Does the Digital Economy Enhance Regional Innovation Capability? Evidence from China

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Abstract. This study empirically examines how the digital economy influences regional innovation capability, building on a theoretical analysis of its impact. The empirical test is conducted with the provincial level panel data in China from 2012 to 2019. The result shows that the digital economy significantly promotes regional innovation capability. The digital economy enhances innovation capabilities indirectly by strengthening regional absorptive capacity.

Keywords: Digital economy, innovation capability, absorptive capacity, China.

1 Introduction

China emphasizes the importance of independent innovation in recent years. Regional innovation is an important factor for constructing an innovation-oriented country. Nowadays, it is necessary to discuss whether the development of the digital economy can effectively promote regional innovation capacity. Meanwhile, the impact of the digital economy is a hot topic in academia in recent years.

Scholars have empirically studied the casual relationship between digital economy and regional innovation. In terms of theoretical research, Jin and Sun (2019) analyzed from macro and micro dimensions [1]. Their study pointed out that the the digital economy can stimulate innovation capabilities. Cao (2019) found that the digital economy contributes to regional innovation performance in the filed of economies of scale [2]. In terms of empirical research, some scholars analyzed the positive impact of regional digital economy on innovation from micro, meso, and macro levels (Wen, 2020; Guan et al., 2022) [3,4]. Liu (2022) used 2011-2020 provincial panel data for an empirical study and found that the digital economy had a significant positive impact on regional innovation [5]. Existing studies deeply analyzed the influence mechanism of the digital economy on regional innovation using provincial panel data. The result found that the positive effect of the digital economy on regional innovation had a threshold effect. And the threshold effect is caused by human capital accumulation and R&D capital input (Wang & Cen, 2022) [6]. Hu et al. (2022) empirically tested the effect of the digital economy on regional innovation. They pointed out the existing of threshold effects of the regional absorptive capacity [7].

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Through literature review, existing studies have analyzed the impact of the digital economy on regional innovation. However, few studies empirically analyze the impact mechanism of the digital economy on regional innovation. Based on provincial panel data, this paper examines the effect and mechanism of the impact of digital economy on regional innovation capability.

2 Research Hypothesis

2.1 Direct Effect of Digital Economy

The related research on the impact of the digital economy on regional innovation are mainly conducted in the following ways: (1) The implementation of digital technology can greatly reduce the time lag of information transmission and information asymmetry [8]. Thus, enterprises can obtain stronger resource integration ability and explore innovation opportunities. (2) The digital economy helps information transmission, and it makes the interaction between subjects more frequent. Promote innovation activity by strengthening linkages across sectors. (3) The digital economy enables innovative subjects to collect market information more comprehensively and establish efficient algorithm models. Through comprehensive information evaluation, reduce the uncertainty of innovation [9]. The dispersion of innovation risks increases innovation activities. (4) Digital economy is permeable and diffusive, which not only provides innovation resources for enterprises but also improves regional innovation ability through its diffusion effect. Accordingly, hypothesis 1 is proposed.

Hypothesis 1: The digital economy development can promote regional innovation capacity.

2.2 Indirect Effect of Digital Economy

In the development process of regions with differences on economic development, the digital economy affects on regional absorption capacity, and then have an indirect impact on regional innovation capacity. (1) The digital economy helps enterprises quickly obtain the required information and improve the ability to capture information. Moreover, the digital economy makes knowledge move faster among regions. It also enhances the correlation between fields. Improve regional absorptive capacity by facilitating information access and digestibility. (2) Higher absorptive capacity helps enterprise to absorb knowledge and transform them into the ability of innovation [10]. Accordingly, hypothesis 2 is proposed.

Hypothesis 2: The digital economy indirectly improves regional innovation capacity through the improvement of regional absorptive capacity.

3 Empirical Analysis

3.1 Model Specification

To verify Hypothesis1 in this paper, Model (1) is constructed:

$$innov_{it} = \alpha_0 + \alpha_1 diecon_{it} + \sum_k \alpha_k control_{it} + \varepsilon_{it} \quad (1)$$

In model 1, $innov_{it}$ is the regional innovation capability. $diecon_{it}$ in model (1) is regional digital economy. In addition, $control_{it}$ are the control variables.

With the analysis of mechanism, the indirect effect of the digital economy in the theoretical analysis above, the regional absorptive capacity is pointed out. This study constructs a mediating effect model. The mediation effect model has three steps.

First, regression of the explained variable to the explained variable is carried out, that is, refer to the above model (1).

Secondly, the explanatory variable is regressed to the regional absorption capacity of the mediating variable, as shown in Model (2).

Finally, both explanatory and mediating variables are added to the regression analysis. The mediating effect model of this study is shown in Model (3).

$$absorb_{it} = \theta_0 + \theta_1 diecon_{it} + \sum_k \theta_k control_{it} + \varepsilon_{it} \quad (2)$$

$$innov_{it} = \gamma_0 + \gamma_1 diecon_{it} + \gamma_2 absorb_{it} + \sum_k \gamma_k control_{it} + \varepsilon_{it} \quad (3)$$

3.2 Variables and Data

Regional innovation capability: Because of the nature of innovation activities, we cannot directly measure the quality and quantity of technological innovation, so we can only use some alternative indicators to measure it. Most studies measuring regional innovation as technological activity output, using the number of patent applications as regional innovation. This paper uses the number of patents applicated in each province to measure regional innovation capability for regression analysis.

Digital economy: To measure the level of the digital economy, Zhao et al. (2020) constructed an index [11]. The index includes five indicators.

Absorptive capacity: According to the practice of Hu et al. (2022), using the regional R&D expenditure over regional GDP [12].

Control variables: $educ_{it}$ is the number of college students per 100,000 people in the selected region. The more educated the labor force is, the more likely it is to capture market opportunities and explore knowledge, and the more likely it is to generate innovative behaviors. Government expenditure ($govt_{it}$), using the general government budget expenditures over GDP [10].

4 Results

4.1 Baseline Regression

The results of Table 1 show digital economy development on regional innovation capability is positive. The addition of control variables based on column (1) still shows that the digital economy significantly promotes regional innovation ability. Among the control variables, GDP, education and government expenditure are all positively affect regional innovation.

Therefore, hypothesis 1 is verified.

Table 1. Results of baseline regression

	(1)	(2)	(3)	(4)
diecon	0.4702***	0.3881***	0.3140***	0.3079***
	(0.0211)	(0.0272)	(0.0313)	(0.0317)
gdp		-0.0512***	-0.0500***	-0.0496***
		(0.0114)	(0.0110)	(0.0109)
educ			1.0750***	1.1427***
			(0.2513)	(0.2564)
govt				0.8643***
				(0.1377)
_cons	9.6819***	10.17***	1.8023***	-2.9468***
	(0.0238)	(0.0110)	(1.9581)	(1.9512)
N	240	240	240	240
Within R2	0.7036	0.7299	0.7518	0.7917

4.2 Results of Mediating Effect

The test results of effect mechanism with the mediating model are shown in Table 2. Three steps of the mediating effect model are shown in column (5) to (7).

Table 2. Regression results of mediating model

variable	innov (5)	absorb (6)	innov （7）
diecon	0.3079***	0.1049***	0.2913***
	(0.0317)	(0.0155)	(0.0335)
absorb			0.1339***
			（0.0939）
Control variable	YES	YES	YES
_cons	9.6819***	1.6422***	9.0523***
	(0.0238)	(0.0175)	(0.3720)
observations	240	240	240

In the baseline regression analysis, the impact of the digital economy on regional innovation capability is significantly positive. It is verified that the digital economy promotes regional absorptive capacity.

In the model of regional innovation capability, the digital economy development increases by 1 unit causing the regional innovation capability increases by 0.2913 units when other factors remain unchanged. At the same time, each unit increase in the development of the digital economy also increases the regional absorptive capacity by 0.1339 units. It proves the indirect increase of regional innovation capacity.

It leads to the total effect on innovation capability of 0.3079 units. The results on table 2 show that the mediating effect is existing.

The development of the digital economy can promote regional innovation capability through the improvement of regional absorption capacity.

The result verifies hypothesis 2 of this paper. It means that the digital economy increases regional absorptive capacity, and then higher regional absorptive capacity creates more regional innovations.

5 Conclusion

This study prove that the digital economy can significantly improve regional innovation ability. From the mechanism analysis results, the digital economy is conducive to the improvement of regional absorptive capacity, and then indirectly affects the regional innovation capacity. Based on the empirical results, here are some policy implications.

First, all regions should promote the digital economy. Regions in China must continuously accelerate their digitalization efforts to enhance regional innovation capacity. By boosting R&D investment, they can increase innovation output. Governments must also provide robust policy support to foster the development of the digital economy. This includes creating an enabling environment through initiatives such as tax incentives, grants, and subsidies for digital startups and businesses [13]. Additionally, implementing regulatory frameworks that facilitate innovation while ensuring data security and privacy is crucial. By investing in digital infrastructure and promoting digital literacy programs, governments can empower both businesses and individuals to fully engage with and benefit from the digital economy. Such comprehensive support not only accelerates technological advancement but also drives economic growth and enhances overall competitiveness in the global market. Secondly, regional absorptive capacity should be improved by increasing R&D investment to promote innovation capacity. To enhance regional absorptive capacity, it is essential to increase R&D investment, which plays a crucial role in fostering innovation development. By allocating more resources to research and development, regions can better acquire, assimilate, and apply new knowledge and technologies. This investment will facilitate collaboration between universities, research institutions, and businesses, creating a dynamic ecosystem that encourages innovation. Additionally, improving infrastructure and providing training programs will equip the workforce with the necessary skills to harness new advancements. Ultimately, strengthening regional absorptive capacity through increased R&D funding will significantly promote the overall development of innovation

capacity, driving economic growth and competitiveness in an increasingly digital landscape.

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