Fiscal expenditure on science and technology, digital economy and coordinated development among regions

-- Take the Yangtze River Delta as an example

Xinxin Zhang

School of Economics, Anhui University, Hefei, 230601, China

837982086@qq.com

Abstract. Based on the panel data of 41 cities in the Yangtze River Delta region from 2011 to 2021, this paper conducts an empirical test, and uses the two-way fixed effect model and the intermediary effect model to study the impact of fiscal science and technology expenditure on the coordinated development of the Yangtze River Delta region, and expands and analyzes the mechanism of the impact of digital economy development level on fiscal science and technology expenditure on the coordinated development of the region. The results show that the fiscal expenditure on science and technology can directly and effectively promote the coordinated development of the Yangtze River Delta region. Fiscal science and technology expenditure can have a positive impact on regional coordinated development by promoting the development of digital economy.

Keywords: Regional coordinated development; Yangtze River Delta region; Government expenditure on science and technology; Digital economy development; Mechanism analysis.

1 Introduction

At present, China's regional development is unbalanced which is not conducive to achieving high-quality economic development. In order to study the relationship between fiscal expenditure on science and technology, digital economy and coordinated regional development, this paper takes 41 cities in the Yangtze River Delta as samples to discuss the above issues.

2 Literature Review

2.1 Coordinated Development Among Regions

The definition of the connotation of regional coordinated development. Some scholars believe that regional coordinated development refers to the coordinated development of sub-systems within a region and the development level of sub-systems between

Y. Guan et al. (eds.), *Proceedings of the 2024 International Conference on Digital Econimics and Marxist Economics (ICDEME 2024)*, Advances in Economics, Business and Management Research 314,
https://doi.org/10.2991/978-2-38476-344-3_11

regions being controlled within an appropriate range and gradually converging. Some scholars believe that regional coordinated development means that all regions complement each other's advantages in moderate slanting and key development while taking into account efficiency and equity.

The means to measure the level of regional coordinated development. Victoria Mahasova constructed regional coordinated development indicators from three aspects: society, economy and environment [1]. Yang Juan adopted entropy weight -TOPSIS method to measure the level of regional coordinated development from four dimensions: economic scale, economic quality, factor flow and institutional environment [2].

2.2 The Fiscal Expenditure on Science and Technology and the Coordinated Development of Regions

Hu Yan proved that fiscal expenditure on science and technology can effectively promote the coordinated development of the Yangtze River Delta [3]. Pan Mingming believe that fiscal science and technology expenditure and digital economy can significantly promote the high-quality development of China's economy [4].

3 Theoretical Analysis

3.1 The Role of Government Spending on Science and Technology

Financial expenditure on science and technology can guide the flow of funds to the science and technology field through direct subsidies and improve the infrastructure construction.

The green innovation technology spawned by it also has obvious effect on curbing urban pollutant discharge, which can significantly curb the discharge of sulfur dioxide and waste water. Based on the above analysis, this paper proposes hypothesis 1.

H1: The fiscal science and technology expenditure can realize the coordinated development of regions by optimizing the problems existing in the three aspects of economy, society, resources and environment.

3.2 The Mediating Effect of the Development Level of Digital Economy

Fiscal spending on science and technology can improve digital infrastructure, guide more funds into the digital economy, effectively allocate digital economic resources, and promote the development of the digital economy.

The improvement of the level of digital economy will change the regional energy production mode and promote the development of circular economy [5].

H2: Fiscal science and technology spending can achieve regional coordinated development by promoting the development of digital economy.

4 Research and Design

4.1 Sample Selection and Data Source

In this paper, 41 prefecture-level cities and above in the Yangtze River Delta region from 2011 to 2021 are taken as samples, and the data come from China Economic Statistical Yearbook and each city Statistical yearbook from 2011 to 2021. Due to the different timeliness of data publication in different regions, a small amount of missing data is supplemented by interpolation method.

4.2 Definition of Variables and Model Selection

In order to test hypothesis 1 , this paper constructs model (1) :

$$CRDit = \alpha o + \alpha 1RDit + \alpha 2Xit + \mu i + \delta i + \varepsilon it \quad (1)$$

In order to test hypothesis 2, this paper constructs model(2).

$$DIGIit = \alpha o + \alpha 1RDit + \alpha 2Xit + \mu i + \delta i + \varepsilon it \quad (2)$$

In the above model, CRDit stands for regional coordinated development index; RDit stands for government financial expenditure on science and technology; DIGIit represents the level of digital economy development; Xit is the control variable; μi is the individual fixed effect; δi is the time fixed effect; εit is the random disturbance term, subscript i represents the city, t represents the period; αi and βi are the parameters to be estimated.

4.3 Description of Variables

4.3.1. Explained Variables: Regional Coordinated Development Level (CRD).

Based on the existing data and the theoretical analysis above, this paper draws on the practice of Yang Renfa [6] and adopts the entropy method to comprehensively measure the level of CDR from the three aspects of economy, life, resources and environment. Shown in Table 1.

4.3.2. Core Explanatory Variable: Fiscal Expenditure on Science and Technology (RD).

This paper reflects the intensity of RD by the proportion of science and technology expenditure in the general public budget expenditure.

4.3.3. Intermediate Variable: Digital Economy Development Level (DIGI).

In this paper, referring to the practices of Zhao Tao [7], this paper adopts the entropy method to construct the DIGI index system from four aspects and obtains the comprehensive development index of digital economy. For specific indicator system, see Table 1.

Table 1. Comprehensive evaluation index system of CRD & DIGI

Index	Level 1 indicators	Secondary indicators	Tertiary indicators	Nature of indicators
Coordinated regional development	Economy	Economic level	GDP per capita	+
		Economic structure	Value added of tertiary industry as a share of GDP	+
		Economic density	GDP as a percentage of urban area	+
	Life	Income level	Per capita disposable income of urban residents	+
		Public services	Density of drainage pipes	+
		Infrastructure	Per capita road area in the city	+
	Resources and Environment	Resources	Electricity consumption per capita	+
		Environmental protection	Green coverage rate of built-up areas	+
			Per capita park green space	+
Digital economy development level	Digital infrastructure	Internet penetration	Internet broadband users per 100 people	+
		Mobile phone penetration	Number of mobile phones per 100 people	+
	Development of digital industry	Output of telecommunication industry	Total telecommunications business per capita	+
		Employment in the information industry	Percentage of people employed in computers and software	+

4.3.4. Control Variables.

There are four control variables to enhance the robustness of the model. ① Urbanization level (CSH): measured by the proportion of non-agricultural registered population to the total population. ② Innovation level (CX): measured by the number of patents granted by 10,000 people. ③ Financial development level (JR): measured by the ratio of outstanding loans of financial institutions to the gross regional product. (4) Human capital level (RLZB): The ratio of college students per 10,000 people. In order to alleviate the negative impact of heteroscedasticity on the model, logarithms of relevant variables are taken in this paper.

4.4 Descriptive Statistics

The descriptive statistics of major variables are shown in Table 2.

Table 2. Descriptive statistics of variables

Variables	Sample size	Mean	median	Variance	Minimum	Maximum
lnCRD	451	-1.611	-1.602	0.438	-2.687	-0.429
lnRD	451	-2.825	-2.753	0.611	-4.962	-1.301
lnDIGI	451	-1.450	-1.249	0.682	-4.641	-0.00200
lnCSH	451	-1.047	-0.998	0.568	-2.235	0.386
lnCX	451	2.920	3.101	1.120	-0.209	5.229
lnJR	451	0.127	0.0970	0.358	-0.750	1.123
lnRLZB	451	-4.233	-4.178	0.872	-6.361	-2.063

5 Empirical Results and Analysis

5.1 Analysis of Benchmark Regression Results

5.1.1. Coordinated Development of RD with Regions.

The regression results of the impact of RD on CRD are shown in Table 4. Column (1) of Table 4 shows that the regression coefficient of RD is significantly positive at the level of 1%, indicating that RD will promote CRD. In column (2), control variables are added on the basis of column (1), and the regression coefficient of RD is still significant at the level of 1%. It shows that RD can still play a positive role in CRD after other factors that may affect CRD are controlled. The above regression results prove hypothesis 1, indicating that RD can promote CRD.

5.1.2. RD and the Development of DIGI.

First, model (2) is used to study the impact of RD on the development level of DIGI. The regression results are shown in column (3) of Table 4. The results show that the regression coefficient of RD is significant at the level of 5%, that is, RD plays a positive role in improving the development level of DIGI.

5.1.3. RD, DIGI and CRD.

At present, a large number of literatures have proved that the development of DIGI can promote the CRD. DIGI can accelerate the marketization of labor factors and capital factors. The marketization of technology and data can realize the rational allocation of resources, thus promoting the narrowing of regional development gap .DIGI can promote regional division of labor and cooperation through the three aspects of value distribution, value realization and value creation, so as to promote regional coordinated development .Although scholars have different research perspectives, they all prove that the development of DIGI plays a positive role in promoting CRD.

It has been proved above that RD can promote CRD and DIGI, and a large number of existing studies have proved that DIGI can promote CRD. Therefore, to sum up, it can be proved that RD can promote the development of DIGI and CRD. H2 is proved. The results are shown in Table 3.

Table 3. Regression results of RD, DIGI and CRD

	(1) lnCRD	(2) lnCRD	(3) lnDIGI
lnRD	0.066***	0.061***	0.113**
	(0.020)	(0.018)	(0.054)
lnCSH	×	0.222***	-0.073
lnCX	×	0.097***	0.087*
lnJR	×	0.076*	-0.021
lnRLZB	×	0.031	0.110
Year fixed	√	√	√
City fixed	√	√	√

Constant term	-1.683***	-1.563***	-1.407***
	(0.061)	(0.151)	(0.447)
Sample size	451.000	451.000	451.000
Adjusted R	0.769	0.805	0.384

Note: p values in parentheses; ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

5.2 Robustness Test

5.2.1. Replace the Explained Variable.

In order to test the robustness of the research results, this paper adopts the method of replacing the explained variables to test, and transforms the CRD index measured by entropy method into the principal component analysis method. The specific approach is to standardize the data of 9 indicators of regional coordinated development and reduce the dimension to form a new regional coordinated development index CRD1. The regression results are shown in column (1) of Table 4. The results show that RD can still significantly promote CRD, and the regression results are similar to the previous ones, indicating that the research results of this paper are relatively robust.

5.2.2. Endogenous Processing.

Therefore, in order to solve the possible endogeneity problem of the linear regression model set in this paper, that is, the level of CRD may reflect the level of RD in reverse, the following measures are taken: On the one hand, the two-way fixed-effect model is adopted, that is, the city and time are fixed at the same time, so as to avoid the impact of the interaction between RD and CRD on the overall model; On the other hand, the lag period of RD variable is selected as the instrumental variable for 2SLS regression. The output of the first stage is shown in column 4 (2), and the output of the second stage is shown in column 4 (3). The instrumental variables obtained from the table pass the LM and Wald tests, indicating that it is reasonable to select the lag one stage of RD as the instrumental variable. The results show that RD can still significantly promote CRD.

Table 4. Regression results of robustness test on the impact of RD on CRD

	(1)	(2)	(3)
	Replace the explained variables	first	second
Variables	LnCRD1	lnRD	lnCRD
lnRD	0.163***		0.130 * *
L.lnRD		0.358 * * *	(2.51)
		(4.87)	

Control variables	√	√	√
Year fixed	√	√	√
City fixed	√	√	√
R^2	0.746		0.806
Kleibergen-Paap rk LM statistic		23.199	23.199
Cragg-Donald Wald F statistic		63.404	63.404
Kleibergen-Paap rk Wald F statistic		23.695	23.695

6 Conclusions and Recommendations

6.1 Main Research Conclusions

Based on the basic theory that RD affects CRD, this paper combines the characteristics of RD with theoretical analysis and empirical test, and draws the following conclusions: First, RD has effectively promoted CRD; Second, RD will promote the development of DIGI, using the development of DIGI to promote CRD.

6.2 Policy Implications

First, in order to continue to give full play to the positive role of RD in the coordinated development of regions, the government needs to increase fiscal expenditure on science and innovation. On the premise of allowing the market to play a decisive role in allocating science and innovation resources, the government should rationally allocate resources to avoid the formation of industrial agglomeration of science and technology innovation, which will lead to the widening of differences in regional development levels.

Second, considering the obvious heterogeneity of the impact of RD on regional coordinated development, differentiated policies need to be implemented. For the economically developed areas, the focus of RD can be placed on higher-level technology to adapt to the higher level of information technology. In less developed areas, more attention should be paid to the construction of science and technology infrastructure, while avoiding excessive interference with the market and resulting in waste of resources.

Third, RD can affect the coordinated development of regions through the development of the DIGI, so we should pay more attention to the development of DIGI to give full play to its supporting role. The government should increase spending on the DIGI, improve the system for new forms of business in the context of the DIGI, improve supporting facilities for the DIGI, and designate policies to encourage the development of the DIGI.

References

1. Marhasova V ,Tulchynska S ,Popelo O , et al.Modeling the Harmony of Economic Development of Regions in the Context of Sustainable Development[J].International Journal of Sustainable Development and Planning,2022,17(2):
2. [Yang Juan, Duan Junshan. Analysis on the level measurement and dynamic evolution of coordinated regional economic development in China [J]. Statistics and decision, 2023, 33 (12) : 6. 120-125 DOI: 10.13546 / j.carol carroll nki tjyjc. 2023.12.021.
3. Hu Yan, Zhang Jiayang, Du Yu. Fiscal spending on science and technology, human capital and the Yangtze river delta regional harmonious development [J]. Journal of east China economic management, 2023, 5 (10): 13-22. DOI: 10.19629 / j.carol carroll nki. 34-1014 / f, 220606003.
4. Pan Mingming, Zhang Jie. Fiscal Science and Technology expenditure, digital economy and high-quality economic development: An empirical test based on provincial panel data [J]. Management modernization, the lancet, 2023 (4): 29-37. DOI: 10.19634 / j.carol carroll nki. 11-1403 / c. 2023.04.004.
5. Lorente B D ,Shah R A S .Stay circular economy, empowerment, and natural resource utilization factual factors for SDG 12? The principal role of digital technologies, [J]. Journal of Environmental Management, 2024370224, 59-122459.
6. [Yang Renfa, Shen Chen.Scientific and technological innovation, government intervention and regional coordinated development of the Yangtze River Economic Belt [J]. Statistics and Information Forum,202,37(03):24-33.]
7. Zhao Tao, Zhang Zhi, Liang Shangkun. Digital economy, entrepreneurial activity and high-quality development: Empirical evidence from Chinese cities [J]. Management world, 2020, 4 (10): 65-76. The DOI: 10.19744 / j.carol carroll nki. 11-1235 / f 2020.0154.