Journal of Information Economics

Homepage: https://anser.press/index.php/JIE

Tax effect of digital economy development in China: The policy effect and transmission mechanism

Jun Mao [a], Jianmin Liu [b, c, *], Zhiyuan Liu [d]

[a] *School of Mathematics and Statistics, Hainan Normal University, Haikou, China*

[b] *School of Economy and Trade, Hunan University, Changsha, China*

[c] *School of Economics and Management, Changsha University of Science and Technology, Changsha, China*

[d] *Carey Business School, The Johns Hopkins University, Baltimore, USA*

ABSTRACT

The development of digital economy is becoming an important path to promote the kinetic energy of China's tax revenue development. Based on the panel data from 2011 to 2018, this paper uses Gini coefficient to analyze the regional differences of China's digital economy, and uses fixed effect model, spatial Durbin model, multi-period double difference model and other empirical methods to examine the tax effects of digital economy development. The results show that the regional disparity is the main reason for the regional disparity of digital economy development in China. The development of digital economy directly increases the tax amount of local digital industry, and at the same time it also radiates and drives the increase of local total tax revenue; The tax effect of digital economy has a negative spatial spillover, showing a "siphon effect" to neighboring areas; Mechanism analysis shows that the development of digital economy mainly promotes the increase of local tax revenue through growth effect.

KEYWORDS

Digital economy; Tax effect; Broadband China; Economic growth

* Corresponding author: Jianmin Liu
E-mail address: jml@hnu.edu.cn

ISSN 2972-3671
doi: 10.58567/jie01010004

Received 14 December 2022; Accepted 14 January 2023; Available online 16 January 2023

1. Introduction

The complexity of international economic environment, the uncertainty of the outbreak of COVID-19 and the "package" policy of tax reduction and fee reduction are superimposed. As a result, the growth rate of tax revenue of local governments in China continues to show a downward trend. The development of digital economy is becoming an important path to promote China's new development momentum (Xue et al., 2022; Wu et al., 2021). As a new economic form brought by digital technology, digital economy includes digital industrialization and industrial digitalization, and has become the focus of leading the high-quality development of China's economy (Zhao et al., 2020). Digital economic reconstruction of tax distribution order leads to the transformation of tax governance and the breadth of tax source distribution. The development of digital economy is trying to stabilize tax sources, tap potential and increase income, and help local governments to build tax sources; Relying on the development of digitalization and information technology to realize the monitoring and management of tax sources and reduce the loss of tax sources (Feng, 2021; Ren et al., 2021); Digitalization of enterprises increases the risk of unbalanced growth of regional tax revenue, and online transaction brings about trans-regional transfer of tax sources (Yang, 2020; Ren at al., 2022). Therefore, under the background of the decline of local tax revenue growth rate, it is of great significance to explore the path, spatial heterogeneity and transmission mechanism of digital economy affecting local government tax revenue.

The main contents of the existing research literature on digital economy can be divided into the following two aspects: First, the statistics and measurement of the scale of digital economy, including the index compilation method (Wu, 2019) and the research on value-added measurement (Xu and Zhang, 2020). The second is the evaluation of the social and economic impact of digital economy development. (1) Digital economy plays an important role in the high-quality development of regional economy. By expanding the scale of foreign investment (Dong and Mi, 2019; Deng et al., 2021), promoting consumption (Tian, 2020) and enhancing entrepreneurial activity (Qian et al., 2020), the digital economy can effectively promote the dynamic change of high-quality economic development. At the same time, the digital economy promotes the efficiency change of high-quality economic development by optimizing labor allocation (Zheng et al., 2020) and improving the efficiency of international trade (Fan, 2020); By empowering global value chain governance (Guo and Qiu, 2020) and reshaping the structure of labor demand (He, 2020), we can drive the economy to achieve quality change of high-quality development. In addition, the development of digital economy has had a certain impact on regional disparities (Jones and Henderson, 2019; Hao et al., 2023), lifestyle changes (Xu et al, 2020) and the development of real economy (Jiang and Sun, 2020). (2) Digital economy has an important influence on participants. Digital economy promotes the transformation of enterprise management by promoting the transformation of enterprise governance structure and objectives (Qi and Xiao, 2020). At the same time, the development of digital economy drives the process of financial digitalization, which in turn affects the household income and consumption level of residents (Zhang et al, 2019); By influencing the irrational behavior of decision makers and managers, the degree of information asymmetry can be reduced, and then the level of corporate governance can be improved (Qi et al., 2020; Liu et al., 2022).

Taxation plays a fundamental, pillar and supportive role in national governance, and technological change has an impact on tax revenue (Casi et al., 2020; Wu et al., 2020). Koova et al. (2020) found that the implementation of e-government can improve the government's ability to raise and use financial resources by reducing the cost of tax compliance. Gnanon and Brun (2018) found that when a country narrows the gap of Internet development with other countries, its non-resource tax revenue will increase in the short to medium term. Therefore, the development of digital economy brings opportunities and challenges to tax revenue (Jiang et al., 2021). On the one hand, the digital economy can bring about the expansion of tax base, the efficiency of tax collection and management, and the improvement of tax governance capacity. It can also lead to the improvement of fiscal transparency and the reduction of tax compliance costs, thus stimulating the increase of tax revenue scale (Li et al., 2020); On the other

hand, under the background of digital empowerment, the cross-regional and cross-border mobility of commodities is enhanced, which is more likely to cause tax base erosion and profit transfer (Yang and Han, 2017; Wang et al., 2019). Therefore, China's tax collection and management system aggravates the loss of tax sources, and the tax effect of digital economy is uncertain.

To sum up, it is particularly important to study the impact of the development of digital economy on local tax revenue in China under the background of increasing pressure of local fiscal revenue and expenditure. There are few literatures about the influence of digital economy development on local government tax revenue, and the endogenous problems need to be further solved. This paper focuses on the analysis of the tax effect of the development of digital economy. The main innovations and contributions are as follows: First, this paper uses the data of provincial and prefecture-level cities, fully considers the digital industrialization and digitalization of industries, and can reflect the real situation of the development of digital economy in China; Dagum index is used to measure the regional difference and evolution trend of digital economy development level in China. Secondly, the development of digital economy and local tax revenue are brought into a unified research framework, and the tax effect and influencing mechanism of digital economy development are empirically analyzed, which broadens the research scope of local tax influencing factors. Thirdly, from the perspective of spatial spillover and regional heterogeneity, this paper analyzes the tax effect of digital economy, expands the existing analytical horizon and enriches the research in the field of tax effect of digital economy.

2. Measurement of China's regional digital economy development

According to the availability of data, this paper constructs the evaluation index system of digital economic development from three aspects: digital infrastructure, industrial integration and environment (see Table 1 for details). In order to verify the robustness of the results, this paper uses entropy weight method and global principal component analysis method to measure the development level of digital economy in 30 provincial administrative regions and 209 prefecture-level and above cities in China.

Table 1. Index system for measuring digital economy development level.

Primary index	Secondary indicators (provincial level)	Secondary indicators (municipal level)
Infrastructure index	Number of Internet broadband access ports per 10,000 people	Number of Internet users per 10,000 people
	Number of mobile phone users per 10,000 people	Number of mobile phone users per 10,000 people
	Number of websites owned by 10,000 people	
Industrial integration development index	Enterprise e-commerce sales	Number of employees in information transmission, computer service and software industry
	Software business income	
	Information technology service income	Total telecom business
	Digital financial development index	
environmental index	Authorized amount of patent	Authorized amount of patent
	Number of students in colleges and universities	Number of students in colleges and universities

In this paper, Dagum Gini coefficient is used to decompose the unbalanced development of China's digital economy among regions, and the temporal and spatial evolution of China's regional digital economy development is investigated (see Table 2 for details). The results from Table 2 show that: (1) The overall regional gap of China's digital economy development showed a downward trend during the sample period, from 0.5156 in 2011 to 0.3641 in 2018. The implementation of China's "Broadband China" policy and the construction of network infrastructure have narrowed the "digital divide" between regions; "Taobao Village" and "Taobao Town" are accelerating their

penetration into the central and western regions and northeast regions, reducing the regional differences of digital dividends. (2) The regional difference of digital economy development level in central China is obviously higher than the national average, which indicates that the regional difference of digital economy development in central China is the main reason for China's "digital divide", while the regional difference of digital economy development level in western China is the smallest and shows a steady development trend. The possible reason lies in the promotion of the western development strategy, and the national policy support provides strong support for its digital economy development. (3) From the perspective of regional disparity, the development disparity of digital economy among regions is on the decline. Among them, the regional gap between the east and the west is the biggest. The eastern part of China takes the lead in developing digital technology and benefits from "digital dividend" by taking advantage of its unique location conditions and elements. The development level of digital economy in the central and western regions is relatively low, but the "digital divide" is gradually narrowing due to the influence of technology transfer and knowledge spillover in the eastern region. (4) This paper analyzes the root causes of regional differences in the development of digital economy in China by using intra-regional disparities, inter-regional disparities and super-variable density. As can be seen from Table 2, the regional disparity is the main reason for the regional disparity of digital economy development in China. To sum up, the development of China's regional digital economy is unbalanced. When studying the tax effect of China's digital economy, it is necessary to take the regional spatial spillover into account in the model.

Table 2. Gini coefficient of China's digital economy development and its decomposition results.

Year	Sum	Intraregional disparity			Regional disparity			Contribution rate (%)		
		Eastern	Central	Western	Eastern-Central	Eastern-Western	Central-Western	Within the region	Interregional	Intensity of transvariation
2011	0.5156	0.2745	1.3977	0.3577	0.490	0.594	0.340	33.33%	59.16%	7.50%
2012	0.4395	0.2555	1.1433	0.2406	0.444	0.512	0.244	33.33%	59.18%	7.48%
2013	0.4018	0.2440	1.0146	0.2031	0.416	0.470	0.211	33.33%	58.65%	8.02%
2014	0.3893	0.2410	0.9760	0.1893	0.408	0.455	0.200	33.33%	58.13%	8.54%
2015	0.3708	0.2340	0.9229	0.1729	0.394	0.434	0.185	33.33%	58.25%	8.42%
2016	0.3648	0.2307	0.9026	0.1694	0.387	0.429	0.180	33.33%	58.54%	8.12%
2017	0.3561	0.2299	0.8853	0.1558	0.385	0.416	0.169	33.33%	57.91%	8.76%
2018	0.3641	0.2371	0.9362	0.1457	0.404	0.419	0.162	33.33%	57.83%	8.83%

3. Theoretical analysis and empirical design

3.1. Theoretical analysis

The influence of digital economy development on local government tax revenue can be summarized in three aspects: First, digital economy development has a direct impact on local government tax revenue. The development of digital economy directly affects the tax revenue of local digital industry. With the rapid development of digital economy industries such as digital equipment manufacturing and digital information transmission, the industrial scope is constantly expanding, which can effectively increase the tax revenue of local digital economy industries (Landefeld and Fraumeni, 2001). In addition, the digitalization of government under the digital economy and its empowerment can improve the efficiency of tax collection and management. In the era of digital economy, the tax authorities take advantage of new tax collection and management measures such as "tax management service cloud platform" and enterprise electronic invoices to carry out tax integration management, which can effectively reduce the loss of tax sources while reducing the cost of tax management (Shao and Zhang, 2020). Second, the development

of digital economy has an indirect effect on local government tax revenue. Relying on the development of modern network information technology, enterprises' production and transaction costs are reduced and market boundaries are expanded (Lange et al., 2020), which will lead to economies of scale, economies of scope and long tail economy, thus effectively expanding the tax base and generating revenue for local governments. Third, the construction of digital economy affects the tax revenue of local governments through different channels. The development of digital economy broadens information channels and strengthens social interaction, which is conducive to giving play to the typical demonstration and driving effect of successful employment and entrepreneurship, and influencing individual risk preference (Hu and Zhang, 2014). At the same time, the development of digital inclusive finance expands the coverage of commercial finance, helps to ease the financing constraints of enterprises and individuals, provides financial guarantee for the development of entrepreneurial activities, and is conducive to stimulating the enthusiasm of social employment and entrepreneurship. In addition, economic digitalization can enhance industrial competitiveness, accelerate the international flow of factors, and promote enterprises to increase foreign investment; Digital platform expands consumption channels, improves the level of consumption facilitation, and becomes a new kinetic energy to release consumption potential. Therefore, the digital economy can stimulate economic growth by improving the social enthusiasm for employment and entrepreneurship, stimulating consumption, increasing foreign investment, etc., and eventually lead to the increase of local tax revenue.

3.2. Model

In order to test the influence of the development of digital economy on local tax revenue, this paper makes a preliminary judgment by using the fixed effect model, which is shown in formula (1):

$$Tax_{it} = \alpha + \beta Digeco_{it} + \gamma X_{it} + \mu_i + v_t + \delta_{it} \quad (1)$$

Where i and are the region and time respectively. Tax snd Digeco are local government tax revenue and the development level of digital economy. X represents control variables. μ and are individual fixed effect and time fixed effect respectively; Is a random disturbance term.

As the core of the digital economy, the Internet has externalities. With the increase of the number of users, the marginal spillover effect of the Internet shows an increasing trend. Therefore, it is reasonable to think that the tax effect of digital economy may also have spatial spillover effect (Wu et al.,2022). In addition, ignoring the spatial spillover effect between variables often leads to the bias of the estimation of the model, so this paper considers using spatial Durbin model to test the spatial spillover effect of the development of digital economy on local government tax revenue. As shown in the model (2):

$$Tax_{it} = \alpha + \beta Digeco_{it} + \gamma X_{it} + \rho W * Digeco_{it} + \mu_i + v_t + \delta_{it} \quad (2)$$

Where W is the spatial weight matrix, the geographic weight matrix () and the economic weight matrix () are used to set the spatial weight, and the distance weight matrix is constructed according to the latitude and longitude of the distance between the base areas. The economic weight matrix () is constructed according to the average GDP of each region in the sample period.

Considering the endogenous problem of variables, this paper refers to the research of (Li and Zhou, 2021; Wu et al., 2020), takes the quasi-natural experiment of "Broadband China" as the breakthrough point, and constructs a multi-period DID model to test the tax effect of digital economic development. As an important information infrastructure, broadband has become an important part of the national digital economy strategy. Many developed countries (the United States, France, South Korea, Italy, etc.) have successively introduced new broadband development strategies to seize the new opportunities of digital economy development. In 2013, China officially released the implementation plan of "Broadband China" strategy, and in 2014, 2015 and 2016, 120 cities were selected in three batches as pilot cities to strengthen broadband construction. The pilot policy aims to comprehensively improve the digital level of demonstration cities and drive the development of digital economy by

improving broadband network capability and broadband information application. From the policy effect, the pilot reform of "Broadband China" is an important policy exploration to promote the development of digital economy. Therefore, this paper takes the construction of "Broadband China" as the exogenous impact of policy, and evaluates the tax effect of digital economy development by multi-period DID method. The specific analysis model is constructed as follows:

$$Tax_{it} = \alpha + \beta policy_{it} + \gamma X_{it} + \mu_i + v_t + \delta_{it} \quad (3)$$

Where policy is a virtual variable set up according to the relative exogenous events of the pilot cities approved as "Broadband China" demonstration cities at different time points. If the target city is approved as a "Broadband China" demonstration city during the sample period, the value of policy is 1, otherwise it is 0.

$$Tax_{it} = \alpha + \beta policy_{it} + \gamma X_{it} + \mu_i + v_t + \delta_{it} \quad (4)$$

$$Pgdp_{it} = \alpha + \rho Digeco_{it} + \gamma X_{it} + \mu_i + v_t + \delta_{it} \quad (5)$$

$$Tax_{it} = \alpha + \theta Digeco_{it} + \sigma policy_{it} + \gamma X_{it} + \mu_i + v_t + \delta_{it} \quad (6)$$

Where $Pgdp_{it}$ is mediator variable, expressed by economic growth. Formula (4) tests the influence of digital economic development on local government tax revenue, formula (5) tests the influence of digital economic development on economic growth of intermediary variables, and formula (6) puts digital economic development and intermediary variables into regression model at the same time to observe their influence on local tax revenue. If the coefficients, and are all significant, and become smaller or significantly lower, it indicates the existence of intermediary effect, that is, the theoretical mechanism mentioned above is established.

3.3. Variables and data

The explained variable is the local government tax revenue (Tax), which is the digital industry tax revenue (Tax1) and tax revenue (Tax2) respectively. The calculation of digital industry tax revenue includes the following three aspects: First, the digital economy industry of digital empowerment infrastructure products, including computer hardware (I-63), software (I-64) and telecommunications equipment (C-39); Second, the digital economy industry of digital media products, including Internet distribution and publishing (R-85), Internet broadcasting (R-86) and traffic and download support services (I-64); Third, the digital economy industry of digital trading products, including B2B wholesale (F-51) and B2C retail (F-52). From this, the taxes payable by the digital economy industry are screened out as an index to measure the tax revenue of the regional digital economy industry. In addition, due to the availability of data, the tax revenue of cities at all levels and above is measured by the value-added tax and main business tax payable by industrial enterprises in this region this year and the additional sum.

The core explanatory variable of this paper is the development level of digital economy (Digeco). Control variables include economic growth, industrial structure, openness to the outside world, urbanization level and technological innovation level: (1) Economic growth (Pgdp) expressed by real GDP per capita of each region. (2) Industrial structure (Stru) is expressed by the ratio of the added value of tertiary industry in each region to GDP. (3) The level of urbanization (Urban) is represented by the ratio of urban population to total population in each region. Due to the lack of this index at the city level, the city scale is chosen to represent the urbanization level of cities at or above the local level. (4) The level of technological innovation (Crea) is expressed by the proportion of expenditure on science and technology in local general budget. This paper selects 30 provinces and 209 prefecture-level cities and above in China from 2011 to 2018 as research samples, and excludes Tibet and some prefecture-level cities with serious data deficiency. The data are from China Statistical Yearbook, China Tax Yearbook, China Information Yearbook, China Communication Yearbook, China Economic Census Yearbook and China Urban Statistical Yearbook, some of which are from the statistical yearbooks of various provinces. Descriptive statistics of each variable are shown in Table 3.

Table 3. Descriptive statistics.

Variables	Explanations	Mean	S.D	Min	Max
Provincial data					
Tax1	Digital industry tax (100 billion yuan)	0.203	0.298	0.004	1.413
Tax2	Total tax revenue of various industries (trillion yuan)	0.204	0.176	0.012	0.974
Digeco1	Digital economic development level (calculated by entropy method)	0.206	0.154	0.015	0.878
Digeco2	Digital economic development level (measured by principal component analysis)	0.191	0.149	0.012	0.901
Pgdp	Per capita real GDP (10,000 yuan)	5.226	2.458	1.526	13.860
Stru	Industrial structure (%)	45.480	9.536	29.70	80.980
Urban	Urbanization level (%)	57.110	12.300	35.000	89.600
Crea	Innovation (%)	2.020	1.405	0.389	6.578
City data					
Tax2	Total tax revenue of various industries (100 billion yuan)	0.131	0.228	0.003	2.137
Digeco1	Digital economic development level (calculated by entropy method)	0.092	0.101	0.009	0.667
Digeco2	Digital economic development level (measured by principal component analysis)	0.080	0.086	0.008	0.737
Pgdp	Per capita real GDP (10,000 yuan)	1.453	0.841	0.291	8.365
Stru	Industrial structure (%)	48.180	10.380	14.950	89.340
Urban	City size (100 square kilometers)	1.737	2.146	0.065	14.970
Crea	Innovation (%)	12.250	1.746	2.992	16.610

4. Empirical results

4.1. Benchmark regression results

In order to systematically investigate the influence of digital economy on the taxation of digital industries and the total taxation of various industries, this paper adopts a two-way fixed effect model to test the taxation effect of digital economy development. The estimated results are shown in Table 4. The results of columns (1) and (2) show that the influence coefficient of digital economy development on digital industry tax is significantly positive at the statistical level of 1%, and the development of digital economy significantly promotes the tax revenue growth of local digital industry. The results of columns (3) and (4) show that the development of digital economy has a significant positive effect on local total tax revenue. To sum up, the development of digital economy will not only directly increase the tax amount of local digital industries, but also drive the total tax revenue of local industries to increase. The main reasons may be as follows: First, the development of digital economy includes the process of digital industrialization and industry digitalization. The renewal and application of digital technology will directly lead to the continuous growth of digital economy industry, thus increasing the tax revenue of regional digital industry. With the popularization of digital technology, the traditional industry will also be affected, and then its industrial structure will be optimized and transformed into digital industry, further increasing the tax revenue of digital industry. Secondly, the application of digital equipment or digital production methods will cause the overall changes of the economic system, and the wide application of digital technology will lead to the economies of scope, scale and long tail, which will directly expand the tax base. With the rise of 5G communication technology,

blockchain, artificial intelligence and other technologies, it is bound to have a new impact on the scale of China's economic development. The establishment of more technology companies will further boost China's tax revenue. For the public, the emergence of new technologies will promote public participation, stimulate public consumption and further expand tax revenue. Third, the digital economy and the digitalization of the government supported by it will improve the efficiency of tax collection and management of local governments, and then push up local tax revenue. When the digital technology is not popularized, China's tax system and policies can't effectively protect the tax right and tax benefits, and can't find the significant role of digital enterprises in economic development. With the development of digital technology, the government's tax department can manage and control tax more efficiently, and further improve the efficiency of tax collection. Fourthly, the development of the digital economy will promote the improvement of the economic level, thus raising wages and increasing employment opportunities, expanding the scale of personal income tax and increasing tax revenue. In addition, the digital economy will help the local employment and entrepreneurship activity to improve through demonstration effect and information transmission effect, and ultimately increase local tax revenue. In today's digital information age, the development of digital economy will become the direction of development, and it will be continuously promoted throughout China, thus increasing the employment and entrepreneurial activity of regional digital enterprises and further increasing tax revenue.

Table 4. Descriptive statistics.

	Tax1		Tax2	
	(1)	(2)	(3)	(4)
Digeco1	1.329***	1.086***	0.812***	0.736***
	(0.182)	(0.243)	(0.129)	(0.137)
Pgdp		0.003		0.0004
		(0.016)		(0.010)
Stru		0.001		0.001
		(0.002)		(0.001)
Urban		-0.013*		0.001
		(0.007)		(0.002)
Innov		0.014		0.0132***
		(0.015)		(0.005)
Open		0.012***		0.011***
		(0.002)		(0.002)
Time FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Constant	0.412***	1.283*	-0.0181	-0.370
	(0.0851)	(0.691)	(0.0585)	(0.256)
Observations	240	240	240	240
Ajusted R2	0.861	0.861	0.861	0.861

*Notes: The figures in () are robust standard errors. *** p<0.01, ** p<0.05, * p<0.1, the same below.*

4.2. Spatial econometric estimation results

In this paper, Spatial Durbin Model (SDM) is used to estimate the spatial spillover of tax effects in digital economy. As can be seen from Table 5, from the influence direction, the fitting coefficient of digital economy development level is positive under different spatial weight matrices, and it is significant at 1% significance level, indicating that the development level of digital economy can significantly increase tax revenue, which is consistent with the benchmark regression result. Considering the spatial spillover effect of digital economy, the fitting coefficients of W×Digeco1 are all significantly negative at the level of 1%, indicating that the development of digital economy has a negative spatial spillover effect on local tax revenue, that is, the development of digital economy in

neighboring areas will significantly reduce local tax revenue.

Table 5. Spatial econometric regression results.

	Tax1				Tax2			
	W1		W2		W1		W2	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Main								
digecosz	1.286***	1.235***	1.297***	1.193***	0.793***	0.741***	0.794***	0.689***
	(0.144)	(0.205)	(0.149)	(0.199)	(0.137)	(0.146)	(0.142)	(0.122)
pgdp		-0.004		-0.010		0.002		0.003
		(0.013)		(0.017)		(0.007)		(0.009)
stru		0.006***		0.003		0.001		0.000
		(0.002)		(0.002)		(0.001)		(0.001)
urban		0.001		-0.004		0.000		-0.000
		(0.003)		(0.011)		(0.001)		(0.001)
innov		0.022		0.018		0.014***		0.018***
		(0.014)		(0.013)		(0.003)		(0.005)
open		0.017***		0.014***		0.010***		0.010***
		(0.003)		(0.005)		(0.001)		(0.001)
_cons	0.028	-0.298*	0.030	-0.361	0.025**	0.010	0.043***	0.001
	(0.025)	(0.161)	(0.025)	(0.234)	(0.012)	(0.101)	(0.011)	(0.109)
Wx								
digecosz	-0.878***	-0.739***	-0.835***	-0.724***	-0.636***	-0.556***	-0.524***	-0.441***
	(0.103)	(0.238)	(0.124)	(0.230)	(0.111)	(0.112)	(0.123)	(0.112)
Spatial rho	0.436***	0.269***	0.385***	0.280***	0.711***	0.698***	0.523***	0.500***
	(0.104)	(0.097)	(0.074)	(0.091)	(0.046)	(0.051)	(0.052)	(0.058)
Variance								
lgt_theta	-1.945***	-1.623***	-1.926***	-2.141***	-1.918***	-1.928***	-1.848***	-1.869***
	(0.172)	(0.357)	(0.175)	(0.490)	(0.117)	(0.125)	(0.099)	(0.157)
sigma2_e	0.003***	0.002***	0.003***	0.002***	0.001***	0.001***	0.001***	0.001***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	240	240	240	240	240	240	240	240

4.3. Policy effect test

According to the formula (3), this paper makes a multi-period DID estimation. As can be seen from Table 6, the regression coefficients of policy variables are all kept at the level of 1%, which shows that the digital economy has a positive tax effect. After being approved as a "Broadband China" demonstration city, the local tax revenue level is significantly improved.

Table 6. Policy effect test results.

Variables	Tax2					
	(1)	(2)	(3)	(4)	(5)	(6)
Policy	0.016***	0.023***	0.021***	0.017***	0.017***	0.017***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Pgdp		0.051***	0.052***	0.050***	0.049***	0.049***
		(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Stru			-0.001	-0.001	-0.001	-0.001

			(0.000)	(0.000)	(0.000)	(0.000)
Urban				-0.010***	-0.008**	-0.008**
				(0.003)	(0.003)	(0.003)
Crea					0.004***	0.004***
					(0.002)	(0.002)
Constant	0.116***	0.041***	0.053***	0.034*	0.030*	0.030
	(0.001)	(0.009)	(0.017)	(0.018)	(0.018)	(0.029)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1 640	1 640	1 640	1 640	1 640	1 640
R-squared	0.419	0.457	0.458	0.464	0.469	0.469

4.4. Transmission mechanism test

According to the intermediary effect models (4)-(6), this part examines the specific mechanism of tax effect of digital economy (see Table 7 for details). As can be seen from Table 7, the regression coefficient of digital economy development to local digital industry tax revenue in column (1) is significantly positive at the level of 1%, the regression coefficient of digital economy development to economic growth in column (2) is significantly positive at the level of 1%, and the regression coefficient of digital economy development to local digital industry tax revenue in column (3) is significantly positive at the level of 1%, and the regression coefficient of digital economy development is 1.088. Compared with the regression coefficient in column (1) without intermediary variables, it is smaller, which proves the existence of intermediary effect of economic growth, and shows that promoting the development of digital economy is conducive to local economic growth, thus bringing positive tax effect. Columns (4)- (6) are the test results of the intermediary model when the explained variable is local total tax revenue. Consistent with the above analysis, the intermediary effect of economic growth still exists.

Table 7. Transmission mechanism test.

Variables	Tax1	Pgdp	Tax1	Tax2	Pgdp	Tax2
	(1)	(2)	(3)	(4)	(5)	(6)
Digeco1	1.101***	5.684***	1.086***	0.738***	5.684***	0.736***
	(0.249)	(1.417)	(0.243)	(0.092)	(1.417)	(0.137)
Pgdp			0.003			0.004
			(0.016)			(0.010)
Stru	0.001	0.019	0.001	0.001	0.019	0.001
	(0.002)	(0.026)	(0.002)	(0.001)	(0.026)	(0.001)
Urban	-0.013*	-0.045	-0.013*	-0.001	-0.045	-0.001
	(0.007)	(0.038)	(0.007)	(0.002)	(0.038)	(0.002)
Crea	0.014	0.070	0.014	0.013***	0.070	0.013***
	(0.015)	(0.111)	(0.015)	(0.004)	(0.111)	(0.005)
Constant	1.291*	2.804	1.283*	0.369	2.804	0.370
	(0.683)	(4.272)	(0.691)	(0.239)	(4.272)	(0.256)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	240	240	240	240	240	240

5. Conclusion

Based on China's provincial and city level panel data from 2011 to 2018, this paper constructs a fixed effect model, a spatial Durbin model, a multi period DID model, and an intermediary effect model to examine the tax effect

of digital economy development. The research conclusions are as follows: First, the development of digital economy has a significant positive incentive effect on increasing local tax revenue, which is still valid under the robustness test of changing core explanatory variables and samples; Second, the development of the digital economy in this region has a negative inhibitory effect on the increase of tax revenue in neighboring regions; Third, the development of digital economy has an indirect impact on the increase of local government tax revenue. Specifically, the development of digital economy affects regional tax revenue by promoting regional economic growth.

Funding Statement

This research was funded by the National Social Science Foundation of China (20AJY024); High-level talent project of Hainan Natural Science Foundation (720RC615); Haikou Philosophy and Social Science Planning Project (2021-ZCKT-24).

Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

References

Casi, E., Spengel, C., & Stage, B. M. (2020). Cross-border tax evasion after the common reporting standard: Game over?. Journal of Public Economics, 190, 104240

Deng, F., Li, H., Yang, M., Zhao, W., Gai, Z., Guo, Y., ... & Wu, H. (2021). On the nonlinear relationship between energy consumption and economic and social development: evidence from Henan Province, China. Environmental Science and Pollution Research, 28(25), 33192-33207

Dong Y., Mi X. (2019). Internet Maturity, Digital Economy and China's Foreign Direct Investment -- An Empirical Study Based on Panel Data from 2009 to 2016. Shanghai Economic Research, (3): 65-74

Fan X. (2020). Digital economy development, international trade efficiency and trade uncertainty Finance and Trade Economy, 41 (8): 145-160

Feng Q. (2021). A prospective study of the tax system framework in the digital economy era -- based on the theoretical perspective of the tax system determined by factors of production. Financial Research, (6): 31-44

Gnangnon, S. K., & Brun, J. F. (2018). Impact of bridging the Internet gap on public revenue mobilization. Information Economics and Policy, 43, 23-33.

Guo Z., Qiu Y. (2020). Reconstruction of Global Value Chain in the Digital Economy Era: Typical Facts, Theoretical Mechanism and China's Strategy. Reform, (10): 73-85

Hao, X., Wen, S., Xue, Y., Wu, H., & Hao, Y. (2023). How to improve environment, resources and economic efficiency in the digital era?. Resources Policy, 80, 103198

He Z., Zhang X., Wan G. (2020). Digital finance, digital divide and multidimensional poverty. Statistical Research, 37 (10): 79-89

Hu J., Zhang B. (2014). Social Network, Private Financing and Family Entrepreneurship -- An Empirical Analysis Based on the Differences between Urban and Rural Areas in China . Financial Research, (10): 148-163

Jiang S., Sun Y. (2020). Empirical Study on the Effect of Digital Economy on Real Economy. Scientific Research Management, 41 (5): 32-39

Jiang Z., Su J., Yang J. (2021). Transformation of the Digital Economy and Changes in the Tax System Structure . Economic Trends, (5): 115-128

Jones, C., & Henderson, D. (2019). Broadband and uneven spatial development: The case of Cardiff City-Region. Local Economy, 34(3), 228-247.

Kochanova, A., Hasnain, Z., & Larson, B. (2016). Does e-government improve government capacity? Evidence from tax administration and public procurement. Evidence from Tax Administration and Public Procurement (April 28, 2016). World Bank Policy Research Working Paper, (7657)

Landefeld, J. S., & Fraumeni, B. M. (2001). Measuring the new economy. Survey of current business, 81(3), 23-40

Lange, S., Pohl, J., & Santarius, T. (2020). Digitalization and energy consumption. Does ICT reduce energy demand?. Ecological Economics, 176, 106760

Li G., Zhou X. (2021). Whether promoting the development of digital economy can improve China's environmental pollution -- a quasi natural experiment based on the "broadband China" strategy. Macroeconomic Research, (7): 146-160

Li X., Liu S., Yao Q. (2020). International experience and policy recommendations on tax collection and management system in the context of digital economy. Economic System Reform, (1): 156-163

Liu, J., Xue, Y., Mao, Z., Irfan, M., & Wu, H. (2022). How to improve total factor energy efficiency under climate change: does export sophistication matter?. Environmental Science and Pollution Research, 1-11

Qi H., Cao X., Liu Y. (2020). The impact of digital economy on corporate governance -- based on the perspective of information asymmetry and managers' irrational behavior. Reform, 2020 (4): 50-64

Qi Y., Xiao X. (2020). Enterprise Management Reform in the Digital Economy Era. Management World, 36 (6): 135-152+250

Qian H., Tao Y., Cao S., Cao Y. (2020). Theory and Demonstration of China's Digital Financial Development and Economic Growth. Research on Quantitative Economy and Technical Economy, 37 (6): 26-46

Ren, S., Hao, Y., & Wu, H. (2022). Digitalization and environment governance: does internet development reduce environmental pollution?. Journal of Environmental Planning and Management, 1-30.

Ren, S., Hao, Y., Xu, L., Wu, H., & Ba, N. (2021). Digitalization and energy: How does internet development affect China's energy consumption?. Energy Economics, 98, 105220

Shao L., Zhang Z. (2020) Challenge and response of digital economy to tax governance. Tax Research, (9): 63-67

Tian Z. (2020). Collectivism and Household Consumption: Empirical Findings from China. Financial Research, (5): 132-150

Wang B., Qiu K., Zhang Q. (2019). The Impact of Digital Economy on International Tax Collection and Management and Countermeasures -- Based on the Perspective of Permanent Establishment. Tax Research, (2): 86-91

Wang Y. (2020) The Impact of Digital Economy on Tax System and Tax Division: An Analytical Framework -- Also on the Core Proposition of Tax Reform. Tax Research, (11): 67-75

Wu Y. (20219). Construction of National Digital Competitiveness Index and International Comparative Study. Statistical Research, 2019, 36 (11): 14-25

Wu, H., Hao, Y., & Ren, S. (2020). How do environmental regulation and environmental decentralization affect green total factor energy efficiency: Evidence from China. Energy Economics, 91, 104880.

Wu, H., Sun, M., Zhang, W., Guo, Y., Irfan, M., Lu, M., & Hao, Y. (2022). Can urbanization move ahead with energy conservation and emission reduction? New evidence from China. Energy & Environment, 0958305X221138822

Wu, H., Xue, Y., Hao, Y., & Ren, S. (2021). How does internet development affect energy-saving and emission reduction? Evidence from China. Energy Economics, 103, 105577

Xu X., Zhang M. (2020). Research on China's Digital Economy Scale Measurement Based on International Comparison. China Industrial Economy, 2020 (5): 23-41

Xu X., Zhang Z., Guan H. (2020). China's new economy: role, characteristics and challenges. Finance and Trade Economy, 41 (1): 5-20

Xue, Y., Tang, C., Wu, H., Liu, J., & Hao, Y. (2022). The emerging driving force of energy consumption in China: Does digital economy development matter?. Energy Policy, 165, 112997

Yang Q. (2020).The impact of digital economy on the transformation of tax governance and countermeasures -- based on the perspective of political economics and governance theory analysis. Tax Research, 2020 (10): 56-62

Yang X., Han L. (2017). Reflection on the division of tax jurisdiction in the context of digital economy -- based on the perspective of value creation .Tax Research, (12): 53-56

Zhang X., Wan G., Zhang J., He Z.(2019). Digital economy, inclusive finance and inclusive growth. Economic Research, 54 (8): 71-86

Zhao T., Zhang Z., & Liang S. (2020). Digital economy, entrepreneurial activity and high-quality development Managing the World, (10)

Zheng X., Pang C., Liu J. (2020). Outsourcing transformation and high-quality economic development in the era of digital economy -- a marginal analysis of the evolution of division of labor. China Industrial Economy, (7): 117-135