

DIGITAL ECONOMICS FOR SOCIAL SUSTAINABILITY: EVIDENCE FROM HUMAN DEVELOPMENT AND POVERTY IN INDONESIAN DISTRICTS

Mohammad Rofiuddin

Faculty of Economics and Business, Airlangga University
Jl. Airlangga 4-6, Surabaya, East Java, 60286, Indonesia
mohammad.rofiuddin-2023@feb-unair.ac.id

ABSTRACT

This study analyzes the impact of the digital economy on human development and poverty in Indonesia using panel data from 514 districts/cities during the period 2022–2024. The Human Development Index (HDI) and poverty rate (P0) are used as dependent variables, while the Digital Society Index (DSI), which covers four pillars: infrastructure and ecosystem, digital skills, digital empowerment, and digital jobs, is used as the main independent variable. Regional economic growth is included as a control variable. Estimations were performed using a panel data regression approach, including the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM), with Chow, Hausman, and Breusch-Pagan tests used to determine the best model. The results show that the digital economy contributes positively to HDI improvement and poverty reduction. The pillars of digital employment and digital skills have the most significant influence on poverty reduction, while digital infrastructure has a greater influence on HDI improvement. The *robustness* model with alternative poverty indicators (P1 and P2) reinforces the main findings. These findings emphasize the importance of digital transformation in supporting inclusive development and poverty alleviation. Policy implications are directed at increasing the productive capacity of the poor in the digital ecosystem, making digital transformation a genuine tool for promoting social justice and sustainable development.

Keywords: Digital Economy, Digital Society Index, Human Development, Poverty, Social Sustainability

INTRODUCTION

Digital transformation has become a significant catalyst in transforming the global development landscape. Information and communication technology (ICT) is now not only a tool, but also a major driver in promoting economic growth, improving quality of life, and reducing poverty. Previous studies show that ICT contributes significantly to economic productivity, efficiency, and innovation (Iqbal et al., 2019; Oladipo et al., 2016; Yousefi, 2011), as well as expanding access to social services, including education and health (Ahmed et al., 2010; Blaschke et al., 2009). In addition, digitization also increases financial inclusion and institutional capacity, which are important for poverty alleviation (Awad, 2023; Dzator et al., 2023).

The digital economy has proven capable of expanding access to education through online platforms, improving the efficiency of health services, creating new job opportunities, and accelerating a more equitable distribution of income (Boakye, 2024; Han & Tian, 2024). This transformation has had a significant impact, especially in developing countries, where infrastructure limitations and social inequality remain major development challenges. Digital technology enables public services to reach marginalized communities more effectively, thereby strengthening social inclusion and reducing disparities between regions.

In Indonesia, the development of the digital economy shows a rapid trend, marked by increased internet connectivity, the growth of technology startups, and various government initiatives such as the "100 Smart City" program (KOMDIGI, 2020a; Nugroho et al., 2017) and "Indonesia Digital Nation" (KOMDIGI, 2020b). To monitor this progress, the Ministry of Communication and Information Technology launched the Indonesian Digital Society Index (IMDI), which consists of four pillars: infrastructure and ecosystem, digital skills, digital

empowerment, and digital jobs. This index is an important tool for assessing the readiness and equity of digitalization across regions in Indonesia.

Despite significant developments, empirical literature examining the impact of the digital economy on human development and poverty reduction at the regional level (districts/cities) is still relatively limited. Most previous studies have focused on the national level, thus failing to comprehensively describe how digital transformation affects quality of life and welfare at the local level. However, several studies have shown a positive relationship between digitalization and an increase in the human development index (HDI), whether through access to education, health, or income (Birdsall & Birdsall, 2005; Mohamed et al., 2024). On the other hand, the digital economy also contributes to poverty alleviation through the expansion of employment opportunities and digital finance (Kurantini & Osei-Hwedie, 2019; Ng et al., 2025). This raises an important question: to what extent does digital transformation truly impact the quality of life and poverty reduction evenly across all regions of Indonesia. To fill this gap, the study aims to evaluate the impact of the digital economy on human development and poverty in 514 districts/cities in Indonesia during the period 2022–2024. Specifically, this study uses the Digital Society Index (DSI) as a comprehensive measure of the digital economy. It takes economic growth into account as a control variable to isolate the pure effect of digitalization on social variables. The contribution of this study is to enhance a more holistic understanding of how digital transformation can promote social sustainability in the digital economy era.

LITERATURE REVIEW

The Relationship between the Digital Economy and Human Development

The digital economy has become one of the key drivers in promoting human development, which is generally measured through the Human Development Index (HDI). Several studies have found a significant positive relationship between digital progress and HDI improvement, covering three main dimensions: education, health, and income. Studies by Birdsall & Birdsall (2005) and Chernysheva et al. (2023) show that the application of digital technology is significantly positively correlated with an increase in HDI. Access to and use of digital technology provide various socio-economic benefits that directly impact the quality of human life. One of the main contributions of the digital economy to human development is in the education sector. Digital technology expands access to learning resources, facilitates distance learning, and creates a more flexible learning environment. In this context, the literature notes that digitization enables a more inclusive transformation of education, especially in the post-pandemic era (Al-Roubaie, 2022; Menshchikova et al., 2021). Furthermore, Mohamed et al. (2024) found that the digital economy contributes to the development of education systems and expands access to higher-quality learning resources, preparing individuals to face technological advances and evolving global challenges.

Not only in education, but the digital economy also has a positive impact on the health and income sectors. Access to health services has become more efficient through digital platforms such as health applications, online appointment systems, and AI-based medical information. This has significantly increased health awareness, service quality, and affordability for vulnerable groups (Mohamed et al., 2024; Urunov et al., 2023). Initiatives such as smart cities, according to J. Li et al. (2025) have even contributed to improving public health behavior and expanding service coverage, especially for children, through the dissemination of technology-based information and increased household income. Thus, the digital economy has great potential in promoting comprehensive human development.

The Relationship Between the Digital Economy and Poverty

The digital economy has become a transformational force that influences various aspects of social and economic development, including poverty reduction. The increasing penetration of digital technology and information has created new opportunities for low-income communities to access basic services, expand employment opportunities, and

improve overall living conditions. One important dimension of this relationship is the role of the digital economy in reducing energy poverty. Several studies show that increased internet use and employment opportunities through the digital economy significantly reduce energy poverty, especially among low-income and low-education households (Tian et al., 2025; Wang et al., 2023; Zhang & Bu, 2024). Furthermore, access to information and communication technology (ICT) has proven to expand access to clean energy, both in urban and rural areas, making the digital economy a sustainable tool for energy poverty alleviation (Avom & Ngounou, 2025).

Another crucial aspect of poverty alleviation through the digital economy is digital finance. Financial technology (fintech) provides new access to financial services for individuals whom formal financial institutions previously underserved. This access includes the ability to save, access microcredit, and conduct secure and efficient digital transactions. Several studies confirm that digital finance has made a real contribution to poverty reduction, particularly in rural areas and economically marginalized communities (Kurantin & Osei-Hwedie, 2019; Ng et al., 2025; Yin & Li, 2023). Bamiro et al. (2024) Digital finance also promotes entrepreneurial opportunities and access to credit for smallholder farmers, thereby improving economic welfare in remote areas.

In the context of employment and income distribution, the digital economy opens up new, more flexible job opportunities, including for those with low skills. A study by Li et al. (2018) Shows that digital platforms such as Uber increase labor force participation and reduce unemployment among the poor. This is reinforced by the findings of Boakye (2024) , which shows that digital technology improves business operations, productivity, efficiency, and overall economic growth, which indirectly contributes to poverty reduction. Furthermore, Han & Tian (2024) and Zainullin et al. (2024) Note that the digital economy significantly affects income distribution by increasing labor productivity and creating new jobs, thereby reducing income inequality and poverty. These conditions show that the digital economy clearly contributes to poverty alleviation.

METHODS

This study uses annual panel data from 514 districts/cities in Indonesia during the 2022–2024 period, resulting in a total of 1542 observations. The data was obtained from several verified official sources, namely the Central Statistics Agency (BPS) and the Indonesian Digital Society Index (IMDI) developed by the Center for Communication and Digital Human Resources Ecosystem Development, Ministry of Communication and Information Technology. The dependent variables in this study are the Human Development Index (HDI) and poverty rate, both sourced from BPS. Poverty is measured using the poverty rate (P0), as well as two additional indicators for testing robustness, namely the poverty gap (P1) and poverty severity (P2). The main independent variable is the Digital Society Index (DSI), sourced from the Indonesian Digital Society Index (IMDI), which is a composite index of four pillars: infrastructure and ecosystem, digital skills, digital empowerment, and digital jobs. In addition, economic growth is added as a control to anticipate the influence of general economic fluctuations on human development and poverty. To estimate the relationship between variables, this study uses a panel data regression model. Three estimation approaches are used, namely the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). The Chow test is used to choose between CEM and FEM, while the Hausman test is used to determine whether FEM or REM is more appropriate to use. In addition, the Breusch-Pagan Lagrange Multiplier (BP-LM) test was conducted to ensure that there were significant individual effects in the REM model (Gujarati, 2009; Pesaran, 2015). The empirical models used in this study are as follows, Model 1: Digital Economy and Human Development (Eq 1)

$$HDI_{it} = \beta_0 + \beta_1 DSI_{it} + \beta_2 Growth_{it} + e_{it} \quad (1)$$

Model 2: Digital Economy and Poverty

$$Poverty_{it} = \beta_0 + \beta_1 DSI_{it} + \beta_2 Growth_{it} + e_{it} \quad (2)$$

Explanation: HDI = Human Development Index; Poverty = P0, P1, and P2; DSI = Indonesian Digital Society Index; Growth = regional economic growth; i and t indicate regencies/cities and years, respectively; ε = error. As a *robustness* test, alternative models were developed by replacing the composite DSI with its four pillars to identify the dimensions of the digital economy that have the greatest impact on increasing HDI and reducing poverty. In addition, the use of alternative dependent variables (P1 and P2) strengthens the validity of the results against different definitions of poverty.

RESULTS

Descriptive Statistics

The descriptive statistics in Table 1 show that there are more dominant differences between districts/cities (between units) than changes over time (within units) for most of the research variables. For example, the Human Development Index (HDI) has a much greater variation between units (sd = 6.35) than variation over time (sd = 0.56), with HDI values ranging from 34.10 to 88.77. This suggests that differences in development levels are primarily determined by regional characteristics rather than annual changes. A similar pattern is also seen in poverty levels (P0) and other indicators (depth – P1 and severity – P2), which show that poverty in Indonesia is structural and contextual in nature. Meanwhile, the Digital Society Index (DSI) and its pillars show a different pattern. For example, the Infrastructure and Ecosystem variables have a standard deviation over time (within-unit) of 7.99, which is higher than the variation between units (between-unit) of 6.49. A similar pattern is seen in Digital Skills, Digital Empowerment, and Digital Jobs, indicating more active digital change dynamics from year to year. Meanwhile, economic growth has greater between-unit variation than between-time variation, indicating that spatial differences (districts/cities) play a greater role than annual fluctuations.

Digital Economy and Human Development

Based on the results of the Chow, Hausman, and Breusch-Pagan Lagrange Multiplier (BPLM) tests, the Fixed Effect Model (FEM) was selected as the best model. The regression results in Table 2 show that the Digital Society Index (DSI) has a positive effect on the Human Development Index (HDI), with a coefficient of 0.07056 ($p < 0.01$). The results show that an increase in the digital society index leads to an increase in human development. This means that the higher the digital society index in each district and city, the more positive the impact on improving human quality. Empirically, these results are in line with Birdsall & Birdsall (2005), which shows the influence of economic digitalization on human development. The results of this study are also reinforced in the disaggregation model (Table 3), where the three main pillars — digital infrastructure and ecosystem, digital skills, and digital jobs — also affect Human Development. However, the digital empowerment pillar actually shows a negative relationship with the HDI, which opens up space for critical interpretation of the dynamics of digital transformation at the local level.

The finding that digital infrastructure contributes to HDI improvement is consistent with previous studies that emphasize the importance of internet access and digital devices in expanding education and health services, especially in disadvantaged areas (Mohamed et al., 2024; Zghidi & Trabelsi, 2025). Similarly, digital skills play a role in improving the quality of life through increased technological literacy and human resource capacity, which drives learning outcomes (Al-Roubaie, 2022; Mohamed et al., 2024). In addition, digital jobs create new employment opportunities in the digital economy sector, increase labor force participation and income, and strengthen the economic dimension of the HDI (Han & Tian, 2024; Zainullin et al., 2024). However, despite its expected positive impact, *Digital Empowerment* has a negative effect on HDI at the district/city level. This means that high levels of community digital activity, such as on social media and e-commerce, do not necessarily support improved quality of life if they are not directed toward productive goals or accompanied by adequate digital literacy.

Table 1. Statistical Description of Variables

Variables		mean	sd	min	max	Obs
Human Development Index	overall	71.259	6.371	34.100	88.770	N = 1,542
	between		6.351	35.197	88.247	n = 514
	within		0.556	70.163	72.369	T = 3
Poverty rate	overall	11.450	7.166	2.230	42.030	N = 1,542
	between		7.162	2.293	41.153	n = 514
	within		0.359	9.297	13.734	T = 3
Poverty Gap	overall	1.889	1.770	0.110	14.010	N = 1,542
	between		1.717	0.183	11.917	n = 514
	within		0.433	-3.421	5.459	T = 3
Poverty Severity	overall	0.502	0.682	0.010	7.590	N = 1,542
	between		0.638	0.023	5.393	n = 514
	within		0.242	-2.881	3.062	T = 3
Digital Society Index	overall	41.675	6.039	16.495	54.708	N = 1,542
	between		4.233	30.509	51.813	n = 514
	within		4.310	22.381	54.224	T = 3
Infrastructure and Ecosystem	overall	50.992	10.289	17.020	86.000	N = 1,542
	between		6.493	29.943	81.980	n = 514
	within		7.985	29.178	69.072	T = 3
Digital Skills	Overall	54.930	11.254	5.110	79.730	N = 1,542
	between		7.054	36.443	71.937	n = 514
	within		8.773	14.164	77.220	T = 3
Digital Empowerment	overall	24.642	5.496	1.000	38.340	N = 1,542
	between		3.746	14.250	33.800	n = 514
	within		4.024	9.592	35.076	T = 3
Digital Jobs	overall	36.602	6.431	13.050	59.660	N = 1,542
	between		3.286	27.267	44.243	n = 514
	within		5.530	18.919	52.822	T = 3
Growth	Overall	4.771	3.812	-10.374	102.377	N = 1,542
	between		3.139	-3.553	54.397	n = 514
	within		2.165	-31.226	52.750	T = 3

Source: Processed Data (2025)

Table 2. Comparison of Panel Data Estimators: Effect of Digital Economy on Human Development

	(1) CEM	(2) FEM	(3) REM
Digital Society Index	0.49074*** (0.02374)	0.07056*** (0.00247)	0.07421*** (0.00260)
Growth	0.15109*** (0.03762)	-0.00103 (0.00502)	0.00135 (0.00535)
Constant	50.08675*** (1.02231)	68.32374*** (0.10986)	68.16009*** (0.29799)
N	1542	1542	1542
R-square	0.22144	0.29948	0.2994
Chow test p-value		0.00000	
Hausman test p-value			0.00000
BP-LM test p-value			0.0000

Source: Processed Data (2025), Note: std. error in parentheses, * p<0.1, ** p<0.05, *** p<0.01, dependent: human development index

Table 3. Fixed Effects Regression Results: The Effect of Digital Economy and Its Pillars on Human Development

	(1) HDI	(2) HDI
Digital Society Index	0.07056*** (0.00247)	
Infrastructure and Ecosystem		0.04835*** (0.00189)
Digital Skills		0.01039*** (0.00154)
Digital Empowerment		-0.00967*** (0.00367)
Digital Jobs		0.01876*** (0.00230)
Growth	-0.00103 0.00502	-0.00443 (0.00516)
Constant	68.32374*** 0.10986	67.79627*** (0.13810)
N	1542	1542
R-square	0.29948	0.46659

Source: Processed Data (2025), Note: std. error in parentheses, * p<0.1, ** p<0.05, *** p<0.01, dependent: human development index (HDI)

Digital Economy and Poverty

The model test in Table 4 shows that FEM is again the most appropriate model for analyzing the impact of the digital economy on poverty. The results of the estimates in Tables 4 and 5 show that the Digital Society Index (IMD) consistently has a negative effect on various measures of poverty (P0, P1, and P2). These findings reinforce the argument that the digital economy contributes to poverty reduction, both in rate (P0) and the depth (P1) and severity (P2) of poverty. This is inseparable from the fact that digital transformation opens up new opportunities for poor communities through increased access to information, digital finance, and technology-based business and employment opportunities (Bamiro et al., 2024; Ng et al., 2025; Yin & Li, 2023).

Table 4. Comparison of Panel Data Estimators: Effect of Digital Economy on Poverty

	(1) CEM	(2) FEM	(3) REM
Digital Society Index	-0.36021*** (0.02873)	-0.02397*** (0.00262)	-0.02492*** (0.00265)
Growth	-0.17715*** (0.04552)	-0.00265 (0.00799)	-0.00350 (0.00813)
Constant	27.30736*** (1.23706)	12.46207*** (0.12169)	12.50594*** (0.36398)
N	1542	1542	1542
R-square	0.09890	0.08221	0.822
Chow test p-value		0.00000	
Hausman test p-value			0.00000
BP-LM test p-value			0.00000

Source: Processed Data (2025), Note: std. error in parentheses, * p<0.1, ** p<0.05, *** p<0.01, dependent: poverty rate

Table 5. Robustness Check: Relationship between Digital Society Index and Multidimensional Poverty Indicators

	Poverty rate	Poverty Gap	Poverty Severity
Digital Society Index	-0.02397*** (0.00262)	-0.00868*** (0.00278)	-0.00308* (0.00163)
Growth	-0.00265 (0.00799)	-0.00631 (0.00767)	-0.00315 (0.00386)
Constant	12.46207*** (0.12169)	2.28113*** (0.13056)	0.64522*** (0.07534)
N	1542	1542	1542
R-square	0.08221	0.00793	0.00350

Source: Processed Data (2025), Note: std. error in parentheses, * p<0.1, ** p<0.05, *** p<0.01

Based on Table 6, the three main pillars, which include digital infrastructure, digital skills, and digital jobs, show a significant negative effect on poverty levels (P0), indicating that expanding network access, improving digital literacy, and growing platform-based job opportunities play an important role in improving household economic conditions (Han & Tian, 2024; Tian et al., 2025; Zainullin et al., 2024). This effect is particularly evident in the reduction of the overall number of poor people.

Table 6. Fixed Effects Regression Results: The Effect of Digital Economy and Its Pillars on Poverty

	Poverty rate	Poverty rate
Digital Society Index	-0.02397*** (0.00262)	
Infrastructure and Ecosystem		-0.01974*** (0.00217)
Digital Skills		-0.00353** (0.00155)
Digital Empowerment		0.00881** (0.00362)
Digital Jobs		-0.01259*** (0.00293)
Growth	-0.00265 (0.00799)	-0.00095 (0.00794)
Constant	12.46207*** (0.12169)	12.89942*** (0.17685)
N	1542	1542
R-square	0.08221	0.14873

Source: Processed Data (2025), Note: std. error in parentheses, * p<0.1, ** p<0.05, *** p<0.01, dependent: poverty rate

Table 7. Robustness Check: Disaggregated Effects of Digital Infrastructure, Skills, Empowerment, and Jobs on Multidimensional Poverty

	Poverty rate	Poverty Gap	Poverty Severity
Infrastructure and Ecosystem	-0.01974*** (0.00217)	-0.00458 (0.00368)	-0.00111 (0.00224)
Digital Skills	-0.00353** (0.00155)	-0.00309* (0.00176)	-0.00126 (0.00093)

Rofiuddin: Digital Economics For Social Sustainability...

Digital Empowerment	0.00881** (0.00362)	0.00282 (0.00669)	0.0003 (0.00374)
Digital Jobs	-0.01259*** (0.00293)	-0.00578* (0.00305)	-0.00234 (0.00178)
Growth	-0.00095 (0.00794)	-0.00597 (0.00749)	-0.00311 (0.00377)
Constant	12.89942*** (0.17685)	2.46337*** (0.20670)	0.71898*** (0.12717)
N	1542	1542	1542
R-square	0.14873	0.01275	0.00611

Source: Processed Data (2025), Note: std. error in parentheses, * p<0.1, ** p<0.05, *** p<0.01

However, when analyzed against indicators of depth (P1) and severity of poverty (P2), the pattern of influence in Table 7 becomes more selective. For P1, only the Digital Skills and Digital Jobs pillars still show a significant negative influence, while Digital Empowerment and Infrastructure no longer have an effect. This suggests that skills and access to digital jobs are more effective in lifting poor groups to a more decent income level than the mere availability of infrastructure or the intensity of general digital activity. Meanwhile, on the P2 indicator (severity of poverty), none of the four pillars of the digital economy shows a significant effect. These findings show that the digital economy tends to be more effective in reducing the number and depth of poverty but is less able to reach the poorest groups who are in the most vulnerable conditions. Another finding is that Digital Empowerment consistently has a positive and insignificant effect on poverty (P0 and P1), which is in line with previous findings on human development, indicating that digital activities are not necessarily economically productive.

Overall, the results of this study confirm that the digital economy has significant potential to strengthen human development and reduce poverty. However, its impact is highly dependent on the dominant digital pillar and how it is implemented at the local level. Pillars such as digital skills and digital jobs have been shown to make a positive contribution. In contrast, digital empowerment can actually have a negative impact if it is not accompanied by critical literacy and adequate inclusion strategies. Therefore, the formulation of digital policies should not only encourage increased access to or use of technology but should also take into account the quality gap in its utilization.

CONCLUSION

This study shows that the digital economy, as measured by the Digital Society Index (DSI), generally contributes positively to increasing the Human Development Index (HDI) and reducing poverty (P0, P1, P2) at the district/city level in Indonesia. The pillars of digital skills and digital jobs are the most consistent determinants in driving human development and poverty alleviation, while digital infrastructure has a greater impact on HDI improvement. However, the results also reveal that digital empowerment has a negative impact on HDI and is inconsistent with poverty indicators, showing that an increase in the intensity of digital activities is not always directly proportional to the quality of life. This underscores the importance of productive and critical digital literacy so that digital transformation does not deepen existing disparities.

REFERENCES

- Ahmed, A., Ehsan, N., Mirza, E., Awan, S. A., & Ishaque, A. (2010). Information technology: A means of quality in healthcare. *Proceedings - 2010 3rd IEEE International Conference on Computer Science and Information Technology, ICCSIT 2010*, 9, 26–30. <https://doi.org/10.1109/ICCSIT.2010.5564669>
- Al-Roubaie, A. (2022). Rethinking Education in Arab Countries: The Case of COVID-19. In

- COVID-19 Challenges to University Information Technology Governance (pp. 83–101). https://doi.org/10.1007/978-3-031-13351-0_4
- Avom, D., & Ngounou, B. A. (2025). Bright cities and intelligences: Can access to ICTs sustainably reduce energy poverty in Africa? *Energy Policy*, 202. <https://doi.org/10.1016/j.enpol.2025.114568>
- Awad, A. (2023). Information and communication technologies role in alleviating poverty in Sub-Saharan Africa: Impacts and transmission channels. *Sustainable Development*, 31(2), 1149–1165. <https://doi.org/10.1002/sd.2447>
- Bamiro, N. B., Oshoba, A. O., & Raimi, B. O. (2024). Driving Economic Prosperity: Digital Finance in Economically Disadvantaged Agricultural Regions. In *Agripreneurship and the Dynamic Agribusiness Value Chain* (pp. 153–165). https://doi.org/10.1007/978-981-97-7429-6_9
- Birdsall, S. A., & Birdsall, W. F. (2005). Geography matters: Mapping human development and digital access. *First Monday*, 10(10). <https://doi.org/10.5210/fm.v10i10.1281>
- Blaschke, C. M., Freddolino, P. P., & Mullen, E. E. (2009). Ageing and technology: A review of the research literature. *British Journal of Social Work*, 39(4), 641–656. <https://doi.org/10.1093/bjsw/bcp025>
- Boakye, A. (2024). Estimating the impact of digital technologies on government operations, business operations and general welfare: The case of South Africa. *African Journal of Science, Technology, Innovation and Development*, 16(2), 274–282. <https://doi.org/10.1080/20421338.2023.2296181>
- Chernysheva, Y. S., Gornostaeva, Z. V., & Mikhailov, A. B. (2023). The Use of Human Resources to Drive Business Transformation Through Digital Evolution. In *Approaches to Global Sustainability, Markets, and Governance: Vol. Part F175* (pp. 279–284). https://doi.org/10.1007/978-981-19-4005-7_31
- Dzator, J., Acheampong, A. O., Appiah-Otoo, I., & Dzator, M. (2023). Leveraging digital technology for development: Does ICT contribute to poverty reduction? *Telecommunications Policy*, 47(4). <https://doi.org/10.1016/j.telpol.2023.102524>
- Gujarati, D. N. (2009). *Basic Econometric*.
- Han, L., & Tian, Z. (2024). Digital Economy and Skills Wage Gap: An Empirical Study with CFPS Data. *Modern Economic Science*, 46(2), 75–89. <https://doi.org/10.20069/j.cnki.DJKX.202402006>
- Iqbal, K., Hassan, S. T., & Peng, H. (2019). Analyzing the role of information and telecommunication technology in human development: panel data analysis. *Environmental Science and Pollution Research*, 26(15), 15153–15161. <https://doi.org/10.1007/s11356-019-04918-4>
- KOMDIGI. (2020a). *Langkah Menuju “100 Smart City.”* Komdigi.Go.Id. <https://www.komdigi.go.id/berita/sorotan-media/detail/langkah-menuju-100-smart-city>
- KOMDIGI. (2020b). *Wujudkan Digital Nation, Kominfo Fasilitas Ruang Digital dan Literasi.* Komdigi.Go.Id. <https://www.komdigi.go.id/berita/pengumuman/detail/wujudkan-digital-nation-kominfo-fasilitas-ruang-digital-dan-literasi>
- Kurantin, N., & Osei-Hwedie, B. Z. (2019). Digital financial integration, investment, economic growth, development and poverty reduction. In *The Gains and Pains of Financial Integration and Trade Liberalization: Lessons from Emerging Economies* (pp. 101–112). <https://doi.org/10.1108/978-1-78973-999-220191015>
- Li, J., Wu, M., & Zhi, Y. (2025). Digital Economy Development and Children's Health Outcomes: Evidence and Mechanisms. *Emerging Markets Finance and Trade*. <https://doi.org/10.1080/1540496X.2025.2480161>
- Li, Z., Hong, Y., & Zhang, Z. (2018). Empowerment or substitution? Entry of Platform-based Sharing Economy on the Local Labor Markets. *International Conference on Information Systems 2018, ICIS 2018*. <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062510301&partnerID=40&md5=ac279d34d1cbae2ff5cebf84733a6740>
- Mohamed, N. M. A., Frega, K. A.-E. A., & Binsuwadan, J. (2024). Can the Digital Economy Outperform the Oil Economy in Terms of Achieving Human Development? *Sustainability (Switzerland)*, 16(12). <https://doi.org/10.3390/su16125028>

- Ng, T.-H., Lim, Y.-Z., Lye, C.-T., Chan, K.-H., & Lim, Y.-S. (2025). Catalysing sustainable change: the role of digital finance in poverty alleviation in Asia. *Quality and Quantity*, 59(Suppl 2), 1305–1325. <https://doi.org/10.1007/s11135-025-02067-0>
- Nugroho, W., Threestayanti, L., Febrian, E., Gintings, C., Widarningsih, A. W., Afandi, Yulianti, R., & Rosdalina, I. (2017). *Gerakan Menuju 100 Smart City 2017: Risalah Penyusunan Master Plan Smart City di 24 Kota/kabupaten Peserta Gerakan Menuju 100 Smart City Tahap Pertama*. Direktorat E-Government, Kementerian Komunikasi & Informatika Republik Indonesia berkerjasama dengan Majalah InfoKomputer Kompas Gramedia.
- Oladipo, O., Murphy, A., Anannsingh-Jamieson, F., & Amaghionyeodiwe, L. (2016). Information and communication technology, and economic growth in Nigeria: A time series analysis. *International Journal of Technology, Policy and Management*, 16(2), 149–162. <https://doi.org/10.1504/IJTPM.2016.076315>
- Pesaran, M. H. (2015). *Time series and panel data econometrics*. Oxford University Press.
- Tian, Y., Hua, M., Li, W., & Nike, J. (2025). Energy poverty, digital economy, and financial deepening: A study of regional differences based on transportation geography. *International Journal of Hydrogen Energy*, 131, 287–297. <https://doi.org/10.1016/j.ijhydene.2025.04.300>
- Urunov, R., Makhmudov, S., Mamadiyrov, Z., Khamdamov, S.-J., Kurbanov, Z. N., & Dadabaev, U. (2023). Digitalization and its Econometric Analysis on Transforming Sustainable Regional Development into Improved Population Living Standards. *ACM International Conference Proceeding Series*, 438–442. <https://doi.org/10.1145/3644713.3644776>
- Wang, Y., Wang, Y., & Shahbaz, M. (2023). How does digital economy affect energy poverty? Analysis from the global perspective. *Energy*, 282. <https://doi.org/10.1016/j.energy.2023.128692>
- Yin, Z., & Li, Y. (2023). The Impact of Mobile Payment on Relative Poverty. *Modern Economic Science*, 45(5), 128–140. <https://doi.org/10.20069/j.cnki.DJKX.202305010>
- Yousefi, A. (2011). The impact of information and communication technology on economic growth: Evidence from developed and developing countries. *Economics of Innovation and New Technology*, 20(6), 581–596. <https://doi.org/10.1080/10438599.2010.544470>
- Zainullin, S. B., Feng, P., Nwachukwu, R. C., Zhang, Y., & Zuo, S. (2024). Impact of the Development of Digital Economy on Economic Growth and International Cooperation. In *Sustainable Civil Infrastructures: Vol. Part F3650* (pp. 195–203). https://doi.org/10.1007/978-3-031-70962-3_23
- Zghidi, N., & Trabelsi, R. (2025). Impact of Digitalization on Sustainable Development: A Comparative Analysis of Developed and Developing Economies. *Journal of Risk and Financial Management*, 18(7). <https://doi.org/10.3390/jrfm18070359>
- Zhang, K., & Bu, C. (2024). The power of digitalization: A study of the effect of the digital economy on household energy poverty. *Energy*, 313. <https://doi.org/10.1016/j.energy.2024.133652>