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INTERSECTIONAL DIGITAL INEQUALITY IN INDONESIA*

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Abstract. Indonesia is an emerging economy with a fast-growing digital sector. However, the development is not uniform across the country, with wide gaps related to regional differences and personal characteristics. This paper analyses the digital gap in Indonesia in the intersectional framework. I consider several metrics, such as the ratio of the population accessing the Internet, villages receiving mobile internet signal, and telecommunication expenditures. The study spans five years, from 2018 to 2022 (with some years missing for some of the variables). The data comes from BPS-Statistics Indonesia 2022 report "Telecommunication Statistics in Indonesia". I compute the Equality Ratios for one-dimensional and intersectional inequality as the value of the digitalisation metric for the most underprivileged group divided by the value for the most privileged group. Then, I assess the intersectional surplus as the difference between the inequality experienced by the intersectional group and the combination of one-dimensional inequalities. There is a substantial gap in internet usage and mobile internet availability in Indonesia, mostly related to urban/rural division and disparities between provinces. On the contrary, the gender gap is minimal. I also find no inequality in telecommunication expenditures. The gaps in internet usage were converging in recent years, but this was not true for the gaps in internet availability. People in intersectional groups face the combination of one-dimensional inequalities, but in most cases, there are none or minimal surplus effects.

Keywords: digitalisation; digital divide; intersectional inequality; Indonesia

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1. Introduction

In recent years, Indonesia underwent rapid growth in digitalisation and the ICT industry, with a 46.65% increase between 2018 and 2022 (BPS-Statistics Indonesia, 2022). However, the development is not uniform across the country. According to Priharsari et al. (2023), nascent digitalisation still undermines broadband and skills capacity but has high momentum and propensity to change. Any shortcomings in the organisation of digital life will likely be inflated.

First, there are areas of digitalisation that lag behind. According to the ASEAN Digital Development Index, Indonesia scores above the regional average, primarily in the Data Protection & Cybersecurity pillar and in the Digital Payments & Identities pillar (ASEAN, 2021). The report highlights the Digital Skills & Talent pillar as the

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area requiring the most improvement. The reports SMERU Research Institute et al. (2022) and SMERU Research Institute (2023) came to the same conclusion. The latter brings attention to the shortage of ICT specialists for public administration, between the lack of digital skills in society and the growing needs of the private sector.

Another bottleneck identified by researchers is regulatory and infrastructure readiness for the new technologies. Rumata and Sastrosubroto (2020) pointed out that decentralised and insufficient regulations are restraining digital development. According to the ICT Readiness Index by the World Bank, Indonesia ranked in the 105th position in the Infrastructure category, falling by 20 ranks between 2014 and 2016 (Frost & Sullivan, 2018). Indonesia's heterogeneity and geographical properties make it a hard case for infrastructural expansion.

On top of that, the benefits of digitalisation are not distributed evenly (SMERU Research Institute et al., 2022). The report by SMERU Research Institute et al. (2022) identified six facets of digital inequality based on: a) region, b) age, c) disability, d) gender, e) educational attainment, and f) income.

Perhaps most unique to the Indonesian situation is the regional digital gap, as the country is spread across thousands of islands and unequal in the overall level of development. Moreover, the best-performing regions are also the easiest to research, and the data on the underprivileged regions can be scarce (see, e.g., SMERU Research Institute, 2023).

This study aims to analyse the multifaceted problem of internet access in Indonesia. I consider the metrics of internet use, mobile internet availability, and telecommunication expenditures. With regard to them, I identify the extent of the digital gap in three dimensions: gender, region and the urban vs rural division. It expands the current knowledge by analysing the intersectional properties of the digital divide, as the topic has been studied in a one-dimensional way up to date.

There are substantial gaps in internet usage and mobile internet connection availability between provinces and urban and rural areas. The gender gap in internet use is the smallest and already converged in 2022. I also find no substantial inequalities in the telecommunication expenditures. People in intersectional groups face the combination of one-dimensional disparities, but I see none or minimal surplus effects. There is even a significant, negative surplus in mobile internet availability. The disparities between urban and rural areas are even more striking in the most digitalised provinces than in the less developed regions.

My results can be helpful for policymakers by pointing out the aspects of the digital divide that require the most attention. The paper also highlights the need for intersectional research and data collection. The digital divide is a complex problem and cannot be fully measured by the metrics of internet use, availability, and cost alone. The area of ICT education and job opportunities especially needs further exploration and can reveal more sources of inequality.

2. Literature review

The digital divide may be defined as a “division between people who have access to and use of digital media and those who do not” (van Dijk, 2020). Considering the increasing impact of digital solutions on the economy, social and private life, being deprived of opportunities and abilities to use them may seriously harm the quality of life (SMERU Research Institute et al., 2022; Krulický et al., 2024). A comprehensive analysis of the impact of ICT development in Indonesia has been conducted by Rezki (2023). The author linked the mobile phone adoption to several aspects of the socioeconomic development of the villages, including public services, support programs and opportunities for small enterprises.

The issue of the within-country digital divide is well-recognised in literature. However, the existing studies analyse the separation dimensions rather than the intersectional framework. Table 1 presents the summary of the literature survey, depending on the analysed dimension. Value "Pos" means personal characteristics increase digital opportunities, while "Neg" indicates the opposite. Most of the research focuses on gender, age and education.

Long et al. (2023) found a substantial disparity between men's and women's digital development. The gap was primarily due to the endowment effect, e.g., if women had the same opportunities as men, the gap would shrink by half. The gender gap is wider for more advanced aspects of digitalisation, like skills, entrepreneurship and occupational opportunities (Sey, 2021; Gudjonsson et al., 2022). Moreover, the gender gap is also wider for digitalisation metrics related to meaningful internet use than for the metrics of internet device ownership (Sey & Hafkin, 2019).

SMERU Research Institute et al. (2022) performed an extensive analysis of the digital inequalities in Indonesia. They found the gender digital gap as well, though relatively small compared to the inequalities related to age, place of residence, or income level. Probably the most profound digital divide exists between the able-bodied population and the people with disabilities, among whom only 18% access the Internet.

Similarly, Sujarwoto and Tampubolon (2016) found that people who were female, older, unemployed, less educated or living in poverty had lower internet access rates. The study then analysed interaction terms between telecommunications infrastructure and socioeconomic status. It showed that individuals living in infrastructure-deprived regions were less likely to access the Internet, even if they were wealthy or highly educated. Although the study did not use the intersectional framework, its results showcase the need for one. Digital inequality can come from many sources related to the availability of infrastructure, affordability, education, or personal attitudes. People in the intersectional groups – e.g. uneducated individuals from infrastructure-deprived regions – will suffer twofold.

Another aspect of the digital divide is the availability of digital devices. Puspitasari and Ishii (2016) confirmed the findings regarding age and education level in the case of accessing the Internet through mobile phones. Younger and highly educated people from three Indonesian cities were likelier to own smartphones than feature phones with limited internet access options.

Table 1. Literature review of the inequality dimensions in ICT development in Indonesia

Source	Female	Age	Education	Employment	Income	Rural	Region
Internet access (Sujarwoto and Tampubolon, 2016)	Neg	Neg	Pos	Pos	Pos		
Internet access (SMERU Research Institute et al., 2022)	Neg	Neg	Pos	Pos	Pos	Neg	Pos
Mobile access and smartphones (Puspitasari & Ishii, 2016)		Neg	Pos				
ICT opportunities (Sey, 2021; Long et al., 2023)	Neg						
Online shopping (Budiono et al., 2018)						Neg	
Innovation and public spending (Hilmawan et al., 2023)							Pos

Another division line falls between rural and urban areas, with the former being underprivileged. Budiono et al. (2018) listed several problems with e-commerce development in Indonesian villages: lack of infrastructure, skills,

and low incomes. This division often coincides with regional differences, making it an intersectional issue. The country's most urbanised and populous parts, most notably Java and Sumatra Islands, have better infrastructure (SMERU Research Institute et al., 2022) and productivity and innovation levels (Hilmawan et al., 2023). This, in turn, can foster digital development.

3. Methodology

3.1. The intersectional inequality

Current research on inequality recognises its intersectional nature (Bowleg, 2012), first pointed out by Crenshaw (1989). If the inequality is related to more than one aspect (e.g., race, gender and economic status), then the individual characterised by a few of these aspects may be harmed even deeper (Schein & Bauer, 2019). The problem of the intersectional aspect of the digital divide surfaced after the COVID-19 pandemic (Zheng & Walsham, 2021) when more and more aspects of daily life depended on digital solutions.

Intersectionality is a primarily theoretical framework and does not have a clearly defined quantitative methodology (Guan et al., 2021). In a review of 153 quantitative studies incorporating intersectionality, Guan et al. (2021) found that most used regression with intersection terms to explore this issue. The undoubted advantages of this approach are the ease of interpretation and the possibility of assessing the significance of the intersectional terms. However, it requires more granulated data and cannot be used in this analysis.

Schein and Bauer (2019) created the Intersectional Discrimination Index. They compared the means between groups to show that the intersection of race and gender or sexual minority made the subjects more vulnerable to discrimination and adverse health outcomes. Similarly, Meili et al. (2022) compared the schooling ratios in 39 countries and showed that a lot of inequality in education remains hidden if the ethnicity and gender factors are considered separately.

I follow the methodology of the latter, defining Equality Ratio (ER) as:

$$ER(G) = \frac{\min(s_1, s_2, \dots, s_J)}{\max(s_1, s_2, \dots, s_J)} \quad (1)$$

In Meili et al. (2022) paper, this measure was called the Inequality Ratio (IR). However, I changed the name to Equality Ratio because it takes the values between 0 and 1, where 1 means perfect equality. In this way, the results section will be more intuitive for readers.

The groups $s_1, s_2, \dots, s_J$ are designated with regard to dimension G. Gender and Location dimensions divide the data into only two groups (Men and Women, and Rural and Urban locations). The Province (regional) dimension divides the dataset into 10 groups, from the bottom (least developed) 10% to the top 10%.

For the intersectional analysis, the data is divided into $J_1 \times J_2$ groups, and the ER is computed as follows:

$$ER(G) = \frac{\min(s_{11}, s_{12}, \dots, s_{JJ})}{\max(s_{11}, s_{12}, \dots, s_{JJ})} \quad (2)$$

It can be interpreted as the ratio of the variable obtained for the person from the most underprivileged group (in both dimensions) and the person from the most privileged group. Assuming the sources of inequality are independent (e.g., women face the same inequality, regardless of which province they live in), the ER at the intersection should be equal to the multiplication of one-dimensional ERs:

$$ERm(G1 \times G2) = ER(G1) \times ER(G2) \quad (3)$$

Meili et al. (2022) call it mechanical intersectionality and define surplus intersectionality as:

$$\Delta G1G1 = ER(G1) \times ER(G2) - ERm(G1 \times G2) \quad (4)$$

The positive surplus would mean that the people in the intersectional group face even more inequality than the combination of inequalities related to their one-dimensional identities. For example, that would happen if gender digital inequality was stronger in the less developed regions. It would be a concerning result, as solving intersectional problems may require more than solving the one-dimensional inequalities in separation.

On the other hand, the negative surplus may indicate that the one-dimensional sources of inequality partly "cancel each other out". In other words, some barriers to digital development are of the same nature in both dimensions, and a person in the intersectional group will not face double of them.

3.2. Data

The data is sourced from BPS-Statistics Indonesia (2022) report. It includes variables on Internet use and infrastructure from 34 Indonesian provinces between 2018-2022. The report obtained the data mainly from the National Socioeconomic Survey (Susenas) and Village Potential Data Collection (Podes). Some variables were collected by the Ministry of Communication and Information Technology (Kemenkominfo) and telecommunications providers (BPS-Statistics Indonesia, 2022).

The variables are:

- % of the population aged 5 or more who have accessed the Internet in the last 3 months;
- number of villages that receive strong internet signal;
- average household expenditure on telecommunication as a fraction of total expenditure.

I modified the second variable by dividing it by the total number of villages. I also reversed the third variable by extracting it from 100%, which represents the expenditure left on the household after paying for telecommunication services. This way, it will be more intuitive for interpretation, as the higher the value, the better.

I explore the intersections based on three dimensions:

- Gender (male/female)
- Province
- Location type (rural/urban)

The gender dimension only relates to the internet use variable, as the other two are aggregated to villages and households. Gender and Location dimensions divide the data into only two groups (Men and Women, and Rural and Urban locations). The Province dimension divides the dataset into 10 groups, from the bottom (least developed) 10% of provinces to the top 10%. The deciles are computed according to the current population size. The provinces were sorted by the value of the internet access metric so that the top decile contains the most digitalised provinces inhabited by about 10% of the population.

This procedure was applied to reduce the impact of the outliers on the regional gap. As seen in Figure 1, both the bottom and the top of the distribution have outliers. Especially the least digitalised province stagnates while

digitalisation progresses in the rest of the country, meaning that the size of the gap and its changes over time would be distorted.

4. Results

4.1. Internet usage

The internet-using population in Indonesia rose from 39.9% in 2018 to 66.48% in 2022. Figure 1 presents the distributions of the population percentage using the Internet between provinces. Overall, internet usage is on the rise, except for Papua province, where digitalisation lags behind. This is why the gap between internet usage between the most and the least digitalised provinces is growing (see Table 2). However, the ER between the top 10% and the bottom 10% of provinces is less striking.

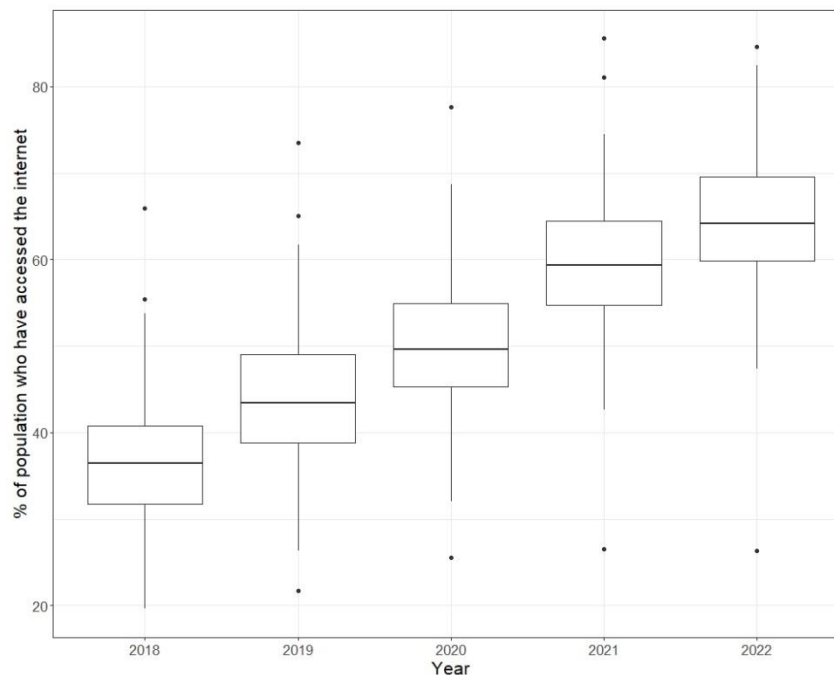


Figure 1. The distribution of the percentage of the population that has accessed the Internet in the last 3 months among provinces

Gender division has the highest ERs, meaning that this dimension exhibits the lowest rate of inequality. In 2022, it reached 99.59%, as men and women accessed the Internet at the same rate. The gaps between rural and urban areas are bigger and the biggest between provinces.

Next, Table 2 provides the intersections between dimensions. The ERs for intersectional groups are typically lower than the ERs in either of the dimensions alone because they suffer from two or more sources of inequality. However, there are some exceptions. In 2022, The ER for the Gender x Province intersection was a bit higher than the ER of just the province intersection (64.07 vs 63.87), and the same is true for the Gender x Location intersection (78.06 vs 75.40). This is because, in 2022, women in urbanised areas in the top provinces had a higher internet usage rate than men.

Surplus inequality is a difference between the multiplication of ERs of two or more groups and the ER of the intersection of these groups. A zero surplus would mean that the dimensions are independent, and a person in the intersectional group suffers the effects of both dimensions.

Table 2. The Equality Ratios and surplus intersectionality of internet access

Dimension	2018	2019	2020	2021	2022
Most digitalised province	65.89	73.46	77.61	85.55	84.65
Least digitalised province	19.59	21.70	25.52	26.49	26.32
ER	29.73	29.54	32.88	30.96	31.09
Top 10% provinces	55.17	63.25	63.51	72.01	74.32
Bottom 10% provinces	26.16	30.29	35.92	43.18	47.47
ER	47.42	47.89	56.56	59.96	63.87
Urban	50.92	58.59	64.25	71.81	74.16
Rural	26.56	33.84	40.32	49.3	55.92
ER	52.16	57.76	62.75	68.65	75.40
Male	-	50.50	51.69	59.75	63.79
Female	-	44.86	46.46	54.46	63.53
ER	-	88.83	89.88	91.15	99.59
Urban x top 10%	60.34	68.08	67.90	75.86	77.39
Rural x bottom 10%	17.95	21.29	25.97	33.37	39.01
ER	29.74	31.28	38.25	43.99	50.41
Surplus	-5.01	-3.62	-2.76	-2.82	-2.25
Male x top 10%	-	60.29	60.82	68.80	70.81
Female x bottom 10%	-	28.39	30.23	37.24	45.37
ER	-	47.09	49.70	54.13	64.07
Surplus	-	-4.55	1.13	0.53	-0.46
Male x Urban	-	61.08	61.01	68.26	67.46
Female x Rural	-	31.13	34.15	42.39	52.66
ER	-	50.97	55.97	62.10	78.06
Surplus	-	0.34	0.43	0.47	-2.96
Male x Urban x top 10%	-	70.79	64.49	71.94	71.38
Female x Rural x bottom 10%	-	19.52	21.49	28.13	35.78
ER	-	27.57	33.32	39.10	50.13
Surplus	-	-3.00	-1.42	-1.58	-2.16

The negative surplus for the Location x Province intersection means the inequality is slightly lower than the combined one-dimensional effects. The inequality between urban and rural areas may be less pronounced in the less digitalised provinces. (Or the differences between provinces may be less pronounced in the rural areas.)

The results for Gender x Province and Gender x Location intersections are mixed, with some of them positive and some negative. Positive values indicate that women in rural and underdeveloped areas face additional hardships in internet access, on top of the one-dimensional effects of gender and location/province. However, the surplus is generally close to zero.

People in the three-dimensional intersection (i.e., women from the rural areas of the least digitalised provinces) face the highest inequality. In 2019, only nearly 20% of them used the Internet, the ratio about 72% lower than for men from urban areas of the top provinces. However, the inequality is diminishing over time at every intersection.

4.2. Infrastructure and affordability

Next, I analyse the inequalities related to infrastructure and affordability of telecommunication services. The former is represented by the percentage of villages receiving a strong mobile internet signal, and the latter by the percentage of the household expenditure after subtracting telecommunication expenditures. Since the data are related to households or villages, I only analysed the regional and urban/rural divisions.

Table 3 presents the results. There is a strong inequality in internet infrastructure related to both dimensions. The penetration is about 40% lower in the less digitalised regions, and the inequality grew slightly in 2019 - 2021. The digital gap between urban and rural areas is almost as high. The intersectional inequality shows that about 48% fewer villages receive a strong signal in the rural areas of less developed provinces. However, the intersectional inequality surplus is negative, meaning that the effect for these groups is lower than the combined effects of one-dimensional inequality.

Table 3. The Equality Ratios and surplus intersectionality of the mobile Internet signal and telecommunication services affordability

Dimension	2019	2020	2021	2022
% of villages with strong signal				
Top 10% provinces	83.41	88.99	89.69	-
Bottom 10% provinces	52.65	54.96	54.38	-
ER	63.12	61.76	60.63	-
Urban	96.96	97.79	97.92	-
Rural	62.50	66.51	66.90	-
ER	64.46	68.01	68.32	-
Urban x top 10%	97.18	97.57	97.98	-
Rural x bottom 10%	49.79	52.36	51.72	-
ER	51.23	53.67	52.78	-
Surplus	-10.54	-26.32	-11.36	-
% of household expenditures without telecommunication				
Top 10% provinces	96.65	96.69	96.31	96.31
Bottom 10% provinces	96.46	96.31	96.00	96.08
ER	99.80	99.60	99.68	99.77
Rural	97.02	96.93	96.51	96.67
Urban	96.57	96.49	96.12	96.17
ER	99.54	99.55	99.60	99.48
Rural x top 10%	97.06	96.69	96.31	96.31
Urban x bottom 10%	95.83	95.69	95.31	95.39
ER	98.73	98.96	98.96	99.05
Surplus	0.61	0.19	0.32	0.20

The telecommunication expenditures (as a % of total household expenditures) are lower in the top 10% provinces. However, they are higher in urban areas, meaning the rural parts are more privileged. Nevertheless, the differences are minimal, and I do not find any substantial inequality in the expenditures. The ER is over 99% for one-dimensional divisions and over 98% for the intersection. The surplus inequality is positive yet barely above zero.

Discussion

Figure 2 compares the Equality Ratios for all considered variables and dimensions. Clearly, the direst are the digital gaps in internet use in intersectional groups, especially in the least developed provinces and rural areas.

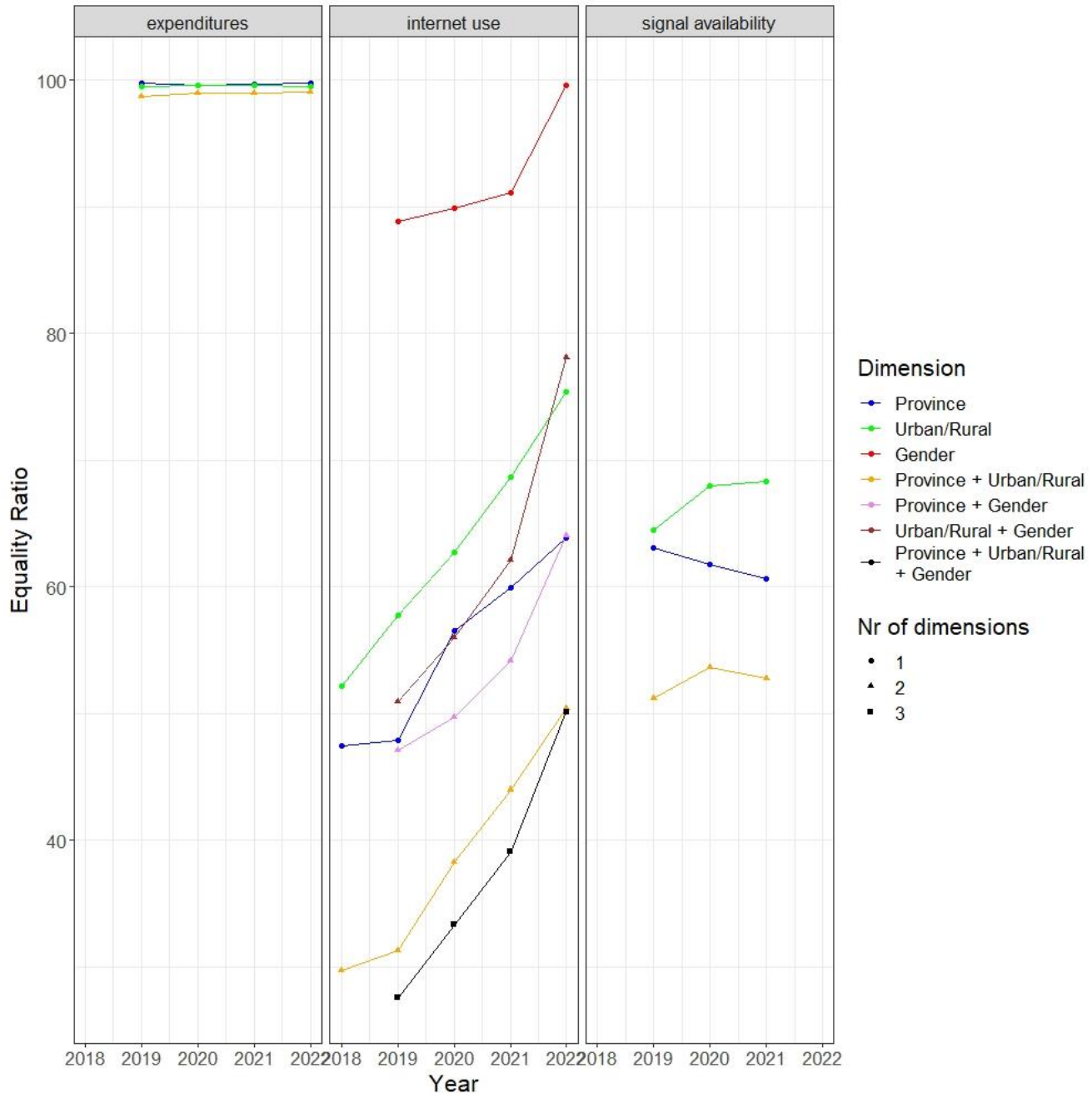


Figure 2. The equality ratios for internet use, availability of mobile internet signal, and telecommunication expenditures.

Comparing my findings with the inequalities in the previous literature (see Table 1), they are compatible regarding regional and urban/rural inequality. I did not find much evidence of strong gender inequality, but this could be for two reasons. First, the gap has diminished recently so that it could be larger in older studies. Second, this type of inequality could be more pronounced in more advanced metrics than just internet use (Sey, 2021). For example, (Kusumawardhani et al., 2023) found that although the adoption of digital technologies allowed more women to enter the workforce, they primarily get low-skilled and informal jobs.

There is not enough evidence to say that gender differences in digital development are over. However, it is a promising sign of the gap convergence.

The gender gap closed between 2021 and 2022, with a sharp rise in the ER related to gender differences in internet use, which also translated to rises in ERs for intersectional groups that include a gender dimension. One potential explanation is that the COVID-19 restrictions encouraged small and medium business owners (the majority of whom are women) to digitalise their businesses (Laksmanawati & Yuniawan, 2021). Nur Asrofi et al. (2023) notes that women who use the Internet have higher chances of starting a business and earning a better income.

On the contrary, the urban/rural gap seems to be closing at a constant rate, and the equality between provinces rose quickly between 2019 and 2020, to slow down with the COVID-19 pandemic.

My study expands the knowledge by applying the intersectional framework. I show that in most cases, the intersectional groups suffer the combination of one-dimensional inequalities. The international surplus is mostly close to zero. The exception is the Province x Location intersection with a large negative surplus, meaning that the two-dimensional inequality is lower than the combination of separate effects.

5. Conclusions

In this paper, I analyse the intersectional digital divide in Indonesia. I examine the differences in internet usage, availability, and telecommunication expenditures. For the latter two, I consider the regional and rural vs urban divisions, and for the former, an additional gender division.

My findings confirm the existence of large digital gaps in internet use. In 2022, the ratio of people accessing the Internet was 36% lower in the 10% least digitalised provinces (than in the top provinces) and 25% lower in rural areas (vs urban areas). These numbers fell from 53% and 48% respectively in 2018.

The gender gap is the least concerning, falling from 11% in 2019 to practically 0 in 2022. In the urban areas in the most developed provinces, the access rates for women were even higher than for men, creating a gender gap in the opposite direction.

I find a positive surplus inequality only in two years for the Gender x Province intersection and in three years for the Gender x Location intersection. However, even there, the effects are minimal. Overall, digital inequality does not have an intersectional property.

Next, I find substantial infrastructural inequality. The less developed provinces and rural areas have 40% and 32% lower ratios of villages receiving strong internet connection. The gap reaches 48% for the intersectional areas, although there is no surplus inequality. Finally, I do not find any inequality regarding expenditures on telecommunication in either dimension or their intersection.

My study explores the gap in research on the Indonesian digital divide by applying an intersectional framework. It points out which dimensions and aspects of digitalisation need further exploration and institutional effort. However, there are several limitations, mainly regarding the data. Other dimensions of the digital gap are not included in this study, such as age or educational attainment (see SMERU Research Institute et al. 2022). Moreover, the metrics used in this study cover the essential aspects of Internet access. Even after reaching convergence in internet access, inequality can still be severe with regard to digital skills or opportunities.

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