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A Literature Review of Digital Economy Measurement Methods and Indexes

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Abstract

The rapid development of the digital economy has posed formidable challenge in accurately measuring its level and impact. This review systematically assesses the existing approaches used to measure the digital economy, identifies the primary indicators used for index construction and highlights the research gap through a comprehensive literature review. It reviewed the relevant articles from the Web of Science in the field of "Economic and Business" from 2022 to 2024. The review reveals that index construction and production efficiency approaches are used by the scholars to gauge the levels of the digital economy. However, index construction emerges as the most frequently adopted approach. Scholars often employ the entropy method, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) entropy method and Principal Component Analysis (PCA) to compute the digital economy index. Additionally, this review also highlights the directions for future research, emphasizing a need for novel approaches and methods that may capture the complexity and the dynamic understanding of the digital economy and its multifaceted impacts on global economic development.

Keywords: Digital Economy Index, Measurements, Digital Economy Indicators, Entropy Method, Principal Component Analysis (PCA)

Introduction

Over the past decade, the digital economy has emerged as a crucial driver of global economic growth (Xia et al., 2024). According to the International Telecommunication Union (ITU), the digital economy encompasses all economic activities facilitated by digital computing technologies (Katz, 2017). With the rapid advancement of technologies, particularly the widespread adoption of cloud computing, big data, artificial intelligence, and the Internet of Things, the impact of the digital economy is profound. It transforms the traditional industrial structures, giving rise to new markets and business models (Javaid et al., 2022).

In recent years, the concept of the digital economy has attracted considerable interest in recent years, with various authors proposing different definitions and frameworks to describe it (Cohen, 2002; Classon, 2004; Zhang et al., 2022; Ren et al., 2022; Luo et al., 2022). Some researchers suggests that information is the fundamental element of the digital economy is information, highlighting its critical role in all economic activities (Cohen, 2002; Singh, 2003; Gulomov, 2019). Moreover, some have also emphasised the transformative power of information and communication technology (ICT) in the digital economy. They defined the digital economy as a global information paradigm, leveraging technological platforms to drive financial and economic activities such as production, distribution, exchange, and consumption of goods and services (Carlsson, 2004; Tsyganov and Apalkova 2016). Subsequently, Ahmedov (2020) stressed the importance of data in the digital economy, enhancing the efficiency of storage, sale, and delivery across various industries. Besides, elements such as digital platforms and artificial intelligence also play crucial roles in the digital economy (Ganichev and Koshovets, 2021). In summary, the digital economy encompasses a wide range of definitions and perspectives, emphasizing the transformative impact of information, ICT, data, and digital infrastructure.

Despite widespread recognition of its significance, precise measurement of the level and the impact of the digital economy remains a formidable challenge. Having precise measurement is not only crucial for understanding trends within the digital economy, but also vital for formulating effective policies that promote economic growth and market competitiveness. Traditional economic measurement methods often fall short when addressing the diversity and complexity of the digital economy, prompting the development of novel methods of measurement.

This study aims to systematically assess the existing approaches used to measure the digital economy, identify the primary indicators used for index construction, and highlight the research gap through a comprehensive literature review.

Research Methodology

This study employs a literature review approach to systematically gather peer-reviewed articles focusing on measuring the digital economy sourced from the Web of Science over the past three years.

The selection of articles was guided by four main criteria. First, the term “digital economy” must be reflected in the title of the article and the term “measure” must appear in the abstract in order to be selected. Second, the articles must be peer-reviewed and indexed in the Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI). Third, to capture the most recent development in digital economy, only articles published between 2022 and 2024 will be selected for preliminary analysis. Lastly, the articles will be narrowed down to the research area “Economic and Business”, and the final selection will be based on the content and relevance to the digital economy measurement.

Results and Discussion

The search for the articles was carried out on May 21, 2024. Following the selection criteria, a total of 320 articles, from the Web of Science, with the terms “digital economy” in the title and “measure” in the abstract is identified, but only 203 articles were listed in SCIE, SSCI and A&HCI. Of these, 172 articles published between 2022 and 2024 were include in the preliminary review by country and research areas. The selection is further narrowed down to

36 articles categorised under the research area "Economic and Business", and only 24 articles were finally selected for the digital economy measurement review.

Figure 3.1 illustrates the research areas related to the digital economy. It highlights diversity and multidisciplinary of the research areas associated with the digital economy studies. The figure shows that "Environmental Sciences Ecology" is the most frequent area of research, emphasising the significant focus on the link between the environmental issues and digital technologies (Zhang et al., 2022a; Liu et al., 2022; Xu et al., 2022). This is followed by "Science Technology Other Topics" and "Business Economics", which indicate a strong interest in the technological innovations and the economic impacts of the digital economy (Ma & Zhu, 2022). Other notable areas include "Public Environmental Occupational Health" and "Social Sciences Other Topics", showcasing the breadth of digital economy research that spans from public health to societal impacts. This distribution underscores the complexity and diversity of digital economy studies, encompassing aspects from technological innovations to environmental sustainability.

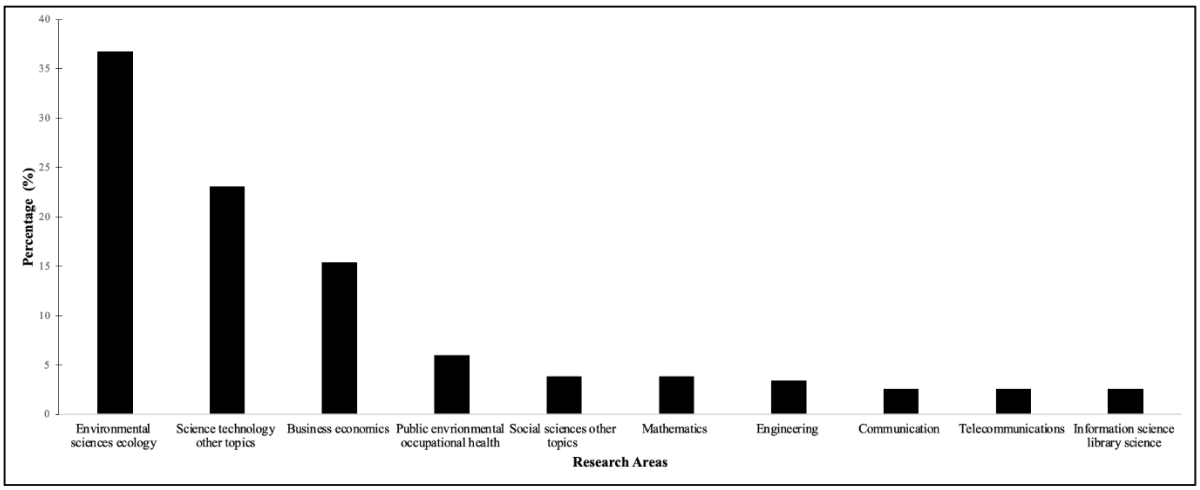

Figure 3.1 Digital Economy by Research Areas (%)
Source: Compiled by the authors based on the search on Web of Science (May 21, 2024)

Figure 3.2 presents the distribution of digital economy research by country. It highlights the importance of digital economy research, especially in China. It accounts for approximately 80% of the selected research articles, underscoring its significant role in the study of the digital economy. Other regions show minimal representation, indicating a disparity in digital economy research focus and intensity across the globe.

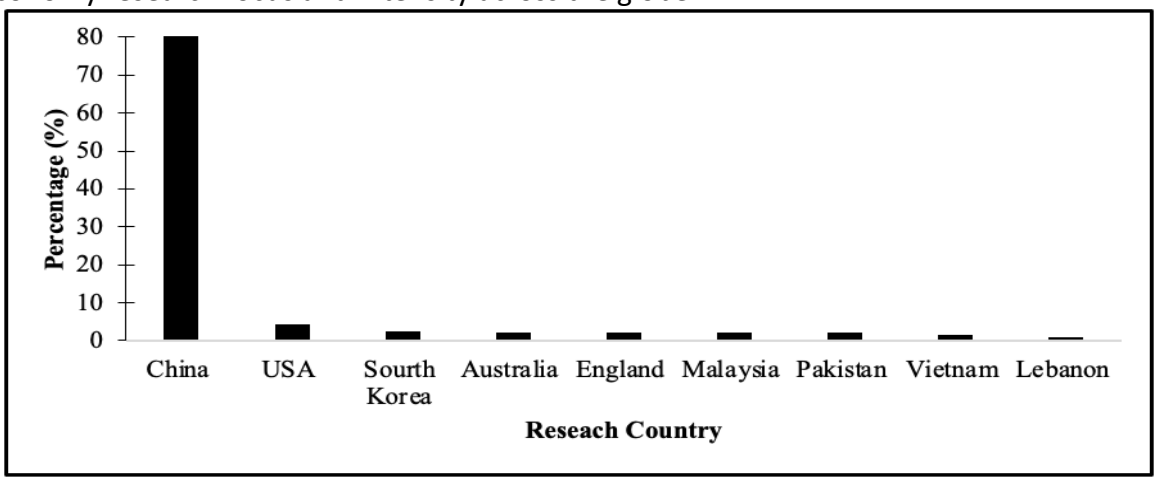

Figure 3.2 Digital Economy by Research Country (%)
Source: Compiled by the authors based on the search on Web of Science (May 21, 2024)

Digital Economy Research Period, Scopes, and Focus

Table 3.1 presents a detailed summary of the final 24 selected research articles according to research period, study location, and focus areas. These studies utilised data spanning from 2003 to 2024, with a notable concentration of studies between 2011 and 2019. Almost all the studies were carried out within China, with only one study in Europe. This highlights the prominence interest of Chinese scholar in exploring digital economic development across various cities and provinces.

The research focus includes green and sustainable development, innovation and technological advancement, energy efficiency and carbon emissions management, economic performance measurement, and social and economic disparities. The majority of studies focus on integrating sustainable practices with economic growth, leveraging technological progress for competitive advantage, and exploring how digitalization in mitigating environmental impact.

Table 3.1
The 24 selected articles in "Economic and Business"

Studies	Period	Location	Focus Area
Ma & Zhu (2022)	2010-2018	281 cities in China	Innovation, high quality green development
Zhang et al (2022)	2011-2019	277 cities in China	Carbon emission
Ren et al (2022)	2004-2019	282 cities in China	Green growth
Luo et al (2022)	2011-2019	108 cities along China's Yangtze River Economic Belt (YREB)	Green development efficiency
Lin & Huang (2023)	2011-2019	227 Chinese cities	Electricity intensity
Chen & Wu (2022)	2012-2018	31 Chinese provinces	Intellectual property protection
Zhu & Lan (2023)	2011-2019	277 Chinese cites	Carbon rebound effect
Liang & Tan (2024)	2012-2020	30 provinces in China	Export technology upgrading
Hong et al (2023)	2011-2018	30 provinces in China	Green development of agriculture
Yao et al (2023)	2007-2018	11 marine provinces of China	Marine low carbon
Ye et al (2022)	2006-2020	30 provinces in China	Tourism industry, industrial integration
Liu et al (2024)	2011-2020	31 Chinese provinces	Industrial agglomeration, and green innovation efficiency
Wang et al (2024)	2010-2019	Chinese A-share listed firms in Shanghai and Shenzhen	Energy-consuming rights trading, green total factor productivity

Luo et al (2023)	2011-2020	41 Chinese cities	Urban green development
Liu et al (2024)	2011-2016	China's customs export data	Agricultural exports
Xu et al (2024)	2011-2019	prefecture-level city in China	Synergistic pollution control and carbon reduction
Lin & Baskaran (2024)	2011-2020	31 provinces in China	tax competition
Tao et al (2024)	2011-2020	provincial panel data	rural residents' income
Wu et al (2024)	2011-2019	provincial data of China	income inequality
Xie et al (2024)	2011-2021	207 cities in China	manufacturing high-quality development
Guo et al (2024)	2011-2019	274 cities in China	Green Technology Innovation
Lin et al (2024)	2011-2019	Representative port cities in Guangdong	Spatial effect
Wen et al (2023)	2003-2019	2 core industries of China's digital economy	Green Technology Innovation
Skvarciany et al (2023)	No	27 EU countries	Efficiency

Digital Economy Measurement Method

As shown in Table 3.2, there are two primary approaches, index construction and production efficiency, used to measure the digital economy in the 24 reviewed articles. Index construction is the most prevalent approach, utilized by scholars in 22 articles. Methods such as PCA, entropy, and TOPSIS entropy methods are frequently used by the scholars to compute the digital economy index across 20 articles. In addition, methods such as the CRiteria Importance Through Intercriteria Correlation (CRITIC) method and the equal weight method are also used in the literature. In contrast, the production efficiency approach such as input-output efficiency, and Data Envelopment Analysis (DEA) is less frequently used. Nevertheless, this approach offers precise estimation of the value added or the production efficiency of the digital economy (Wen et al., 2023; Skvarciany et al., 2023).

Table 3.2
Digital economy measurement of 24 selected articles

Studies	Index Construction	Methods
Ma & Zhu (2022)	Yes	Equal weight
Zhang et al (2022)	Yes	Entropy
Ren et al (2022)	Yes	PCA
Luo et al (2022)	Yes	PCA
Lin & Huang (2023)	Yes	Entropy
Chen & Wu (2022)	Yes	CRITIC method
Zhu & Lan (2023)	Yes	Entropy
Liang & Tan (2024)	Yes	TOPSIS entropy
Hong et al (2023)	Yes	PCA
Yao et al (2023)	Yes	Entropy
Ye et al (2022)	Yes	Entropy
Liu et al (2024)	Yes	Entropy
Wang et al (2024)	Yes	PCA
Luo et al (2023)	Yes	Entropy
Liu et al (2024)	Yes	PCA
Xu et al (2024)	Yes	Equal weight Entropy; CRITIC method
Lin & Baskaran (2024)	Yes	TOPSIS entropy
Tao et al (2024)	Yes	PCA
Wu et al (2024)	Yes	PCA
Xie et al (2024)	Yes	Entropy
Guo et al (2024)	Yes	PCA
Lin et al (2024)	Yes	TOPSIS entropy
Wen et al (2023)	No	Input-output efficiency
Skvarciany et al (2023)	No	Data envelopment analysis (DEA)

Source: Compiled by author

Digital Economy Index

Table 3.3 revealed that “Digital Infrastructure” and “Digital Finance” are the two most frequently indicators used in index construction. Both digital infrastructure and digital finance have been used by 14 and 13 studies, respectively. This highlights their pivotal roles in contemporary research. Digital infrastructure, encompassing information and communication technology (ICT), internet services, internet connectiveness, and digital platforms, forms the fundamental for digital economy development (Milskaya & Seeleva, 2019; Kim, 2006). Adequate funding and advancements in financial instruments are essential for improving environmental conditions, enhancing corporate innovation, and accelerating the digital economy development (Akberdina et al., 2024; Li et al., 2023).

Digital industry development is the third primary indicator, featured in 10 articles. This indicator assesses the extent to which traditional industries have transformed through the adoption of digital techonologies (Xie et al., 2024; Ye et al., 2022).

The digital application indicator is employed in 6 studies. This indicator emphasises the transformative impact of digital tools and platforms in improving efficiency, accessibility, and innovation (Liu et al., 2024; Tao et al., 2024). Similarly, the internet development indicator,

which is the fundamental component of digital transformation, is utilised by scholars in 5 articles. It serves as the backbone for diverse digital technologies and applications, facilitating connectivity, information exchange, and access to digital services.

Other indicators such as human captial and digital innvoation are featured in 3 articles. Human capital, which includes essential skills, knowledge, and competencies, plays an important role in driving the digital transformation and innovation.Meanwhile, digital innovation itself, serves as a key driver of economic growth and competitiveness (Zhang et al., 2023; Zhu & Lan, 2023).

Table 3.3
Counts of primary indicators

Indicator	Counts	Studies
Digital infrastructure	14	Ma & Zhu (2022), Chen & Wu (2022), Ye et al. (2022), Liu, Y. et al. (2024), Xie et al. (2024), Lin & Baskaran (2024), Luo et al. (2023), Wang et al. (2024), Liang & Tan (2024), Tao et al. (2024), Zhang et al. (2022b), Zhu & Lan (2023), Skvarciany et al. (2023), Ren et al. (2022)
Digital finance	13	Zhang et al. (2022b), Zhu & Lan (2023), Hong et al. (2023), Guo et al. (2024), Lin & Baskaran (2024), Luo et al. (2022), Lin & Huang (2023), Luo et al. (2023), Luo et al. (2022), Xie et al. (2024), Wang et al. (2024), Wu et al. (2024)
Digital industry development	10	Lin & Baskaran (2024), Xie et al. (2024), Ye et al. (2022), Wu et al. (2024), Chen & Wu (2022)
Digital applications	6	Liu, J. et al. (2024), Tao et al. (2024), Ren et al. (2022), Liang & Tan (2024), Ye et al. (2022)
Internet development	5	Wang et al. (2024), Lin et al. (2024), Wen et al. (2023), Zhang et al. (2022b), Zhu & Lan (2023), Wang et al. (2024)
Human capital	3	Zhang et al. (2022), Zhu & Lan (2023), Skvarciany et al. (2023)
Digital innovation	3	Liu et al. (2024), Tao et al. (2024), Chen & Wu (2022)
Digital production	2	Liu et al. (2024), Tao et al. (2024)
Total telecommunication business per capita	2	Zhang et al. (2022b), Zhu & Lan (2023)
Postal business per capita	2	Zhang et al. (2022b), Zhu & Lan (2023)
ICT	1	Chen & Wu (2022)
Digital economy resources	1	Ren et al. (2022)
Development potential	1	Liang & Tan (2024)
Integration of digital technology	1	Skvarciany et al. (2023)
Digital public services	1	Skvarciany et al. (2023)
Capitalization level of digital economy enterprises	1	Chen & Wu (2022)
The informatization	1	Wu et al. (2024)

Source: Compiled by author

Figure 3.3 presents the frequency of indicators used across the 22 selected articles. It clearly illustrated the areas within the digital economy that have attracted the most academic interest. Both "digital infrastructure" and "digital finance" emerge as the most frequently

used indicators, underscoring their importance in constructing digital economy index. In cosntract, indicators such as "digital public services", “information” and "capitalization level of digital economy enterprises" are less frequently employed. This suggests that these areas are relatively underexplored, pointing to the potential areas for future research.

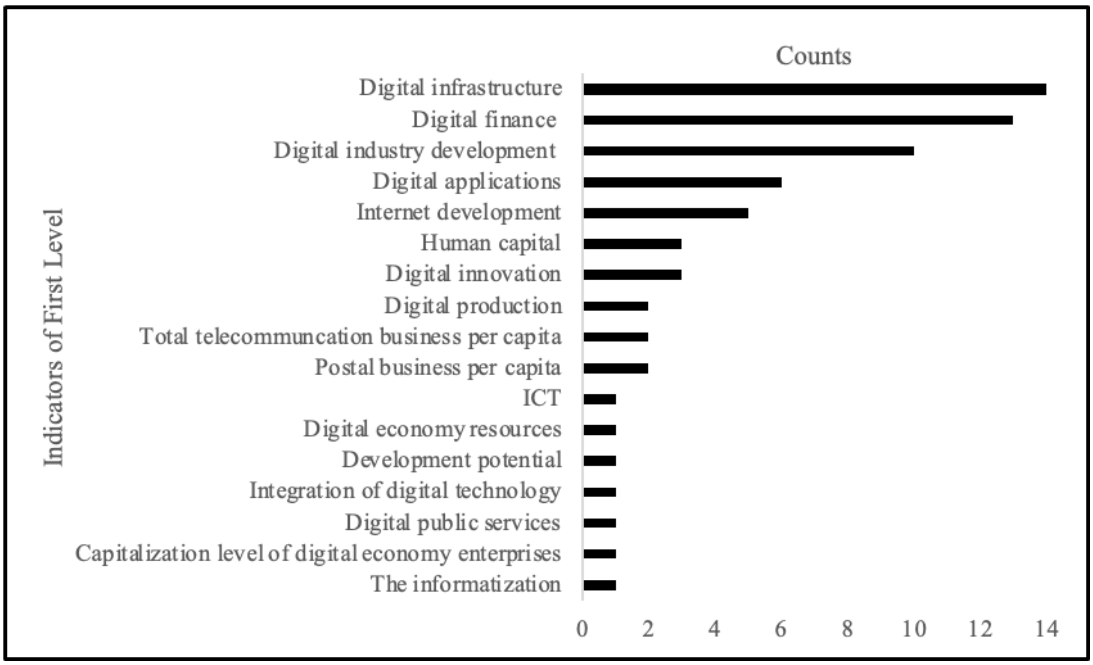

Figure 3.3 Counts of Indicoatrs in First Level
Source: Complied by author

Conclusion and Future Direction

This study first reviewed a total of 172 articles related to digital economy from SCIE, SSCI, and A&HCI (Web of Science) spanning year 2022 to 2024. Subsequently, it focused on the 24 articles categorised under the research area of “Economic and Business” for a detailed examination of digital economy measurement.

The review identifies two main approaches to measuring the digital economy: index construction and production efficiency. Methods such as the entropy method, TOPSIS entropy method and PCA method are commonly used to compute digital economy index using multi-dimensionality indicators. The digital economy index is crucial for understanding how digital economy reshapes traditional industries, drives innovations, and fosters new business models.

The review of the 172 articles highlights a notable diversity and multidisciplinary nature in research areas related to the digital economy. The three prominent research areas include environmental sciences ecology, science technology and business economics. The majority of digital economy research is concentrated in China.

In the focused review of the 24 articles, primary digital indicators from various dimensions have been used to measure the level of digital economy. Digital infrastructure, digital finance and digital industry development emerge as the three most frequently used indicators, highlighting their important roles in constructing the digital economy index. In addition, digital applications and internet development are also utilized to measure the digital economy.

Traditional digital economy approaches frequently fail to capture the complexity and dynamism of the digital economy. Despite the substantial development in understanding and measuring the digital economy, challenges persist. There is a need for novel approaches and methods to accurately capture its development stage and impacts. Furthermore, there is a distinct lack of studies undertaken outside of China and in areas such as exports and foreign direct investments, which offer promising opportunities for future research.

Reference

Ahmedov, I. (2020). The impact of digital economy on international trade. *European Journal of Business and Management Research, 5*(4).

Akberdina, V., Lavrikova, Y., & Vlasov, M. (2024). Environmental financing: Does digital economy matter? *Frontiers in Environmental Science, 11.* https://doi.org/10.3389/fenvs.2023.1268286

Bukht, R., & Heeks, R. (2017). Defining, conceptualising and measuring the digital economy. *Manchester Centre for Development Informatics Working Paper 68.* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3431732

Carlsson, B. (2004). The digital economy: what is new and what is not? *Structural Change and Economic Dynamics, 15*(3), 245-264.

Chen, W., & Wu, Y. (2022). Does intellectual property protection stimulate digital economy development? *Journal of Applied Economics, 25*(1), 723–730. https://doi.org/10.1080/15140326.2022.2045846

Cohen, G., Salomon, I. & Nijkamp, P. (2002) Information-communications technologies (ICT) and transport: does knowledge underpin policy? *Telecommunications Policy, 26*, 31- 52.

Ganichev, N. A., & Koshovets, O. B. (2021). Forcing the digital economy: how will the structure of digital markets change as a result of the COVID-19 pandemic. *Studies on Russian Economic Development, 32*(1), 11–22. https://doi.org/10.1134/S1075700721010056

Gulomov S.S. (2019). Blockchain technologies in the digital economy. *Economics and Finance*, 2019, 396.

Guo, F., Yang, C., & Feng, S. (2024). The impact of digital economy on green technology innovation and its mechanism: evidence from 274 cities in China. *Emerging Markets Finance and Trade,* 1–15.

Hong, M., Tian, M., & Wang, J. (2023). The impact of digital economy on green development of agriculture and its spatial spillover effect. *China Agricultural Economic Review, 15*(4), 708–726. https://doi.org/10.1108/CAER-01-2023-0004

Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Gonzalez, E. S. (2022). Understanding the adoption of Industry 4.0 technologies in improving environmental sustainability. *Sustainable Operations and Computers, 3*, 203–217. https://doi.org/10.1016/j.susoc.2022.01.008

Katz, R.L. (2017). Social and economic impact of digital transformation on the economy. *GSR-17 Discussion Paper.* Accessed on: https://www.itu.int/en/ITU-D/Conferences/GSR/Documents/GSR2017/Soc_Eco_impact_Digital_transformation_finalGSR.pdf

Kim, J. (2006). Infrastructure of the digital economy: Some empirical findings with the case of Korea. *Technological Forecasting and Social Change, 73*(4), 377–389. https://doi.org/10.1016/j.techfore.2004.09.003

Li, Q., Chen, H., Chen, Y., Xiao, T., & Wang, L. (2023). Digital economy, financing constraints, and corporate innovation. *Pacific-Basin Finance Journal, 80*, 102081. https://doi.org/10.1016/j.pacfin.2023.102081

Liang, S., & Tan, Q. (2024). Can the digital economy accelerate China's export technology upgrading? Based on the perspective of export technology complexity. *Technological Forecasting and Social Change, 199*, 123052. https://doi.org/10.1016/j.techfore.2023.123052

Lin, B., & Huang, C. (2023). How will promoting the digital economy affect electricity intensity? *Energy Policy, 173*, 113341.

Lin, B., Tang, J., Dai, C., & Lu, B. (2024). Spatial effect of digital economy on the coordinated development of Port cities. *Research in Transportation Economics, 103*, 101385. https://doi.org/10.1016/j.retrec.2023.101385

Lin, X., & Baskaran, A. (2024). Regional economic growth, digital economy and tax competition in China: Mechanism and spatial assessment. *Journal of the Asia Pacific Economy*, 1–27. https://doi.org/10.1080/13547860.2024.2325251

Liu, J., Fang, Y., Ma, Y., & Chi, Y. (2024). Digital economy, industrial agglomeration, and green innovation efficiency: Empirical analysis based on Chinese data. *Journal of Applied Economics, 27*(1), 2289723.

Liu, Y., Dong, Y., & Qian, W. (2024). Digital economy and China's agricultural exports: Based on trade cost and market competition effect. *China Agricultural Economic Review*. https://doi.org/10.1108/CAER-08-2023-0213

Liu, Y., Yang, Y., Li, H., & Zhong, K. (2022). Digital economy development, industrial structure upgrading and green total factor productivity: empirical evidence from China's cities. *International Journal of Environmental Research and Public Health, 19*(4), Article 4. https://doi.org/10.3390/ijerph19042414

Luo, K., Liu, Y., Chen, P.-F., & Zeng, M. (2022). Assessing the impact of digital economy on green development efficiency in the Yangtze River Economic Belt. *Energy Economics, 112*, 106127. https://doi.org/10.1016/j.eneco.2022.106127

Luo, W., Tang, G., Yang, P., Jia, C., & Yang, R. (2023). Examining digital economy's role in urban green development: A study of the Yangtze River Delta Region. *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-023-01532-1

Ma, D., & Zhu, Q. (2022). Innovation in emerging economies: Research on the digital economy driving high-quality green development. *Journal of Business Research, 145,* 801–813. https://doi.org/10.1016/j.jbusres.2022.03.041

Milskaya, E., & Seeleva, O. (2019). Main directions of development of infrastructure in digital economy. *IOP Conference Series: Materials Science and Engineering, 497*, 012081. https://doi.org/10.1088/1757-899X/497/1/012081

Ren, S., Li, L., Han, Y., Hao, Y., & Wu, H. (2022). The emerging driving force of inclusive green growth: Does digital economy agglomeration work? *Business Strategy and the Environment, 31*(4), 1656–1678.

Singh, N. (2003). The digital economy. *The Internet Encyclopedia*, 1-33.

Skvarciany, V., Lapinskaite, I., & Stasytyte, V. (2023). Efficiency of digital economy in the context of sustainable development: DEA-Tobit approach. *Prague Economic Papers, 32*(2), 129–158. https://doi.org/10.18267/j.pep.824

Tao, J., Wang, Z., Xu, Y., Zhao, B., & Liu, J. (2024). Can the digital economy boost rural residents' income? Evidence from China based on the spatial Durbin model. *Economic Analysis and Policy, 81*, 856–872.

Tsyganov, S., & Apalkova, V. (2016) Digital economy: a new paradigm of global information society. *Economic Review, 45*, 295-331.

Wang, W., Wang, J., & Wu, H. (2024). The impact of energy-consuming rights trading on green total factor productivity in the context of digital economy: Evidence from listed firms in China. *Energy Economics, 131*, 107342.

Wen, H., Liang, W., & Lee, C.C. (2023). Input–output efficiency of China's digital economy: statistical measures, regional differences, and dynamic evolution. *Journal of the Knowledge Economy.* https://doi.org/10.1007/s13132-023-01520-5

Wu, M., Ma, Y., Gao, Y., & Ji, Z. (2024). The impact of digital economy on income inequality from the perspective of technological progress-biased transformation: Evidence from China. *Empirical Economics*. https://doi.org/10.1007/s00181-024-02563-6

Xia, L., Baghaie, S., & Mohammad, S.S. (2024). The digital economy: Challenges and opportunities in the new era of technology and electronic communications. *Ain Shams Engineering Journal, 15*(2), 102411.

Xie, W., Dong, X., & Zhang, Q. (2024). The effects and mechanisms of digital economy on manufacturing high-quality development: An empirical study based on 207 prefecture-level and above cities in China. *Applied Economics, 1–19.* https://doi.org/10.1080/00036846.2024.2312397

Xu, J., Wang, J., Yang, X., Jin, Z., & Liu, Y. (2024). Digital economy and sustainable development: insight from synergistic pollution control and carbon reduction. *Journal of the Knowledge Economy.* https://doi.org/10.1007/s13132-024-01950-9

Xu, S., Yang, C., Huang, Z., & Failler, P. (2022). Interaction between digital economy and environmental pollution: new evidence from a spatial perspective. *International Journal of Environmental Research and Public Health, 19*(9), 5074. https://doi.org/10.3390/ijerph19095074

Yao, W., Zhang, W., & Li, W. (2023). Promoting the development of marine low carbon through the digital economy. *Journal of Innovation & Knowledge, 8*(1), 100285. https://doi.org/10.1016/j.jik.2022.100285

Ye, X., Wang, J., & Sun, R. (2022). The coupling and coordination relationship of the digital economy and tourism industry from the perspective of industrial integration. *European Journal of Innovation Management, 27*(4), 1182–1205. https://doi.org/10.1108/EJIM-08-2022-0440

Zhang, W., Liu, X., Wang, D., & Zhou, J. (2022a). Digital economy and carbon emission performance: Evidence at China's city level. *Energy Policy, 165*, 112927. https://doi.org/10.1016/j.enpol.2022.112927

Zhu, Y., & Lan, M. (2023). Digital economy and carbon rebound effect: Evidence from *Chinese cities. Energy Economics, 126*, 106957.