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Digital Competitiveness and Poverty Index: Mapping the Digital Public Administration Challenge (Evidence from Indonesia)

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Abstract. The role of the internet in reducing poverty has been tested in several countries. However, according to the bibliometric analysis, not much has been studied from the perspective of inclusive digital public administration. The novelty of this study is to complement digital governance research by analyzing the relationship between digital competitiveness and poverty rate in Indonesia. This study aims to map the challenges of developing digital governance in Indonesia in the context of promoting sustainable development and a more inclusive society. The data used are secondary data, i.e. the poverty rate from Statistics Indonesia in 2021 and the Digital Competitiveness Index. The study employed a quantitative method. The descriptive analysis was conducted using two methods: (1) a quadrant analysis to map the position of each province in relation to the two research variables; (2) a linear regression analysis, formulated as Y = a + bX, to calculate the effect of the digital competitiveness index on the poverty index. Both analyses employed the IBM SPSS Statistics v. 20 program. The results of the study show: (i) a digital divide or digital poverty that contributes to the digital competitiveness gap; (ii) the behavior of digital users in terms of productivity that remains low but shows an increase from the previous year; and (iii) a significant effect of increasing the digital competitiveness index on reducing the poverty index. In conclusion, digital development should be designed to pursue inclusive and pro-poor development, supported by productive human resources. Further research is recommended to examine the correlation between the components of the digital development index and those of the poverty index to build an inclusive model of digital public administration.

Keywords: inclusiveness, sustainability, digital governance, poverty index, public values

INTRODUCTION

This study was inspired by the policy agenda of the Indonesian government to accelerate digital progress, which was launched under the name "Making Indonesia 4.0". The government of Indonesia established the Industry 4.0 Digital Center (PIDI 4.0) to develop national digital infrastructure and foster an innovation ecosystem and digital industry. Observed from the perspective of public administration, this policy agenda signifies the phenomenon of digital governance transformation. The governance perspective regards public policy activities as a result of the dynamics of communication, negotiation, and collaboration between business/industry actors and community actors (civil society). It means that the government efforts will not succeed optimally supposing they lack support from business actors and community groups. The purpose of governance itself is to produce a prosperous and harmonious social life system. In other words, the ultimate goal of governance is to realize inclusive development. Observed from the governance perspective, this study wants to analyze whether digital penetration in Indonesia reflects an inclusive development agenda, specifically from a relational aspect to the poverty rate.

On the other hand, this study was also motivated by the theoretical gap based on the recommendations of research results conducted by previous researchers. The research gap in question is the paradox of the impact of internet-based information technology penetration on equalizing the level of public welfare. The paradox is, broadly speaking, that there are two schools related to the relationship between internet penetration and poverty. The first stream is a group of researchers claiming that the presence of the internet contributes to improving public welfare. They argue that the internet helps people obtain the information they need, including job opportunities, skills training opportunities, trade supply chain opportunities, and other new business opportunities. Thus, people who have access to and are able to use the internet have a greater opportunity to increase income and other aspects of social welfare, thereby potentially increasing income (Bayar et al., 2021; Siaw et al., 2020; Akindele et al., 2020; Chao et al., 2021; Denzer et al., 2021; Gürtzgen et al., 2021; Mecinas Montiel, 2016; Hidayat et al., 2021). The second stream, namely another group of researchers, discovers that the penetration of digital technology also widens

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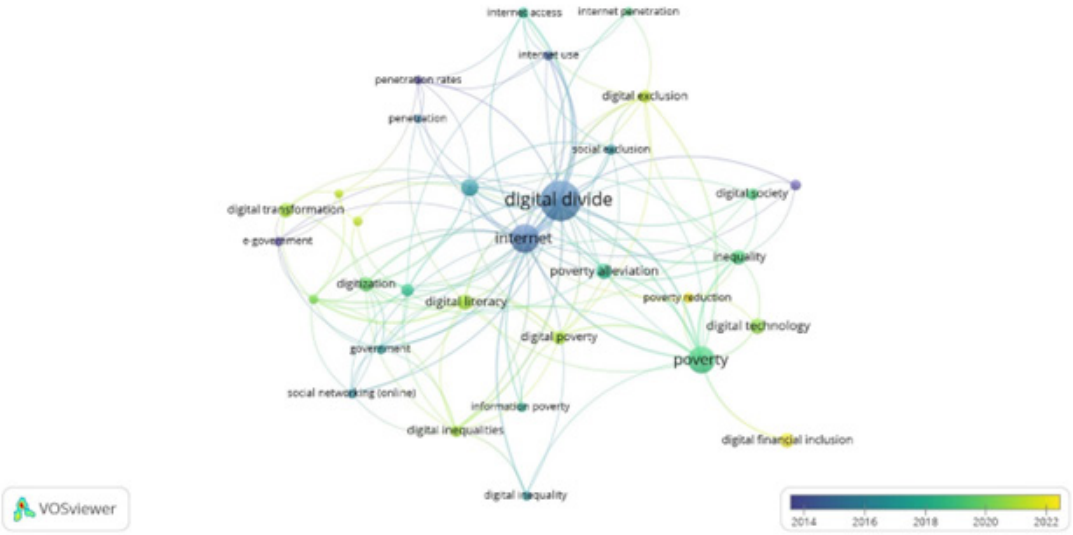
Table 1. Co-occurrence Analysis of Digital Penetration and Poverty Studies in Indonesia in 2017-2022



the gap between groups. While the group obtaining digital access improves their welfare, on the other hand, the group that does not take advantage of the access to technology for productivity will be increasingly left behind. Thus, internet penetration still has the potential to produce a wider gap between groups (Mendonça et al., 2015; Palvia et al., 2018; Mcclure, 2017; Bauer, 2018; Postuła et al., 2021; Adams & Akobeng, 2021; Nguyen et al., 2022).The relationship between digital penetration and the welfare of the community gave rise to the idea of this study, namely, does the evidence in Indonesia confirm or refute this paradox? What are the challenges of digital penetration in developing countries such as Indonesia?

In addition to the aforementioned reasons, this study is also inspired by the gap in research development needs related to the issue of digital penetration and barrier factors associated with poverty. A bibliometric co-occurrence analysis using the Scopus database, journal publications, and proceedings, at the subjects of social sciences, decision sciences, as well as arts and humanities, discovers that the issue remains open to research, not only in Indonesia but also in the world. Figure 1 presents a co-occurrence analysis with the criteria of article title "digital penetration" AND title/abstract/keyword containing the words "poverty" presented with Vosviewer.

Figure 1 shows that the issue of digital penetration is connected to the keyword “internet” and various attributes of the keyword "digital" which lead to the digital divide (the largest cluster). The issue of digital divide as the mouth of the issue of digital penetration is connected to the issue of digital poverty and poverty reduction which is still yellow, meaning that it has a large niche to be studied after 2022. Thus, it means that the issue of digital penetration and its challenges to the governance of poverty reduction policies remain wide open for study.

The purpose of this study is to describe the relationship between the Digital Competitiveness Index (DCI) and the Poverty Index (PI) to reflect the potential challenges of inclusive and pro-poor digital development in Indonesia. This study also intends to examine the relationship and the impact of DCI on PI through a regression analysis. This analysis is able to identify the extent of the changes in PI with every increase in DCI. The novelty of this study lies in the use of a quadrant analysis and an inclusive development perspective. The quadrant analysis supports the understanding of the context of the relationship between digital penetration and the poverty rate, whether it is beyond the normative assumption that digital penetration contributes positively to economic well-being. The quadrant analysis has been applied by previous researchers to map the relationship between poverty and economic growth. Rini and Sugiharti (2017) study the poverty in Indonesia by mapping changes in the position of provinces with a 4 quadrant analysis based on economic growth and the poverty level based on the analysis of the National Socio-Economic Survey data in 2007 and 2012. Tambuh, Wulandari, and Herdayani (2021) describe and map the poverty areas of Palembang City. Rahman et al. (2022) study poverty convergence in North Sumatra Province during 2011-2021. Utilizing the quadrant analysis of Klassen, it is revealed that several regions have moved out of the quadrant while others have moved towards the quadrant line at different levels. Severe inequalities in several regions are classified in the quadrant 4.

Theoretical Background

An inclusive development perspective to observe the potential of harmful risks from the aspects of digital penetration should be taken into account as part of public accountability. The conceptual framework used to analyze this study is a digital public administration approach to inclusive development. The term Digital Public Administration is frequently synonymous with digital governance. The indicators commonly used

to assess the level of digital governance include the number of people using computers, the number of households having access to the Internet, and the number of digital-based government service applications.

Meanwhile, digital development or digital penetration is broadly defined as the development of the living systems of people connected to digital systems (Balashov et al., 2020). In the context of citizen life, digital penetration includes providing more flexible access to public services as those services can be accessed anytime, anywhere, by anyone under the limitations of their rights and authorities. Thus, digital penetration for public administration is also synonymous with increasing the responsiveness, efficiency, and effectiveness of public administration. Digital penetration supports the development of digital governance. Digital governance represents a condition where the components of government institutions, the business world, and non-governmental organizations organize public information communication and public data access services to obtain public goods and services using digital technology. Moreover, the essential component of the digital governance platform is the people who benefit from it because they can meet their needs more quickly and flexibly. Previous research finds that the impact of implementing digital governance differs between countries or regions since it is influenced by the environmental context, namely the contexts of institution, culture, and administration (Balashov et al., 2020).

The positive impacts of digital governance include the increased speed of bureaucratic services, greater public transparency and accountability, faster communication, and mutual public information between the government and the society. Downstreaming increases the potential for increasing public trust in the government (Janowski et al., 2018; Belyakova, 2021). Meanwhile, the negative impacts of digital governance are as follows. Digital governance opens the freedom of the people to access government sites, thus increasing the risk of cybercrimes. Digital governance initially requires enormous infrastructure investment costs, thus the risk of remote areas not obtaining digital access will widen the gap between cities and remote areas. Digital automation also risks creating unemployment as people are replaced by robots or artificial intelligence (AI). The use of digital technology such as AI also has the potential to cause injustice and discrimination. It is because AI works based on algorithms and can cause random biases in individuals who have low frequency of access to digital features.

The latest research carries the concept of sustainable socioeconomic benefits to ensure a safe planetary life for future generations in which nobody is left behind. Observed from this perspective, the impact of digital governance transformation should also be considered from its contribution to creating sustainable and inclusive benefits for all groups of people. The role of public administration is enormous in creating these values. For example, the development of e-commerce should pay attention to rural communities who are relatively disadvantaged and promote products that provide added value from local materials and do not damage nature. Referring to the concept of governance as a network of state, non-state, and community actors, the development of inclusive and sustainable digital governance also requires support from non-state and community actors (Burlacu et al., 2021).

Examined from the perspective of digital public administration for inclusive development, how does digital penetration relate to the efforts to reduce or alleviate poverty? Digital penetration in the anti-poverty system is interpreted as an information technology-based development strategy that considers the obstacles faced by families living in poverty (Castro & Lopes, 2021). Therefore, the role of the state in developing and implementing digital platforms is to maintain a balance between social justice and economic efficiency (Stepanova et al., 2020). Previous research discover that the digitalization of the economy increases new job opportunities for the poor. Why? It is possible as digitalization improves the accessibility of communication for the majority of poor people. The channels accessed include social media, independent information channels, mobile banking, and e-commerce. As a case in point, it applies in Sub-Saharan Africa (Kohnert, 2021). The Social Science Research Council (SSRC) also discovers that digital penetration increases job opportunities and social inclusion, thereby impacting poverty reduction (Bach et al., 2019).

Without denying the normative assumption that information technology-based development should be pro-poor and its supporting evidence, as previously mentioned, the author also finds the challenges of digital governance for the poor. Researchers have previously revealed that the growth of the digital economy has not fully addressed the problems faced by the poor (Bach et al., 2019; Mulyaningsih et al., 2020). Income level is the primary determinant of access to technology. Low incomes pressure households to focus primarily on basic needs, such as food, education, and health. Lack of income restricts poor households to accessing technology, mainly at the beginning of diffusion. In the early stages, the cost of buying hardware such as smartphones, computers, and laptops is significantly high. Therefore, for the poor, there remains digital inequality. Thus, the poor have the potential to experience exclusion. In addition, the low quality of digital equipment has automatically reduced the inclusiveness of the poor. For example, lack of internet quota, slow connections, low-quality hardware, and software that is not updated automatically restrict access to digital platforms. In addition, the poor also have a slower chance of obtaining new information because social interactions and work activities are less interactive with the internet. The use of technology is associated with formal work that requires interaction with people from various

locations. Thus, a digital divide is merely a symptom. A more substantive problem of the poor is economic and social marginalization, which limits the benefits of digital penetration. In addition to structural factors, the individual factor is the obstacle for the poor to be left behind in utilizing digital technology.

What is the evidence from Indonesia? How does digital penetration relate to the poverty rate? In Indonesia, there is a measurement of the level of progress of a digital application for the economic field as measured by the Digital Competitiveness Index (DCI). The quality of digital penetration is expressed in Index, including (i) the readiness of digital infrastructure, (ii) human resources (HR), (iii) digital economy activities, and (iv) local government policies and capacities. DCI has 47 sub-indices, one of which is the poverty rate. Thus, DCI already has a perspective that digital penetration must have an impact on poverty reduction. In terms of poverty rate, Indonesia ranks 73rd as the poorest country in the world in 2022, as specified in a report from the World Population Review (Hidayat, 2022). According to the data from Statistics Indonesia from the 2021 National Socioeconomic Survey, the poverty rate of Indonesia in the second semester of 2021 was 12.53% for villages and 7.60% for urban areas, and the total average was 9.71%.

In the context of the current high burden of numbers, this study will examine evidence in Indonesia related to the relationship of digital penetration (represented by DCI) with the perspective of inclusivity for the poor (represented by the PI). Employing a quadrant analysis, this study seeks to identify the distribution of provinces in the outlier quadrant, namely, high DCI yet high PI as well. This study also intends to examine the relationship and the impact of DCI on PI, through a regression analysis with the formula $Y = a + bX$. This analysis reveals the extent of changes in PI with every increase in DCI. The significance of the relationship between DCI and PI can be an input for digital development policies in Indonesia. This finding will be a foothold for the theoretical tracing of the challenges of digital penetration to reduce poverty in Indonesia.

RESEARCH METHOD

This study implemented a quantitative approach with a descriptive analysis to explain the relationship between digital penetration (represented by the Digital Competitiveness Index / DCI) and the poverty rate (represented by the Poverty Index/PI). The DCI data were obtained from the East Ventures-Digital Competitiveness Index (EV-DCI). Meanwhile, the Poverty Index data were obtained from the results of the 2021 National Socioeconomic Survey (SUSENAS) published by Statistics Indonesia. The data were processed using IBM SPSS Statistics 20 software, with (1) a linear regression analysis to determine the impact of DCI on PI, and (2) a quadrant analysis based on the national average value (Indonesia) as a reference point.

The quadrant analysis was applied to examine the distribution of the relationship between DCI and PI among provinces in Indonesia. A quadrant analysis is a simple turbulence data processing that is useful in investigating the flow of turbulence shifts (Wallace, 2016). A quadrant analysis is an analysis that utilizes a comparison of two indicators. A quadrant analysis can divide the plot area into four based on the specified average value. The four sections are quadrants 1, 2, 3, and 4. The data plot or factors located in a particular quadrant have similar characteristics (homogeneous) to facilitate action, policy-making, and planned activities in the future. Based on the assumptions of quadrant analysis, the individual characteristics in the same quadrant are considered similar in each case. A quadrant analysis places quadrant intersections at the average value of the observation results on each axis as a reference for the position of each factor in that quadrant.

This study positions the X-axis as DCI, while the Y-axis represents PI, by applying the logic that higher digital concentration leads to higher digital competitiveness index, thus supporting poverty reduction efforts.

Based on the characteristics of each quadrant, Quadrant 1 has a high value for the X-axis indicator and a high value for the Y-axis indicator. Quadrant 2 has a low X-axis indicator value but a high Y-axis indicator value. Quadrant 3 has a high indicator value on the X-axis, but a low indicator value on the Y-axis. Meanwhile, Quadrant 4 has both low indicators on the X-axis and the Y-axis. The interpretation of quadrant analysis varies for each quadrant in each case, depending on the interpretation indicators being compared. This study determines the name of the quadrant with the following criteria. Quadrant 1 is intended for plots with a high DCI and a high poverty rate. Quadrant 2 is aimed at plots showing a high DCI and a low poverty rate. Quadrant 3 is for areas with a low DCI and a high poverty rate. Meanwhile, Quadrant 4 is designed for a low DCI and a low poverty rate.

To examine the impact of DCI on PI, this study employed a linear regression analysis with DCI as the independent variable and PI as the dependent variable. The analysis will determine how high—if any—the impact of DCI on PI is, with the assumption that higher DCI will have a negative impact on PI, i.e. higher DCI will render PI lower. The analysis will also determine the contribution of DCI in lowering PI, because this study only focuses on DCI as the independent variable, and does not include other variables as independent variables.

RESULT AND DISCUSSION

This section will answer the question: "How do the Quadrants of the Digital Competitiveness Index relate to the Poverty Index in Indonesia? Referring to the quadrant map, what are the following challenges of digital development policies in Indonesia?

Prior to answering these two questions, a conceptual framework of the Digital Competitiveness Index will be presented and referenced in this study.

The Impact of DCI on PI

The results of the linear regression analysis show that DCI as an independent variable has a significant negative impact on PI, as presented in Table 1.

Unstandardized regression Coefficient B = - 0.234 (sig. 0.020) means that every 1 point increase in DCI will lower PI by 0.234 point. A higher DCI will have an impact on lowering PI. It means that there is a significant relationship between DCI and PI. The model for the impact of DCI on PI is: Y = 19.289 - 0.234 X. A constant value of 19.289 is obtained, meaning that statistically without DCI, the amount of PI is 19.289.

Table 1. The Impact of DCI on PI

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.289	3.734		5.166	.000
	Digital Competitiveness Index	-.234	.096	-.396	-2.440	.020

Coefficients[a]
a. Dependent Variable: Poverty Index
Source: Output of IBM SPSS Statistics v. 20

To determine the contribution of DCI among other independent variables impacting PI, we used the value of R Square from the result of the linear regression analysis as presented in Table 2.

The value of R Square = 0.157 means that DCI has a contribution of 15.7% to lower PI, while other variables have a contribution of 84.3% in impacting PI.

Table 2. Contribution of DCI as an Independent Variable

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.396[a]	.157	.130	5.04632

a. Predictors: (Constant), Digital Competitiveness Index
Source: Output of IBM SPSS Statistics v. 20

Digital Competitiveness Framework in Indonesia

The digital competitiveness of Indonesia remains low. It is shown by the data from the IMD World Digital Competitiveness Ranking Report in 2022, in which Indonesia ranks 51st out of 63 countries (IMD Team, 2022). Meanwhile, a report from East Ventures (Ventura, 2022) reveals that the median value of the competitiveness of Indonesia in 2022 is 35.2 (scale 0-100).

The Digital Competitiveness Framework in Indonesia carries the concept of integrating the pillars of Information and Communications Technology (ICT) Infrastructure, Digital Government, Digital Society, Digital Business, and Sustainable Digital Economy (Ventura, 2022). The explanation of the pillars of digital penetration used as parameters in the Digital Competitiveness Index in Indonesia is as follows.

The pillar of ICT infrastructure focuses on meeting the needs of fundamental infrastructure and devices as a basis for implementing the functions of digital activities by the government, the business world, and society. Supposing the internet-based information technology infrastructure is weak, it hinders the growth and competitiveness of the digital economy for MSMEs. The lack of internet infrastructure and devices will delay the development of the digital literacy of the population. Statistics Indonesia predicts that the existence of ICT infrastructure has a correlation with a digital competitiveness index by 0.80 (very strong and unidirectional), gross regional domestic product by 0.49 (medium) and the Human Development Index by 0.94 (very strong dan unidirectional) (Marhaeni et al., 2022).The sub-indicators used to measure internet infrastructure are (i) fixed telephone subscribers per 100 population (a score of 3.31), (ii) mobile phone subscribers per 100 population (a score of 134.18), (iii) international internet bandwidth (bit/s) per user (a score of 149,499 bit/s), (iv) the percentage of households with computers (a score of 18.95%), and (v) the percentage of households with internet access (a score of 82.07%) (Marhaeni et al., 2022).The score of ICT infrastructure in Indonesia in 2021 is not very high, at merely 5.76 (scale of 1-10). The Annual Report of the Ministry of Communication and Information Technology states that of 83,218 villages, approximately 70,670 villages have been served by 4G mobile broadband access. Meanwhile, 73% of 4G-underserved areas are located in the 3T (Foremost, Outermost, and Disadvantaged) areas. Broadband is very strategic to boost the added value of the regional economy. Several studies show that cell phones and broadband are essential for economic and productivity growth. In addition, several studies discover a relationship between fixed broadband speed and economic development (Vu et al., 2020; Edquist et al., 2018; Edquist, 2022).Thus, the more people use fixed broadband, the greater the increase in the opportunity to add economic value. According to a survey by the Indonesian Internet Service Users Association, the percentage of fixed broadband users in Indonesia are still low, at 24.36% (APJII, 2022). Meanwhile, according to the 2022 IMD World Digital Competitiveness Ranking, internet users in Indonesia occupy the 59th place while Internet bandwidth speed is rank 61st out of 61 countries surveyed (IMD Team, 2022). The data show that digital poverty in Indonesia remains a big challenge (Marhaeni et al., 2022).

The pillar of Digital Government includes government activities as policy and regulatory makers in facing the changing demands of the digital era. In this pillar, the government focuses on preparing a regulatory framework that regulates the implementation of Digital Government services that protect citizens. The digital government of Indonesia is evaluated variously by several assessment agencies. For example, the IMD World Digital Competitiveness Ranking assesses that the components related to the digital government pillar in Indonesia are at a low level. It is shown by data from 2022 that the component of regulatory framework related to ICT in Indonesia is ranked 49th out of 61 countries. Meanwhile, the e-government component is ranked 59th, management of cities is ranked 40th, privacy protection by law content is ranked 57th, and government cyber

security capacity is ranked 58th (IMD Team, 2022). Furthermore, the results of the e-government survey by the United Nations position Indonesia in the 77th place out of 193 countries (top 40%) in 2022, rising from the 88th place in 2020 (United Nations, 2022). The dimensions of the e-government surveyed include three dimensions of performance, namely: the Online Service Index (OSI), the Telecommunication Infrastructure Index (TII), and the Human Capital Index (HCI).

The Pillar of Digital Society focuses on improving the digital literacy skills of people to help support their capacity to carry out digital activities for economic, social, and cultural purposes. The level of digital society of Indonesia is considered to vary by several survey institutions. The East Venture survey discovers that the Digital Literacy Index is not too high, at 62.9 (score 1-100) (Ventura, 2022). Data from the ICT Development Index show that the percentage of individuals using the internet is 62.10%. The digital society also reflects the readiness of society to use digital technology. According to the Inclusive Internet Index, Indonesia ranks 13th out of 100 countries in the aspect of readiness. It is said that the support of the government for literacy for students, teachers, and the general public has been good through digital literacy training strategies.

The Pillar of Digital Business focuses on how to adopt digital technology into business and drive the creative economy, for example, e-commerce, fintech, and edutech. This pillar is represented by the Entrepreneurship and Productivity Sub-Index published by East Ventura (Ventura, 2022), where the median value of Indonesia in 2022 is 23.6 (scale 0-100). The sub-index consists of the following components: (i) the Ratio of the Population Using the Internet in their Main Job (a score of 30.5), (ii) the Ratio of the Population Using the Internet in their Job for Communication (a score of 30.7); (iii) the Ratio of Population Using the Internet in their Job for Marketing (a score of 32.9); (iv) the Ratio of Population Using the Internet in their Job for Sales via Social Media (a score of 27.9); (v) the Ratio of Population Using the Internet in their Job for Sales via E-commerce (a score of 18.8); (vi) Loans Using Fintech (a score of 1.9).

The Pillar of Sustainable Digital Economy focuses on the development of the digital economy in a balanced manner by considering its impact on the environment, social, and governance or Economic, Social, Governance (ESG). With ESG, the benefits of the digital economy and all digital knowledge information can be enjoyed by all groups of people and generations. The measurement results of the Inclusive Internet Index (Fattahi et al., 2022) reveal that Indonesia generally is in the 46th position out of 100 countries and the 11th place out of 22 countries in Asia. The Inclusive Internet Index consists of Availability, Affordability, Relevance, and Readiness components. Availability describes the quality and breadth of available infrastructure required for Internet access and usage levels. Affordability explains the cost of obtaining internet access, the revenue generated, and the level of competition in the internet market. Relevance explains the presence and breadth of regional language content and other relevant local content within the digital platforms of a country. Readiness describes the capacity to access the Internet, including skills, cultural acceptance, and supporting policies.

In conclusion, the condition of digital competitiveness in Indonesia is generally at the middle level. Its performance shows an improvement compared to the previous year. It means that digital penetration in Indonesia has the opportunity to improve better from various aspects, rendering it more inclusive and sustainable.

The Quadrant Analysis of the Digital Competitiveness Index and the Poverty Index

Subsequent to obtaining an overview of the DCI score, the analysis is continued with the quadrant analysis to determine the relationship with PI in the same region. The results of the quadrant analysis are presented in Figure 2.

Observed from figure 2, the highest proportion is in Quadrant 3, with 13 provinces (38%). The second rank is Quadrant II with 11 provinces (32%), followed by Quadrant I with 5 provinces (15%) and Quadrant IV with 5 provinces (15%). This proportion implies the phenomenon that those with high digital penetration tend to have low poverty rates. On the other hand, areas with a low digital penetration index tend to have a high poverty rate. Evidence from Indonesia shows that the highest proportion is in the quadrant, which contains regions with a high digital penetration index and a lower poverty rate. It supports the significance of the regression equation $Y = a\text{-}bX$, where the majority of provinces are in the condition of high DCI-low PI (38%) and low DCI-high PI (32%). Meanwhile, the regression results explain that the contribution of DCI to poverty reduction is 15.7%. As in quadrant 1, the DCI value is high but PI is also high, meaning that variables outside DCI have a greater influence on the poverty rate in five provinces in Quadrant 1 (15%) and five provinces in Quadrant IV (15%).

Quadrant III reflects high DCI and low PI. The data from Quadrant III are meaningful as evidence from Indonesia that supports the preposition formulated by the findings of previous international research that digital penetration does have a positive effect on improving economic welfare (Hidayat et al., 2021; Bayar et al., 2021; Siaw et al., 2020; Akindele et al., 2020; Chao et al., 2021; Denzer et al., 2021; Gürtzgen et al., 2021; Mecinas Montiel, 2016). High internet penetration is believed to contribute to a decrease in poverty to achieve a low poverty rate.

Quadrant II is occupied by 11 provinces or 32%. Quadrant II depicts low digital competitiveness and a high poverty rate. It proves that digital penetration has an inverse relationship with poverty. Supposing internet penetration is low, the contribution to poverty

reduction is also low, implying a high poverty rate. In other words, areas with high poverty will face numerous obstacles in adopting digital technology, hence a low digital competitiveness. The symptoms in Quadrant II can serve as evidence of the presence of the digital divide, namely the gap in ICT infrastructure development as a precondition for digital penetration. The national average ICT Access and Infrastructure Index in 2021 is 5.76 (scale of 0-10) (Marhaeni et al., 2022). Provinces included in Quadrant II have the ICT Access and Infrastructure Index values as follows: 1-Aceh (5.68), 6-South Sumatra (5.89), 8-Lampung (5.69), 18-West Nusa Tenggara (5.52), 19-East Nusa Tenggara (5.42), 26-Central Sulawesi (5.71), 29-Gorontalo (5.69), 30-West Sulawesi (5.61), 31-Maluku (5.92), 33-Papua Barat (5.43), and Papua (3.71). The average ICT Access and Infrastructure Index of these 11 provinces is 5.4, which means it is below the national average. This tendency is understandable when compared to the data from East Ventura. The average ICT infrastructure index is 52, below the national average (64.8). It proves the existence of a digital divide, where 73% of provinces in Quadrant II has ICT access and infrastructure below the national average. The data from East Ventura (Ventura, 2022) illustrates the tendency of the 11 provinces of 73% of provinces in Quadrant II to have a digital literacy index ranking higher than the ICT usage ranking index. It can be interpreted as a tendency for community groups in this region to experience obstacles in adopting digital penetration, even though they have received quite good technological literacy.

Quadrant I reflects a high DCI but also a high PI. There are five provinces (15%) in Quadrant I. Why does this condition occur? The first possibility is that digital penetration impacts the gap between the adopting group and the non-adopting group, thus creating an economic gap that impacts PI. The data from the ICT Development Index in 2021 state that groups of provinces with relatively high ICT development and relatively large income inequality include Central Java, DI Yogyakarta, East Java, and Southeast Sulawesi (Marhaeni et al., 2022). The income gap in a region is measured by the Gini ratio (0-1). The 2022 Gini Ratio for each province in Quadrant I is as follows: 7-Bengkulu (0.315), 13-Central Java (0.374), 14-DI Yogyakarta (0.439); 15-East Java (0.371), and 28-Southeast Sulawesi (0.387). The Gini Ratio shows that the income gap in these provinces is categorized in the high category. As a result, although digital penetration is high, the poverty rate remains high. This evidence from Indonesia reinforces the findings of previous studies that digital progress also risks creating a more extensive digital divide (Mendonça et al., 2015; Palvia et al., 2018;Mcclure, 2017, Bauer, 2018; Postuła et al., 2021; Adams & Akobeng, 2021; Nguyen et al., 2022).The second possibility is that the advancement of digital penetration in the industry will reduce the human workforce, thereby increasing the unemployment group. This is corroborated by the data on the decreased ratio of Workers of the Vulnerable Group to Digitalization in the five provinces of the quadrant from 2021 to 2022, as follows: 7-Bengkulu (2.3), 13-Central Java (5.2), 14-DI Yogyakarta (2.7); 15-East Java (1.2), 28-Southeast Sulawesi (2.5). This decrease is thought to have reduced the employees unable to operate digital technology. The third possibility is that this condition is influenced by geographical conditions, where these provinces have large rural areas. Poverty is higher in provinces with large rural areas. The data from Statistics Indonesia state that poverty in the second semester of 2021 reaches 12.53% in rural areas and 7.60% in urban areas. Thus, rural poverty is 165% higher compared to urban poverty. Based on the number of villages, Central Java Province has the largest number of villages in Indonesia, amounting to 8,562 villages, followed by East Java Province with 8,496 villages. Rural areas have more poor people due to several reasons. The first possibility is that most livelihoods rely on the primary sector, thus the economic added value is low. As a result, the level of household expenditure is also low. Meanwhile, poverty measurement is based on the ability to spend per capita. Since spending in rural areas is relatively low, PI in rural areas has the potential to be high.

Quadrant IV reflects a low DCI and a low PI. In this quadrant area, the community is relatively prosperous with a low poverty rate, but digital innovation is not developing optimally. Quadrant IV is occupied by five provinces (15%), namely 5-Jambi, 9-Bangka Belitung Islands, 20-West Kalimantan, 21-Central Kalimantan, and 32-North Maluku. These five provinces show symptoms of a digital divide, but the willingness of the community to adopt digital technology is higher than the average literacy level. The ICT Access and Infrastructure Index of the five provinces in 2021 are, on average, at the national threshold of 5.7, namely 5-Jambi (6.01), 9-Bangka Belitung Islands 6.05), 20-West Kalimantan (5.75), 21-Central Kalimantan (5.74), and 32-North Maluku (5.36) (Marhaeni et al., 2022).Referring to the infrastructure index data published by East Venture, the average index value of these five provinces is 5.47, below the national average (64.8). Although access to ICT infrastructure remains relatively low, people from provinces in this quadrant show a high ability to use ICT, even exceeding the literacy index value. Regarding the national average, 80% of the provinces in Quadrant IV have a higher ICT usage rating than the digital literacy index ranking. It can be interpreted that the community in this area has high confidence in digital penetration, particularly for digital economic activities. It is why the poverty rate in this region is low, despite its low digital competitiveness. Supporting data are shown from the gap between the national and regional averages of DCI (Ventura, 2022). In the Infrastructure Sub-Index, the average difference between these five provinces and the national one is 10.7 points. Meanwhile, in the Entrepreneurship and Productivity Sub-Index, the average difference between these

five provinces and the national one is 2.92 points. Therefore, the performance of the Entrepreneurship and Productivity Sub-Index is higher than that of the Infrastructure Sub-Index.

Based on the data and discussion of the relationship between four aforementioned quadrants, in general, the paradox of the relationship between digital penetration and poverty is confirmed by evidence from Indonesia. The proposition that the presence of the internet contributes to improving the welfare of the people, but on the other hand, has the potential to increase inequality between groups, is supported by empirical evidence from Indonesia.

The next discussion will address the conditions thought to be the cause of why there are still areas with high poverty despite high digital penetration. They are referred to as the challenges of digital penetration. For the purpose of policy recommendations, the discussion will be led by mapping the challenges of digital penetration and the potential strategies to overcome these conditions.

Mapping the Challenges of Digital Penetration in Indonesia

Summarizing the findings of the discussion above, the issues related to digital governance transformation in Indonesia are as follows: (i) digital divide; (ii) ICT adoption as a response to digital penetration; (iii) risk mitigation of digital penetration. What are the challenges of Digital Public Administration in Indonesia observed from these issues?

The issue of digital divide is explained from the perspective of inclusive and sustainable digital development. Inequality in digital infrastructure causes inequality in access, for example, rural-urban inequality. Statistics Indonesia released data on the percentage of population aged five years and over who have ever accessed the internet based on rural and urban areas in 2021, presented in Figure 3.

Referring to Figure 3, it is evident that in 34 provinces in Indonesia, the population in rural areas has a lower level of access to the internet. The average of internet users in urban areas is 56.94%, which is 21.76 points higher than the average of 35.19% in rural areas. The provinces in urban areas that are below the average are six provinces (17%). Meanwhile, the provinces in rural areas below the average are 12 provinces (35%). Examined from this data, the digital divide in rural areas is 18% higher than in urban areas. Referring to the findings of previous research that the internet has contributed to poverty reduction, the digital governance development in rural areas needs to be prioritized to overcome the issue of digital divide. Meeting infrastructure needs requires budget priorities. In the 2022 State Revenue and Expenditure Budget, the Government of Indonesia allocates a budget of IDR 27.4 trillion for ICT, IDR 24 trillion for central government spending, and IDR 3.4 trillion for Transfers to Regions and Village Funds (TKDD). Indonesia is also targeting the launch of SATRIA-1 High-Throughput Satellite in 2023 to provide internet access at all public service points in Indonesia where internet access is not yet available.

ICT Adoption is a phenomenon that signifies the response of people who experience digital penetration and adjust themselves to adopt ICT which is the main component of digital penetration. The issue of ICT adoption is explained from the perspective of the Diffusion of Innovations (DOI) Theory which was first developed by Rogers (1983). DOI clarifies that the acceptance of new ideas, practices, objects, or technologies is influenced by the awareness and acceptance of individuals recognizing the characteristics of the innovation. Strengthening the DOI lens to explain phenomena in Quadrant 4 is the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1977). TRA explains that the behavior of individuals or groups of people is influenced by normative knowledge, expectations, and the consequences of the actions realized and agreed upon. Expectations and consequences are also motivated by the acceptance of the surrounding community where the individuals or groups of people live. The intention to act is prompted by resources and opportunities to act, such as time, money, skills, and resource support from others (Ajzen, 1991). Referring to this theory, this phenomenon of Quadrant II can be interpreted as a lack of public trust in adopting digital platforms in public activities. It can also be interpreted that the development of digital literacy is still not optimal. Therefore, the challenge for Indonesian public administration is to build a network of support and trust for

Figure 2. Quadrant Analysis of Digital Penetration and Poverty Index in Indonesia in 2022

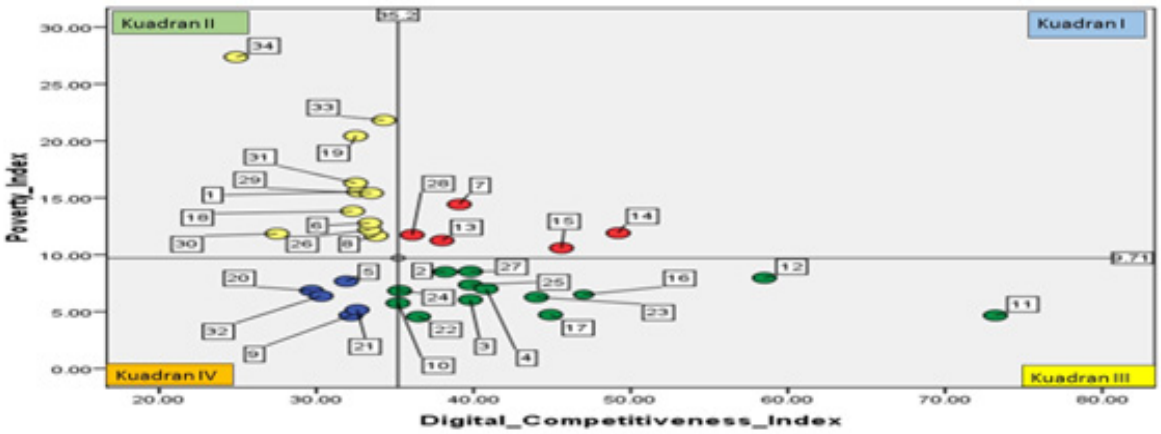
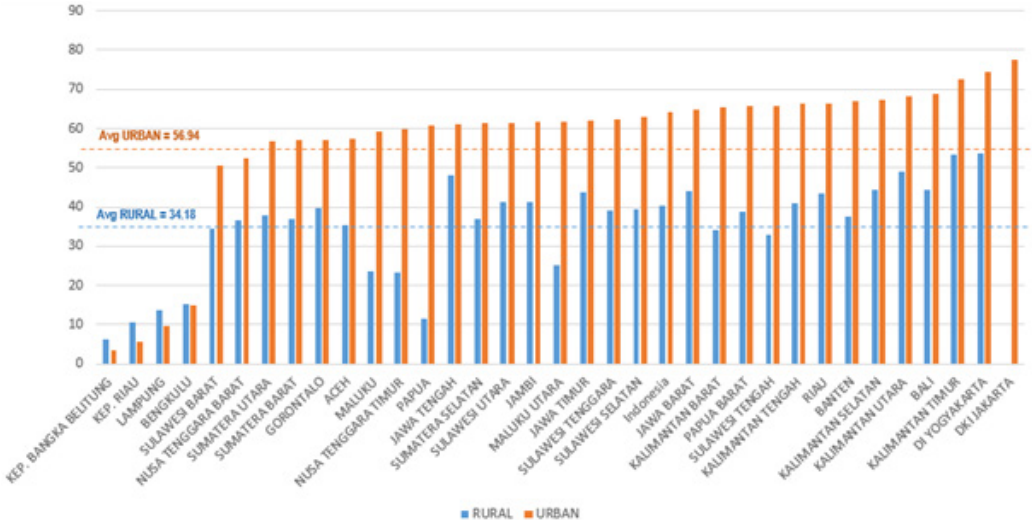


Figure 3. Percentage of the Population Aged 5 Years and Over Who Have Accessed the Internet by Rural and Urban Areas in 34 Provinces in Indonesia in 2021



citizens through digital communication (Janowski et al., 2018). The implication is to increase the capacity of the government human resources as digital talents, enabling them to be more agile in collaborating with the business world, the industrial world, and the community to accelerate digital penetration in Indonesia.

Risk Mitigation of Digital Penetration

As previously discussed, one of the risks of digital penetration is triggering inequality between groups supposing it is not controlled by policies that have an inclusive and sustainable perspective. The World Digital Competitiveness Ranking (IMD Team, 2022) assesses that Indonesia is ranked 49th out of 61 countries in the Regulatory Framework indicator related to ICT. In response to these findings, the first challenge of the Indonesian public administration is to provide a regulatory framework to comprehensively address the risk of the digital divide. It is necessary to generate a strategy that ensures that the poor and people from rural areas have equal access to become productive digital talents to raise per capita income, increase job opportunities, absorb unemployment, and become literate of public information. These are suspected to increase public trust in the government. There are six public values from the development of digital public administration, namely: (i) improving public services; (ii) improving administrative efficiency; (iii) ensuring Open Government capabilities; (iv) increasing ethical behavior and professionalism; (v) increasing trust and confidence in the government; (vi) improving social value and welfare (Moore, 2014; Twizeyimana & Andersson, 2019).

In the economic sector, government regulations should facilitate the business climate for Micro, Small, and Medium Enterprises to increase the competitiveness of the digital economy. In addition, government regulations related to adequate logistics infrastructure is also a challenge in the era of digital economy. In the social, cultural, and public service fields, digital governance regulations should ensure the protection of individual citizen data and the threat of cyber security attacks. Digital penetration should also maintain the quality of public engagement and public collaboration in an inclusive manner.

The second challenge is the issue of digital talents. Digital penetration requires a sizable supply of labor in the digital economy industry. Currently, Indonesia remains in the flux of digital talents. The ratio of Vulnerable Workers affected by Digitalization remains substantial (60.8) (Ventura, 2022). Supposing this workforce is not immediately transformed into workers with the skills to adjust to the digital economy, it will cause a more significant burden of unemployment. Supposing internet penetration and digital penetration are not balanced with their utilization for economic productivity, it will increase the burden of household spending and worsen poverty conditions. The data from Statistics Indonesia publish that internet usage for product sales remains superficial.

The government needs to develop a strategy to produce superior digital talents throughout Indonesia to ensure that the development of digital infrastructure is of productive value.

The third challenge is to develop quality networks with the business, the industry, and non-governmental communities. It is urgent for the accumulation of social capital to strengthen resources to develop digital penetration. This collaboration is vital to foster entrepreneurship and productivity, which are currently still low.

CONCLUSION

There is a significant influence between DCI and PI. Higher DCI will have an impact on lower PI. DCI is not the sole contributor to poverty reduction, but it is significant. Quadrant distribution data from 24 provinces of Indonesia reinforce the evidence that the majority of provinces reflect a significant influence of DCI on PI. Meanwhile, the other ten provinces in

Quadrant I and Quadrant IV reflect that there are other variables that contribute to PI in addition to DCI.

Evidence from Indonesia strengthens the proposition that digital governance development has a positive side and an adverse risk. The positive side is that digital penetration can support poverty reduction, which means improving the welfare of the people. On the other hand, there is a risk of widening the gap supposing the poor are not affirmatively facilitated to catch up in digital penetration.

The long-term challenges of digital penetration in public administration in Indonesia are (i) providing infrastructure needs to overcome the digital divide; (ii) conducting effective public communication to address barriers to ICT adoption; (iii) mitigating counterproductive risks arising from excessive digital penetration. The challenges of inclusive digital penetration for the Indonesian government include: (i) transforming the role of local governments as regulators to generate inclusive digital development; (ii) the government and public decision-makers need to consider the perspectives of citizens to effectively improve the welfare; (iii) applying sustainability principles to achieve the golden era of the digital economy.

The limitation of this study is the use of limited data of DCI and PI as well as the data of ICT Development Index. Therefore, it is recommended that further research examine the correlation of the components of PI to discover a digital penetration development model for inclusive public administration.

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