	-0,0415

Source: processed

From Table 5, it can be seen that the provinces of Jakarta, East Java, West Java, Central Java, and Riau are the top five provinces with the highest individual effects. This indicates that Jakarta has the highest economic growth, assuming all independent variables remain constant. On the other hand, the provinces of Maluku, Gorontalo, North Maluku, West

Sulawesi, and Bengkulu are the five provinces with the lowest individual effects. This suggests that Maluku has the lowest economic growth, assuming all independent variables remain constant. This aligns with the earlier descriptive analysis, indicating that Jakarta indeed has the highest GRDP compared to other provinces and Maluku is one of the lowest GRDP compared to other provinces. This result is consistent with the research by Angelina & Wahyuni (2021), which states that DKI Jakarta is the province with the highest individual effect, while Maluku is the province with the lowest individual effect. And also research by Kartiasih (2019), which states that DKI Jakarta is the province with the highest individual effect. This phenomenon can be attributed to the fact that a significant portion of the economy is concentrated in Jakarta. As a result, Jakarta experiences higher economic growth compared to other provinces. The centralization of economic activities, including business operations, government institutions, and various services, contributes to Jakarta's robust economic performance.

Conclusion

The objective of this study is to examine the impact of ICTs and the tourism sector on economic growth in Indonesia. According to the resulting descriptive analysis, economic growth in Indonesia was only around 5 percent in 2015–2019 and will decline in 2020 and 2021. The province with the highest average GRDP is Jakarta province, and the lowest is North Maluku province. Based on the bivariate choropleth map and scatter plot, it is found that there is an indication of a relationship between the variables of internet users, broadband subscribers, ROR hotel star, and tourists and economic growth.

The limitation of this study is that the data used is from 2015-2021, as data was only available up to 2021 during the research. Using panel data regression analysis, this study investigates the impact of tourism and ICT on economic growth. with the aid of information gathered over a 7-year period from 34 provinces. In accordance with the findings of panel data regression using the Fixed Effect Model (FEM) model and the Feasible Generalized Least Square-Seemingly Unrelated Regression (FGLS-SUR) estimation method, it was discovered that variables related to internet users, the number of fixed broadband subscribers, and tourists had a positive and significant effect on economic growth in Indonesia.

The government must enhance the development of information technology infrastructure in each province to ensure equitable access for the Indonesian population. With widespread internet access in every region, people can easily shop and conduct transactions using their smartphones, like online shop or using e-wallet for the easier transactions. Additionally, it should bolster its efforts in promoting tourism to entice tourists to explore destinations in every province across Indonesia. Similarly, the hospitality industry is expected to elevate its facilities to enhance the comfort of travellers during their hotel stays.

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