



Research on the Quality of Technological Innovation and Regional Economic Development

Yingchao Bai*

College of business administration, Heyuan Polytechnic, Heyuan, 517000, China

*baiying168@163.com

Abstract. Under the background of building a highland of technological innovation, it is still of great significance to study the influence of technological innovation on economic growth. Taking 30 cities in the Yangtze River Delta as the research object, this paper empirically studies the impact of technological innovation on regional economic development based on panel data, and makes a comparative analysis from the perspectives of different provinces and different types of innovation. This paper found that, on the whole, different types of technological innovation have significantly promoted the economic development of the Yangtze River Delta region. Regionally, the promotion intensity of different types of technological innovation is different, and the impact of different types of technological innovation on the economic development of provinces in the region is different. Cities in the Yangtze River Delta region should formulate different development countermeasures based on regional differences.

Keywords: Technological innovation; Economic growth; High-level innovation; Imitative innovation; The Yangtze River Delta region

1 Introduction

1.1 Introduction

The Yangtze River Delta region has experienced many expansions, including 41 cities in Shanghai, Jiangsu, Zhejiang and Anhui provinces, and is one of the regions with the most active economic development and the strongest innovation ability in China. The Development Plan for the Construction of the Yangtze River Delta Science and Technology Innovation Community proposes to coordinate the promotion of scientific and technological innovation, jointly build a major cluster of scientific and technological infrastructure, and build the Yangtze River Delta into a globally leading science and technology innovation community. With the continuous improvement of regional integration in the Yangtze River Delta, vigorously developing science and technology has become a consensus to achieve high-quality development.

1.2 Literature Review

Based on the importance of technological innovation to economic development, scholars have carried out a lot of research. You Tie, J., & Shapira, P. investigated how universities have evolved from traditional research and education functions to knowledge centers that promote innovation, and put forward the role of universities in innovation-driven economic development ^[1]. Torres-Preciado, V.H., Polanco-Gaytán, M. & Tinoco-Zermeño, M.Á. Using spatial data analysis method, they found that technological innovation has a positive impact on Mexico's regional economic growth, and the cross-border diffusion effect of technological knowledge will have a positive impact ^[2]. Yu Yu et al. used night lighting data, and found that green technology innovation has spatial agglomeration, which significantly promoted regional economic development ^[3]. Zhang Guoqing and Huang Lijun adopted the dynamic panel model, and found that technological innovation, institutional innovation and financial innovation all positively promoted the economic development of China. Different regions have differences, and financial innovation has the greatest impact on the central region, while technological innovation and institutional innovation have the greatest impact on the eastern region ^[4]. Zhang Yunhua and Ji Lingyu took the Yangtze River Delta as an example, and found that technological innovation can promote economic development, and the digital economy has an intermediary effect, so we should use the digital economy to achieve high-quality economic development ^[5]. Zhang Sen et al. found that digital economy has a strong promotion effect on invention innovation and utility model innovation, and it also affects the technological innovation effect through channels such as enterprise innovation elements and innovation environment ^[6]. Liang, K., Wu, P., Zhang, R., & Li, M.E. used the latent Dirichlet topic model and sentiment analysis method to construct an evaluation index system that integrates technology news data, and they proposed the RSTI capability evaluation model, which promotes the integration of technology and economy ^[7].

At present, there is relatively little research on analyzing economic growth in the Yangtze River Delta region from the perspective of different types of technological innovation. This article will compare and analyze the contribution of technological innovation to economic growth from the perspective of overall technological innovation and different types of technological innovation, using patent application volume as a proxy indicator, and propose corresponding development suggestions.

2 Research Design

2.1 Model settings

This article takes the Yangtze River Delta region as the research object and explores the impact of technological innovation on regional economic growth. The model is set as follows:

$$\ln pgdp_{it} = \alpha + \beta_1 \text{innov}_{it} + \beta_2 Z_{it} + \varepsilon_{it} \quad (1)$$

Among them, $\lnpgdp_{it}$ represents the economic development level of i city in t year, $\lninnov_{it}$ represents the level of technological innovation, Z_{it} represents a series of control variables, ε_{it} is a random disturbance term. This article mainly examines the coefficient β_1 . If β_1 is significantly positive, it indicates that the level of technological innovation has significantly promoted regional economic growth; Otherwise, it indicates that technological innovation has failed to promote economic growth.

2.2 Sample and Data Description

Drawing on existing research literature, the number of patent applications can better reflect the level of regional technological innovation activity. Therefore, this article adopts the logarithm of the number of patent applications per 10000 people to represent the level of technological innovation in the city; In terms of regional economic development, this article uses the logarithm of per capita GDP as a proxy. Due to the many factors that affect regional economic development, in order to ensure the reliability and effectiveness of research conclusions, this article further controls for common variables that affect economic development. This article selected the following control variables: degree of government intervention (gov), The degree of regional openness (open), Foreign investment level (fdi), Degree of industrialization (str_2), Development level of service industry (str_3). This paper takes 30 cities after the expansion of the Yangtze River Delta Urban Economic Coordination Committee in 2013 as the research object, and selects the panel data of cities from 2009 to 2019 to explore the impact of technological innovation on regional economic development. The data of this paper comes from China research data service platform and the China City Yearbook over the years. The main variables and explanations of this paper are shown in Table 1.

Table 1. Main variables and descriptions.

variable	meaning of variable	calculation method
lnpgdp	the level of economic development	per capita GDP takes logarithm
innov1_all	technical innovation level	taking the logarithm of the total number of patent applications per 10000 people
gov	the degree of government intervention	the ratio of local fiscal expenditure to GDP
open	the degree of regional openness	the proportion of regional total import and export to GDP
fdi	the level of foreign investment	the proportion of foreign direct investment in GDP
str_2	industrialization level	output value of secondary industry/GDP
str_3	development level of tertiary industry	output value of tertiary industry/GDP

3 Empirical Result Analysis

3.1 Full Sample Regression Analysis

In order to eliminate the influence bias caused by individual differences, this paper

uses fixed effect to analyze the influence effect of technological innovation on economic development, and adopts robust standard error to reduce the influence of heteroscedasticity. The estimated results are shown in Table 2. The first column shows the regression results without control variables, while the other columns show the regression results with gradually added control variables. The estimation results show that regardless of whether control variables are included, the coefficient of technological innovation on economic growth is significantly positive at the 1% level, indicating that technological innovation has significantly promoted the improvement of economic development level in the Yangtze River Delta region.

From the perspective of control variables, after adding all control variables, the coefficient of government intervention degree is significantly positive, indicating that local governments have a positive promoting effect on regional economic development, and the invisible hand of the government is beneficial to economic development; The coefficients of both the secondary and tertiary industries are significantly positive, indicating that the development of both industries has promoted the local economy. The coefficient of regional openness is negative but not significant, which may reflect the low quality of opening-up in the process of foreign trade in the Yangtze River Delta region; The coefficient of foreign investment level is significantly negative, which may reflect that with the development of industrial transfer, some foreign investment in the Yangtze River Delta region has shifted to inland and South-east Asian areas, which has had a negative impact on economic development.

Table 2. Influence of Technological Innovation on Regional Economic Development.

variable	(1)	(2)	(3)	(4)	(5)	(6)
	lnpgdp	lnpgdp	lnpgdp	lnpgdp	lnpgdp	lnpgdp
innov1_all	0.392*** (17.27)	0.355*** (10.86)	0.336*** (9.65)	0.302*** (7.03)	0.259*** (5.03)	0.128*** (5.28)
control variable	No	Yes	Yes	Yes	Yes	Yes
_cons	9.854*** (134.59)	9.678*** (89.72)	9.932*** (58.89)	10.11*** (74.94)	11.37*** (29.05)	2.681*** (4.13)
N	330	330	330	330	330	330
Adj.R2	0.534	0.551	0.573	0.663	0.713	0.851

Note: *, * * and * * are significant at the levels of 10%, 5% and 1% respectively; The figures in brackets are the t statistics of the corresponding coefficients. The same below.

3.2 Comparative Analysis

Comparative Analysis of Different Innovation Types.

Invention patents need to be novel, creative and practical, and it usually takes 1-3 years from filing to approval, which usually requires high quality of innovation; Patents for utility models and designs are usually applied designs for the shape and appearance of products, which are easy to pass and take a short time. Therefore, in order to deeply analyze the impact of technological innovation on economic growth and further explore the differences of different types of technological innovation, this paper divides technological innovation into high-level innovation and imitative inno-

vation. High-level innovation (innov1_fm) adopts the agent of 10,000 people's invention patent applications, while imitative innovation (innov1_sywg) adopts the agent of 10,000 people's utility model patents and design patents applications, so as to further explore the differences in the influence effects of different innovation types on regional economic development. See Table 3 for the estimated results.

The estimation results show that the estimation coefficient of high-level innovation is 0.149 and that of imitative innovation is 0.0636, both of which are significant at the level of 1%, indicating that different types of technological innovation can significantly promote regional economic development. By contrast, the estimation coefficient of high-level innovation is obviously greater than that of imitative innovation, which shows that the promotion effect of high-level innovation on regional economic development is significantly higher than that of imitative innovation, which is consistent with the innovative requirements of high-level innovation. Therefore, when guiding the development of scientific and technological innovation, local governments should focus on it, guide imitative innovation to move to high-quality innovation, and improve the development quality of technological innovation.

Table 3. Influence of different types of technological innovation.

variable	(1)	(2)
	lnpgdp	lnpgdp
innov1_fm	0.149*** (7.75)	
innov1_sywg		0.0636*** (3.69)
control variable	Yes	Yes
_cons	4.298*** (6.05)	1.753*** (2.93)
N	330	330
Adj.R2	0.868	0.832

Comparative Analysis of Different Regions.

In order to further explore the differences between different regions, this paper further divides the sample cities into three groups according to Jiangsu Province, Zhejiang Province and Anhui Province, and makes a comparative analysis. The estimation results show that the influence of different types of technological innovation is different among different provinces. From the perspective of high-level innovation, the estimated results of each province are 0.0707, 0.210 and 0.197 respectively, all of which are significant at the level of more than 5%, which shows that the promotion of high-level innovation to economic development has universal applicability to some extent. From the perspective of imitation innovation, the impact of imitation innovation on economic development in Zhejiang Province is 0.116, which is significant at the level of 1%. However, Jiangsu Province and Anhui Province are positive but not significant, which may indicate that the influence of imitation innovation on economic development is different, and the quality of imitation innovation is not high, so the role of imitation innovation on economic development is not universal.

3.3 Robustness Test

In order to further test the robustness of the research results, this paper will re-analyze the regression by replacing the explanatory variables. The estimation results of regression show that the estimation coefficients of overall technological innovation, high-level innovation and imitative innovation in the Yangtze River Delta region are significantly positive at 1%, after the technological innovation variable is replaced by the number of patents granted per 10,000 people, which is consistent with the previous research results. The research results of this paper pass the robustness test.

4 Explanations and Suggestions

In order to further exert the promotion effect of technological innovation level on regional economic development and improve the level of technological innovation, based on the results of the previous inspection and analysis, this paper puts forward the following development suggestions:

(1) adopt different policies for technological innovation and development. Zhejiang province should promote the coordinated development of high-level innovation and imitative innovation, and actively play the role of imitative innovation in promoting economic development. The imitative innovation in Jiangsu Province and Anhui Province has failed to significantly promote economic development. We should appropriately limit the development of imitative innovation and guide it to a high level of innovation from the perspective of limiting or even canceling the incentive policy.

(2) Cooperate to promote high-quality innovation and development. The Yangtze River Delta region should further strengthen regional scientific and technological cooperation, establish a platform for regional scientific and technological collaborative innovation, and encourage regional talent flow; Encourage scientific research institutions, enterprises and researchers to break the boundaries of affiliation, establish a collaborative innovation platform, improve the collaborative innovation mechanism, encourage high-quality innovative regional coordinated development, and then promote regional economic development.

(3) In the process of industrial structure moving to the tertiary industry, the Yangtze River Delta region should still attach great importance to the development of the secondary industry and avoid hollowing out the industry. Cities should give consideration to the coordinated development of the secondary industry and the tertiary industry, guide and optimize the local industrial structure under the background of industrial transfer and industrial structure transformation and upgrading, and focus on developing high-tech industries and high-end equipment manufacturing industries, thus promoting high-quality economic development.

(4) Continue to attract foreign direct investment, encourage enterprises to introduce new technologies, and appropriately strengthen government intervention. The Yangtze River Delta region still needs to increase investment attraction, especially attracting foreign investment, and help the local industrial structure transform and upgrade through high-quality opening up. At the same time, local governments should determine key development industries according to local actual conditions, strengthen local

industrial development planning, and guide local industrial transformation and upgrading. In addition, the Yangtze River Delta region should further improve the quality of opening to the outside world, encourage local enterprises to develop internationally while promoting foreign trade, and optimize the local industrial structure and opening structure.

5 Conclusion

The effects of different regions and types of technological innovation are heterogeneous. The high-level innovation in all provinces has significantly promoted economic development, but the impact of imitation innovation on all provinces is heterogeneous, and only Zhejiang Province has a significantly positive impact. Therefore, in order to better promote economic development, cities should formulate different development strategies according to local specific conditions.

References

1. Youtie, J. and Shapira, P. 2008. Building an innovation hub: a case study of the transformation of university roles in regional technological and economic development. *Research Policy*, 37(8), 1188-1204. DOI:10.1016/j.respol.2008.04.012.
2. Torres-Preciado, V.H., Polanco-Gaytán, M. and Tinoco-Zermeño, M.Á. 2014. Technological innovation and regional economic growth in Mexico: a spatial perspective. *Annals of Regional Science*, 52(1), 183-200. DOI:10.1007/s00168-013-0581-1.
3. Yu Yu, Yang Fan and Shi Qinfen. 2020. Green Technology Innovation and Regional Economic Development: A Study Based on Nighttime Light Data. *Ecological Economy*, 36 (10): 48-54+77.
DOI:<https://kns.cnki.net/kcms2/article/abstract?v=nTS8fe6ew4qDgeXcmKQ1oaZMz7ZhqUFGA-UUVyMi-cw5adsqcJ0jZXAPu4WXuhV2F20d-P6hB5obrMDL14zDIBcYYZCUv-uA-mQueMtlVQrjTD8RhZkayk5oRq6KkDspZLlwowmTXOCeP2Q6ngMufAUgte8H9ax1a988hs3JTqfYmL0Qld3ZSA=&uniplatform=NZKPT&language=CHS>
4. Zhang Guoqing and Huang Lijun. 2021. Technological Innovation, Institutional Innovation, Financial Innovation, and Economic Development: Based on China's Provincial Panel Data. *Financial Economics*, (03): 19-28. DOI:10.14057/j.cnki.cn43-1156/f.2021.03.003.
5. Zhang Yunhua and Ji Lingyu. 2022. Technological Innovation, Digital Economy, and Economic Development: Based on Data Analysis of the Yangtze River Delta Urban Agglomeration. *Science and Economics*, 35 (01): 26-30.
DOI:10.14059/j.cnki.cn32-1276n.2022.01.006.
6. Zhang Sen, Wen Jun and Li Xudong. 2023. Development of Urban Digital Economy and Enterprise Technological Innovation. *Economic System Reform*, (02): 60-68.
DOI:https://kns.cnki.net/kcms2/article/abstract?v=nTS8fe6ew4oPvL-c_fJWuQ7kacit5fi_mwvdxTL0HJuU1jd7Si3rNT_9GowUwABHuW-VxVOC0mYpppXqQ748TyNIHG42of_20Czrjrudr5BDn62fl1Z8-Q0ys-bEdS2O3rNhCwjuHAXnxigDmGNxMUnl4fzp3jaNvLDmhmTDIptKDP2icVVow=&uniplatform=NZKPT&language=CHS
7. Liang K, Wu P and Zhang R. 2024. Research on the Evaluation of Regional Scientific and Technological Innovation Capabilities Driven by Big Data. *Sustainability*, 16(4):1379. DOI:10.3390/su16041379.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 3.0 International License (<http://creativecommons.org/licenses/by-nc/3.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

