The Digital Economy Enables Sustainable Development in the Yangtze River Delta

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Abstract: With the rapid economic growth, the concept of digital economy and sustainable development has gradually become the main task facing our country. This paper constructs the evaluation system of the development level of digital economy and the comprehensive index of regional sustainable development by the entropy weight method, uses the two-way fixed effect model to explore the influence mechanism of digital economy on the sustainable development of the Yangtze River Delta region.
Keywords: Digital Economy; Sustainable Development; Two-Way Fixed Effect Model; Regional Heterogeneity

1. Introduction

Digital economy is one of the most rapidly developing economic fields in recent years. The continuous innovation and application of digital technologies have brought new opportunities and challenges to economic development. The digital economy has become an important driving force for global economic growth and an important means for economic transformation and upgrading in many countries and regions. In 2022, the government report proposed that while promoting the development of the digital economy, it is also necessary to strengthen new development concepts and focus on coordinating the sustainable development of various regions. According to the 2019 Digital Economy Report released by the United Nations Conference on Trade and Development, the size of the digital economy is expected to account for 4.5 to 15.5[4]It can be seen that the digital economy has become a new driving force for economic development, bringing new opportunities and ways for sustainable development in all regions. Therefore, how to use digital economy to alleviate environmental pollution, so achieving regional sustainable development is the main problem to be solved in our country.

2. Literature Review

At present, digital economy and sustainable development have gradually become

the focus of many scholars. Ruyi Wang (2018) combined Delphi method and entropy weight method to measure the general index[2]Wu et al believe that digital technology can reduce energy consumption, thus promoting sustainable ecological development[3]Rowan et al pointed out that improving the production efficiency of products and intensifying the development of low-carbon products are the main measures[5]

3. Construction of measurement index system

3.1 Explanatory variable: digital economy development level

3.1.1 Build an index evaluation system for the development level of digital economy

Following the principles of data accessibility, this paper will select relevant indicators to evaluate the development level of digital

economy from three aspects: the level of digital infrastructure, the level of digital industry development and the progress of digital technology. The details are shown in Table 1.

Table 1 Digital economy development level index evaluation system1

Primary index	Secondary index	Unit
Digital infrastructure level	Mobile phone penetration	Department/person
	Number of Internet access users	Manto
	Optical cable line length	kilometre
Digital industry development level	Value added of the primary industry	Hundred million yuan
	Total volume of telecommunication service	Ten thousand yuan
	Number of enterprises related to digital economy	a
Digital technology progress	Number of patents granted	a
	R&D funds for industrial enterprises above designated size	Ten thousand yuan
	Number of professional and technical personnel	person

After constructing the evaluation system of the development level of digital economy, entropy weight method is adopted to weight each index, and multiple linear function is used to calculate the DELD of the development level of digital economy. The calculation formula is as follows:

$$DELD_i = \sum_{j=1}^{n} \gamma_j \times \omega_{ij}$$

ω_{ij} represents the proportion, $DELD_i$ represents the comprehensive index of regional digital economy development, the value range is [0,1]; n is the evaluation year; γ_j is the index weight; ω_{ij} indicates the proportion of the indicator.

3.2 Explained variable: regional sustainable development

3.2.1 Construct a comprehensive index evaluation system for regional sustainable development

This study will refer to the practice of Caixia Wu (2022)[1] based on the definition and characteristics of sustainable development, and select corresponding variables from the two aspects of resource flow and energy flow respectively to measure the comprehensive index of regional sustainable development, as shown in Table 2.

Table 2 Comprehensive index measurement system of sustainable development 2

First-level indicators	Secondary indicators	Unit
Resource flow	Green coverage rate of built-up area	%
	Comprehensive utilization rate of industrial solid waste	%
	Air pollutant emissions	Tons of
Energy Flow	Energy consumption	Tons of standard coal
	Energy consumption per unit of GDP	Tons of standard coal / 10,000 yuan
	Industrial electricity consumption	Billion kilowatt-hours

According to the selected indicators, a comprehensive index of regional sustainable development is constructed as follows:

$$SDL_{it} = \sum_{i=1}^{m} \left(\sum_{j=1}^{n} N_{ij} P_{ij} \right) P_i$$

Where SDL_{it} represents the level of sustainable development, the SDL_{it} larger the value, the higher the level of sustainable development; m is the number of first-level indicators; n indicates the number of variables of the secondary index.

4. Control variable

This study takes five dimensions of economic development level, opening to the outside world, government financial expenditure, human capital and city size as control variables. The level of economic development (EDL) is represented by regional GDP per capita; The degree of opening up to the outside world (FRN) is expressed by the actual utilization of foreign capital; Government expenditure

(GEFT) is expressed by general budget expenditure of government finance; Human capital level (PUCA) is represented by regional population density; And city size (CISZ) is represented by built- up area land area.

5. Model construction and result analysis

5.1 Model Construction

The model constructed in this paper is as follows:

$$lnSDL_{it} = \beta_0 + \beta_1 DELD_{it} + \beta_2 lnEDL_{it} + \beta_3 FRN_{it} + \beta_4 GEFT_{it} + \beta_5 PUCA_{it} + \beta_6 CISZ_{it} + \mu_i + \nu_t + \varepsilon_{it}$$

Where, SDL_{it} represents the regional sustainable development comprehensive index; $DELD_{it}$ represents the level of digital economy development. β_0 is the intercept term, $\beta_i (i = 1, 2, 3, \cdots, 6)$ is the coefficient parameter corresponding to the explanatory variable; μ_i represents the individual effect; υ_t represents the time effect; ε_{it} is the random disturbance term.

6. Model estimation and result analysis

6.1 Benchmark regression

In order to ensure the stability of the parameters, this paper first explores the impact of digital economy on sustainable development, and then adds control variables in turn. The results are shown in Table 3.

It can be seen from columns (1) to (5) that the regression coefficients of digital economy and sustainable development in the Yangtze River Delta region are both positive and significant at 95% confidence level, indicating that digital economy plays a positive role in the sustainable development of the Yangtze River Delta region.

Table 3 Baseline regression results

Variable names	(1)InSDL	(2)InSDL	(3)InSDL	(4)InSDL	(5)InSDL	(6)InSDL
DELD	0.562***	0.567***	0.534***	0.208**	0.339**	0.312**
EDL		0.374*	0.361*	0.396*	0.410*	0.401*
FRN			0.420*	0.193	0.339	0.360
GEFT				1.616***	1.623***	1.541**
PUCA					1.512**	1.579**
CISE						0.469*
Constant term	1.093***	0.986***	1.098***	1.217***	1.025**	1.069***
City Fixed	YES	YES	YES	YES	YES	YES
Year fixed	YES	YES	YES	YES	YES	YES

From the perspective of control variables, the improvement of economic development level (EDL) will have a positive effect on sustainable development. This may be due to the fact that as the level of economic development promotes the progress and innovation of science and technology, these new technologies can provide more support for sustainable development. The increase in openness to the outside world (FRN) will have a positive effect on sustainable development. This is because opening to the outside world can promote economic development, increase the wealth and strength of the country, thus enabling the government to increase investment in environmental protection. An increase in government expenditure (GEFT) will promote sustainable development. This is because the government's increased investment in air pollution control and other aspects will reduce environmental pollution and ecological damage. The expansion of city size (CISZ) has a positive effect on sustainable development. This is because the expansion of city size can promote the optimal allocation of resources, so as to realize the optimal allocation and recycling of resources. Finally, it is worth noting that the increase of the human capital level (PUCA) has a significant negative effect on sustainable development and is significant at the 5% confidence level. This is because the increase of population will lead to environmental pollution and ecological damage, such as mass discharge of waste gas, wastewater and solid waste.

7. Conclusion

Based on the panel data of 41 cities in the Yangtze River Delta region from 2012 to 2020, this paper explores the impact mechanism of digital economy on regional sustainable development. Conclusions are drawn as follows: First, digital economy plays a positive role in the sustainable development of the Yangtze River Delta region, and this result is reliable. Second, from the perspective of control variables, the level of economic development, the degree of opening up to the outside world, the government financial

expenditure and the size of the city can promote the sustainable development, while the increase of population density will have a significant negative effect on the sustainable development.

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General Project Support: Anhui University of Finance and Economics Undergraduate Research Innovation Fund in 2023 (XSKY23234).