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Harnessing The Internet for Inclusive Development: Evidence from Spatial Panel Data Analysis in Indonesia

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ABSTRACT

Technology utilization is often considered one of the main drivers promoting inclusive development. As a form of technology utilization, whether using the internet can promote inclusive development has been a concern for researchers and policymakers. Considering geographical connectivity characteristics, we examine the effects of internet penetration on inclusive development by applying spatial econometric models and using data from 34 provinces in Indonesia from 2015 to 2020. This study reveals that encouraging the internet penetration can significantly improves the inclusive development in a province. However, the increase of internet penetration leads to the decrease of inclusive development in neighboring provinces. The digital divide among provinces in Indonesia can be attributed to this phenomenon. This study also indicates a strong positive spatial correlation of inclusive development. Our findings point to the need for policies to promote people's use of the internet to achieve more benefits from development, balance the digital development to reduce the harmful effects of the digital divide, and consider the spatial aspects when making policies to promote inclusive development.

Keywords: Inclusive Development; Internet Penetration; Spatial Analysis

INTRODUCTION

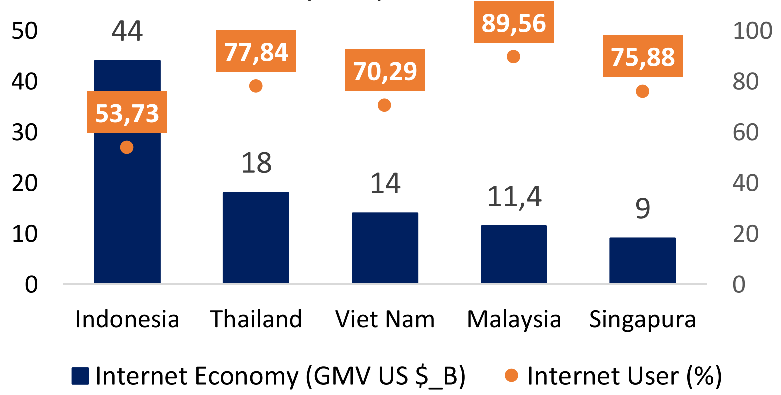
Poverty and income inequality can contribute to poor quality of health and education, and even encourage crime (Ferguson et al., 2007; Imran et al., 2018; Phipps, 2003; Wilkinson & Pickett, 2009). Therefore, the current issue faced by various countries is not how fast or high growth is, but whether economic growth is accompanied by a decrease in poverty and income inequality. This condition is also known as inclusive growth, which all people have opportunity to participate and enjoy the growth (OECD, 2018).

Nationally, Indonesia has experienced an improvement in inclusive growth, indicated by the growth that has been able to reduce poverty and income inequality (Hill, 2021). However, regionally, not all provinces have reached this condition (Listyo et al., 2021). These differences may lead to inequality, jealousy, or competition between regions. By seeking equal distribution of inclusive growth in all provinces, it will strengthen Indonesia's inclusive growth as a whole.

One of the strategies to promote inclusive growth is through Information and Communication Technology (ICT). ICT can increase productivity thereby encouraging economic growth which is a part of inclusive growth (Cardona et al., 2013; Rath & Hermawan, 2019). In addition, ICT has also been proven to provide greater opportunities for small entrepreneurs to participate in the economy (Iulia, 2014). ICT also increases a person's ability to access various facilities such as education and health (Smith et al., 2011).

The availability of digital infrastructure alone becomes less than optimal without being accompanied by people's participation to use and get benefit from it. Despite of adequate infrastructure, if the community does not use it, it will prevent them from accessing development outcomes. In Indonesia, ICT infrastructure development continues to ensure connectivity between regions. The Palapa Ring project is one of the infrastructures to support digital connectivity. However, the utilization of the Palapa Ring is still below 50 percent since its launch in 2019. In addition, according to Google, Temasek, Bain & Company (2021), the estimated economic value of Indonesia's internet at US$ 44 trillion in 2020, which is the highest among ASEAN countries. However, the internet user of Indonesia is 53.73 percent. Assuming all internet users use the internet for the economy, then only 53.73 percent of the Indonesian population enjoys the economic benefits of the internet.

Figure 1. *Gross Merchandise Value* (GMV) and Internet User in ASEAN,2020



Source: Google,Temasek,Bain&Company (2021); BPS(2021)

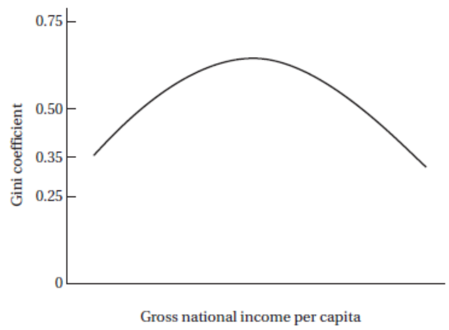
Previous studies have revealed that harnessing technology is one of the drivers of inclusive growth. In their study, Alekhina & Ganelli (2020) found that ASEAN countries' inclusive growth is driven by digitalization. Andrés et al.(2017) also confirmed that ICT adoption (mobile phone and internet penetration) strongly affects inclusive human development. Moreover, Ali et al. (2020) proved that by being digitally included may increase the quality of life. Those studies were carried out to observe the impact of ICT on inclusive growth based on assumption there is no spatial correlation among areas. However, according to Tobler's First Law of Geography, all things are related, but things that are near are more related than those that are far away. In addition, from an econometric perspective, ignoring the spatial effect on spatially correlated variables can result in biased estimates (Anselin, 1988). Moreover, existing literature still focused on inclusive growth, while there is also inclusive development as an extension of inclusive growth. Inclusive growth focuses on income aspects (poverty, income inequality) while inclusive development includes non-income aspects, namely the distribution of welfare (McKinley, 2010; Rauniyar & Kanbur, 2010). Therefore, to fill these gaps, our paper aims to study the impact of the ICT, specifically internet penetration to inclusive development by considering the spatial effect.

LITERATURE REVIEW

Some studies of inclusive growth have been conducted in Indonesia. Amalina et al. (2013) discovered that more inclusive growth occurred in the western part of Indonesia. They used data from 33 provinces in 2008-2012. Another study by Pukuh & Widyasthika (2017) continued the previous research period. They divided the research period into two, namely 2012-2014 and 2014-2016. The results showed that in 2012-2014 income growth in Indonesia was inclusive, while growth that was not yet inclusive occurred in 2014-2016. Recent evidence by Listyo et al. (2021) supported previous research, by using data from 34 provinces for the 2016-2018 period. Their study revealed that only a few provinces have achieved inclusive growth.

According to Kuznets, the relation between growth and inequality is due to structural transformation (Todaro & Smith, 2012). This relation was describe using Kuznets Inverted U Curve. In the early stages of growth (from traditional to modern sectors), inequality will increase to a certain point, then begin to decline as more segments of the population find employment opportunities in the high-income sector.

Figure 2. Kuznets Inverted U Curve



Source: Todaro & Smith (2012)

Furthermore, Barro (1999) stated that in early stages, the society is not ready with high ICT expansion. Hence, many people find difficulties when running their job. It then affects their income and widen the inequality. For the next stage, the society is better prepared with the presence of ICT, then more people enter the economy (advanced sector), resulting the decrease of inequality and achievement the inclusive growth.

Various studies presented mixed results on the role of (ICT) in the economy. Cardona et al. (2013) suggested that ICT has a positive and significant effect on productivity, and increases over time. Moreover, David & Grobler (2020) showed that digital inclusion in the form of ICT penetration has a positive impact on economic growth in Africa. Digital inclusion is measured through an index consisting of indicators of cellular phone users, internet users, and fixed phone users. Another study in Africa by Haftu (2019) proved that there is a significant contribution from the growth of mobile phone penetration to the GDP per capita of the region. In contrast to internet use, which has not significantly contributed to GDP per capita during the study period. In terms of inequality, internet penetration is able to significantly reduce income inequality in Southeast Asia (Ningsih & Choi, 2018).

In Brazil, the greatest impact of broadband penetration on productivity occurs in less developed regions (Jung & López-Bazo, 2017). Slightly different results were presented by Aslam et al. (2021). They conducted research at the country level and showed that digital inclusion only had a significant impact on the inclusive growth of high-income countries. These studies indicate that different results can be obtained because of the dependent variable used. One study used productivity and another looked at more than productivity, namely inclusive growth. In addition, the scope of research, namely the regional level within one country and the level between countries, allows different results to be obtained.

In the context of Southeast Asia, Alekhina & Ganelli (2020) found that ASEAN countries' inclusive growth is driven by digitization which is approximated by cellular phone subscribers per 100 population, while inclusive growth is approximated by real per capita income adjusted for changes in equity index using income distribution data. On the contrary, in terms of digitization, R. Anand et al. (2013) found a different thing that at the country level, the effects of technological change on inclusive growth have not been sufficiently visible. Inclusive growth uses a social mobility function approach based on income distribution, while technological change is approached with the total investment stock of ICT software and hardware as a share of the total capital stock.

In the spatial framework, impact on other regions can occur through the backwash effect and spread effect (Myrdal, 1957). The backwash effect suggests negative impacts on other regions, while the spread effect suggests positive impacts. Lin et al. (2017) discovered that internet penetration is positively related to economic growth, but internet spillover actually causes regional economic divergence. Also in China, Wang et al. (2021) confirmed that ICT has a positive impact on social and economic development. However, in contrast to Lin et al. (2017), the spillover effect of ICT in the surrounding provinces shows a negative result. He argues that the existence of a digital divide has made areas with high technology draw resources from the surrounding areas, resulting in a decline in socio-economic conditions.

RESEARCH METHOD

This study uses panel data from 34 provinces during the 2015-2020 period. The dependent variable is inclusive development as measured by the Inclusive Economic Development Index (IEDI). The main independent variable is internet penetration as measured by individuals using the internet per 100 inhabitants. In addition, this study also includes additional independent variables, namely trade openness, investment, population density, and government spending (Alekhina & Ganelli, 2020; Anand et al., 2013; Aslam et al., 2021; Jalles & de Mello, 2019; Wang et al., 2021). All variables are in the form of natural logarithms. Variable details can be seen in Table 1.

Table 1. Variables and Measurements

Variable	Symbol	Description*)	Data Source**)
Inclusive Economic Development Index	IEDI	The composite index of inclusive development indicators. The scale of index is 1-10.	Ministry of National Development Planning of the Republic of Indonesia
Internet	Inter	Individuals using the internet per 100 inhabitants.	BPS
Trade openness	Open	The ratio of exports plus imports to GDP in percentage.	BPS
Investment	Inv	The ratio of Gross Fixed Capital Formation (GFCF) to GDP in percentage.	BPS
Population density	Den	Number of population/km^2.	BPS
Government expenditure	Gov	Province government expenditure in Rupiahs.	BPS

Notes:
*) The data of GDP, exports, imports, and GFCF are based on 2010 constant prices.
**) BPS stands for *Badan Pusat Statistik* or Central Bureau of Statistics.

All data used in this study were sourced from the aforementioned sources.

Spatial analysis begins with the identification of spatial dependence. In this study, we conduct Lagrange Multiplier (LM) test (Anselin, 2003) and the robust LM test (Elhorst, 2014) to identify the presence of spatial autocorrelation in the form of spatial lag or spatial error in the model. In addition, the spatial dependence of variables was tested by using Global Moran's I test on cross section data. If all results indicate that there is no spatial dependence, the study is continued with traditional panel data analysis. On the other hand, if there is a significant spatial dependence, then the study should be proceeded with spatial panel data analysis.

Generally, Spatial Durbin Model (SDM) becomes the initial basis in spatial modeling. In precise terms, the benchmark SDM applied in this study is specified as:

$$IEDI_{it} = \rho \sum_{j=1}^{n} w_{ij} IEDI_{jt} + \beta_1\, Inter_{it} + \beta_2\, Open_{it} + \beta_3\, Inv_{it} + \beta_4\, Den_{it} + \beta_5\, Gov_{it} + \theta_1 \sum_{j=1}^{n} w_{ij} Inter_{jt} + \theta_2 \sum_{j=1}^{n} w_{ij} Open_{jt} + \theta_3 \sum_{j=1}^{n} w_{ij} Inv_{jt} + \theta_4 \sum_{j=1}^{n} w_{ij} Den_{jt} + \theta_5 \sum_{j=1}^{n} w_{ij} Gov_{jt} + \mu_i + \gamma_t + v_{it}$$

In the above formula, $IEDI_{i,t}$ denotes the dependent variable of province *i* in year *t*; w_{ij} denotes the weighting matrix of province *i* and province *j*; ρ denotes the spatial lag coefficient; β denotes the coefficient of independent variables; $Inter_{it}$, $Open_{it}$, Inv_{it}, Den_{it}, and Gov_{it} denotes the independent variable of province *i* in year *t*; θ denotes the spatial lag coefficient of independent variables; $Inter_{jt}$, $Open_{jt}$, Inv_{jt}, Den_{jt}, and Gov_{jt} are independent variable of province *j* in year *t*; μ_i, γ_t, and v_{it} are errors. Subsequently, the Hausman test is performed to choose between a fixed effect or a random effect.

This model is then tested, whether it can be simplified into a Spatial Autoregressive Model (SAR) or Spatial Error Model (SEM) model using Likelihood Ratio Test (LR Test) and Wald Test. There are two null hypotheses to be tested. First, H_0: $\theta = 0$. If $\theta = 0$, SAR model is superior than SDM. Second, H_0: $\theta + \rho\beta = 0$. If $\theta + \rho\beta = 0$, then SEM is superior than SDM. If both are rejected, then the SDM is selected to interpret the data.

Considering the geographical characteristics of Indonesia and the nature of the internet, we used inverse distance method for the weighting matrix. Each province will have a weight. The weight will be greater as the location of provinces nearer.

RESULTS

To obtain the most suitable model, this study followed the steps taken by Elhorst (2014). First, non-spatial modeling was carried out, then tested with the LM test and robust LM test to determine the presence of spatial effects. In Table 2, it can be seen that the majority of the results of the LM test and robust LM test were significant, indicating spatial effect in the form of spatial lag or spatial error. The results of Global Moran's I in Table 3 also support this, that there is a spatial autocorrelation on inclusive development and internet penetration every year. Therefore, the research continued with spatial analysis.

Table 2. Results of LM test and Robust LM Test

Test	Pooled	Spatial Fixed Effects
LM spatial lag	1.3094	397.77***
Robust LM spatial lag	21.406***	14.845***
LM spatial error	40.501***	400.36***
Robust LM spatial error	60.598***	17.428***

Note: ***p<0.01; **p<0.05; *p<0.10

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Table 3. Results of Global Moran's I Test

Year	Inclusive Economic Development Index (IEDI)	Internet
2015	0.088***	0.042**
2016	0.092***	0.036**
2017	0.099***	0.058***
2018	0.084***	0.088***
2019	0.077***	0.101***
2020	0.060***	0.098***

Note: ***p<0.01; **p<0.05; *p<0.10

Spatial modeling was then carried out using Spatial Durbin Model (SDM) accompanied by the Hausman test. Hausman test results showed that the fixed effect is better than the random effect (19.15, p<0.1). Therefore, the basic model that will be used is SDM with fixed effect. Furthermore, Wald test and LR test were carried out to select the best model. The Wald test and the LR test for spatial lag test in Table 4 present significant results, therefore the SDM is selected over SAR. The Wald test and LR test for spatial error also reveal the significant results, so that the SDM is selected over SEM. According on these results, the most suitable model for analysis in this study is SDM with fixed effects.

Table 4. Results of Wald Test and LR Test

Tests	Statistic
Wald test spatial lag	24.67***
LR test spatial lag	26.21***
Wald test spatial error	17.78***
LR test spatial error	19.26***

Notes: ***p<0,01; **p<0,05; *p<0,10.

Based on the results presented in Table 5, the spatial parameter ρ is significantly positive at the 1% level. It suggests that the increase in inclusive development in neighboring areas will boost the focal area’s development. Moreover, the coefficient of internet penetration is positive at the 1% level, indicating that internet penetration has a positive impact on inclusive development. However, the spatial effects of internet penetration in neighboring regions are found to be significantly negative: a 1% increase in internet penetration in neighboring provinces will lead to a 0.2185% decrease in inclusive development in focal province.

The trade openness and government expenditure are found significantly influence the inclusive development. Meanwhile, investment and government expenditure significantly have spatial effects.

According to LeSage & Pace (2009), we should use marginal effect to interpret the results of Spatial Durbin Model Estimation. Table 6 presents the direct, indirect, and total effects of SDM with fixed effect. The direct effect of internet penetration is positive and significant. It means that a 1% increase in internet penetration level will increase the inclusive development level by 0.0907%. However, the indirect effect of internet

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penetration shows negative results at level of 10% significance. It suggests that a 1% increase in internet penetration in an area will lead to a decrease of the inclusive development in adjacent areas by 0.3758%. The total effect of internet penetration is not significant, suggesting the direct and indirect effect is canceling out and producing an invisible overall effect.

In addition, investment has all positive and significant direct, indirect, and total effects. It implies that investment is a crucial factor to boost the inclusive development. On the other side, trade openness is indeed proven as one driver of inclusive development in an area. However, it does not reveal significant spillover to adjacent areas.

On the other hand, the influence of provincial government expenditure is quite interesting. The result suggests that an increase in government expenditure will lead to a decrease in inclusive development in own area, but increase the inclusive development of adjacent areas. Meanwhile, population density does not show a significant impact on inclusive development.

Table 5. Estimation Results of Spatial Durbin Model with Fixed Effect
Dependent Variable: lnIEDI

Parameter	Coefficients	Parameter	Coefficients
(1)	(2)	(3)	(4)
lnInter	0,0988*** (0,0252)	W*lnInter	- 0,2185*** (0,0798)
lnOpen	0,0405*** (0,0092)	W*lnOpen	0,0497 (0,0606)
lnInv	0,0189 (0,0280)	W*lnInv	0,7272*** (0,1949)
lnDen	- 0,0440 (0,2077)	W*lnDen	1,4987 (1,0375)
lnGov	- 0,0609** (0,0218)	W*lnGov	0,1594*** (0,0639)
ρ	0,5842*** (0,097)		
R^2	0,6555		
N	204		

Notes: ***p<0,01; **p<0,05; *p<0,10. Value in parentheses is the standard error.

Table 6. Direct, indirect, and total effect model SDM with Fixed Effect

Parameter	Direct Effects	Indirect Effects	Total Effects
(1)	(2)	(3)	(4)
lnInter	0,0907***	- 0,3758*	- 0,2851
	(0,0266)	(0,2037)	(0,2122)
lnOpen	0,0443***	0,1766	0,2210
	(0,0110)	(0,1728)	(0,1801)
lnInv	0,0641**	1,7848***	1,8490***
	(0,0323)	(0,500)	(0,5204)
lnDen	0,0390	3,5525	3,5916
	(0,2234)	(2,800)	(2,9133)
lnGov	- 0,0545**	0,2696*	0,2151
	(0,0214)	(0,1469)	(0,1528)

Notes: ***p<0,01; **p<0,05; *p<0,10. Value in parentheses is the standard error.

DISCUSSION

This study reveals that the increase in internet penetration will promote inclusive development. It confirms the importance of harnessing the internet for people to be included in the development. By using the internet, people regardless the socioeconomic status will get information easier to participate in the developments and get benefits from them (Coase et al., 2016).). It is crucial because one factor that hinders the underprivileged from being included in development is the lack of information (Low et al., 2021). However, the rise of people using the internet in an area will hinder the inclusive development in adjacent areas. The digital divide among provinces in Indonesia may be contributed to this phenomenon (Wang et al., 2021). A province with high internet penetration may achieve high growth and seize the benefit of economic development earlier. This condition will attract the sources from neighboring provinces, hence making these provinces more left behind. Therefore, this study implies that we can't rest easy yet and just focus on adopting new technologies. Another important work that must be done is to bridge the digital divide and create a balance of development in all regions in Indonesia to avoid any negative effects that may occur.

In addition, another important factor to boost inclusive development is investment and trade openness. More investment will lead to more opportunities for growth and development, such as job opportunities, infrastructure availability, etc. While trade openness will encourage economic activities and also information exchange with other areas. Meanwhile, provincial government expenditure is found to hamper the inclusive development in a province. It implies that government expenditure has not reached the issue which makes a province not inclusive in its development. Another important result is inclusive development in adjacent areas significantly influences the inclusive development in an area. It suggests a good condition in which all provinces should support each other to chive more inclusive development.

CONCLUSION

Based on the results and discussion of this study, there are several important points to conclude. Using spatial econometric analysis, this study generated Spatial Durbin Model with fixed effect as the most suitable model to analyze the influence of internet penetration on inclusive development. According to this model, internet penetration is confirmed as a driver of inclusive development in a province. However, the increase of internet penetration hampers the inclusive development in neighboring provinces. Other important factors that potentially boost the inclusive development are investment and trade openness. Meanwhile, the government expenditure is found to hinder the inclusive development in own province but give positive spillover effect for neighboring provinces. In addition, Inclusive development of provinces in Indonesia is subjected to positive spatial correlation.

This study provides several implications for policymaker. First, promoting the internet penetration policy to ensure more people at various levels of society can enjoy the benefit of internet. Second, bridging the digital divide by providing more digital facilities (infrastructure, human resources) to less-developed provinces. Third, in order to boost inclusive development, policymakers should consider the spatial aspects such as building cooperation with neighboring provinces to boost inclusive development.

LIMITATION

Our limitation is the data are at provincial level, so it cannot describe individual feature. For future research may use micro data to get more comprehensive understanding about internet usage and inclusive development.

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DECLARATION OF CONFLICTING INTERESTS

Authors have no potential conflict of interest.

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