

Analysis of the Impact of Science, Technology and Innovation on Economic Growth in the Pearl River West Economic Belt

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Abstract

Science and technology innovation has an important impact on economic growth. This paper summarises the relevant theories of domestic and foreign authors on the analysis of the impact of science and technology innovation on economic growth, and combines them with the reality of science and technology innovation on economic growth in the Pearl River West Economic Belt, and argues that there is a certain amount of science and technology innovation outputs in the Pearl River West Economic Belt, which, in turn, promotes economic growth. This paper empirically analyses the impact of STI on the economic growth of the Pearl River-West River Economic Belt by using the statistical data from 2000 to 2020 of the 11 major cities involved in the belt (i.e., Guangzhou, Foshan, Zhaoqing, Yunfu, Nanning, Liuzhou, Wuzhou, Guigang, Baise, Laibin and Chongzuo). The results show that the impact of S&T innovation on the economic growth of the Pearl River-West River Economic Belt is positively correlated, indicating that S&T innovation can promote the economic growth of the Pearl River-West River Economic Belt. And this effect is robust.

Keywords: scientific and technological innovation, economic growth, economic belt

1. Introduction

In the context of globalisation, science, technology and innovation have become a key yardstick for assessing a country's comprehensive national strength. If a country can master a wealth of independent intellectual property rights and core technologies through scientific and technological innovation, it will be able to gain a competitive edge in the international arena. In addition, scientific and technological innovation plays a significant role in promoting industrial upgrading and transformation, as well as enhancing the quality and efficiency of the national economy. Science and technology innovation is the core driving force of economic development. It can give rise to new products and services, effectively meet market demand, and then drive economic growth. At the same time, STI significantly enhances the market competitiveness of enterprises by improving production efficiency and cutting production costs. More importantly, STI can lead the rise and development of new industries, injecting new sources of power for economic growth.

In 2014, China formally incorporated the Pearl River-West River Economic Belt into its national strategy, a move that underscores the region's key position in the country's overall development blueprint. Against this backdrop, the governments of Guangdong Province, Guangxi Zhuang Autonomous Region and other provinces within the belt have worked closely together to promote in-depth cooperation in infrastructure development, economic collaboration, resource sharing and ecological protection. These comprehensive measures have built a solid foundation for the high-quality development of the Pearl River-West River Economic Belt, which has not only accelerated economic integration and optimal allocation of resources within the region, but also strengthened the strategy of ecological environmental protection and sustainable development, and safeguarded the sound advancement of the Economic Belt within the framework of the national strategy. In addition, according to the Outline of the Plan for the Development of the Guangdong-Hong Kong-Macao Greater Bay Area issued by the Central Committee of the Communist Party of China and the State Council, the construction of an important economic corridor with the Guangdong-Hong Kong-Macao Greater Bay Area as the leader, the Pearl River-West River Economic Belt as the support, and the radiation to drive the central-south and southwestern regions, and to influence Southeast Asia and South Asia is clearly put forward. In this regard, the Guangxi Zhuang Autonomous Region should grasp this historical opportunity to actively integrate and play its role. Guangxi needs to grasp the opportunities of the times, focusing on the core of the Pearl River-West River Economic Belt, integrating into

Guangdong's regional economic integration as the main line, and using science and technology innovation as the driving engine, in an effort to promote Guangxi's regional economy to achieve high-quality development. Accordingly, Guangdong should also pay attention to the development potential of the Pearl River-West River Economic Belt, and through close cooperation with Guangxi, jointly promote the economic growth of the western part of Guangdong, thereby strengthening the coordinated development of the region. The core contribution of this paper is that it focuses on the key economic development region of the Pearl River-West River Economic Belt, and through in-depth analysis of the internal mechanism of how science and technology innovation (S&T innovation) is transmitted to economic growth, the paper comprehensively analyses and summarizes the specific roles and paths that S&T innovation has played in the economic growth of the Pearl River-West River Economic Belt. Further, the article adopts empirical analyses to assess the actual effect of STI on the economic growth of the Pearl River-West River Economic Belt, aiming to provide solid theoretical support for the development of the region. This series of research results will not only help Guangxi to strive for economic leadership, but also contribute to the promotion of balanced development and the realisation of common prosperity in Guangdong.

Up to now, domestic research results on how science and technology innovation affects economic growth have been quite fruitful. Scholars have carried out in-depth discussions from multiple dimensions, including human capital accumulation, the foundation of science and technology industry, and the number of innovation achievements, etc., so as to analyse the role of science and technology innovation in promoting economic growth, as well as the spillover effect and threshold effect that may be generated in the process of economic growth. In 'Research on the Driving Role of Technological Innovation on the Quality of Economic Growth', two scholars, Yang Kaijun and Min Chongzhi (2019)^[1], Using the data of Shenzhen Greater Bay Area from 2007 to 2017, this study empirically examines the role of technological innovation in driving the quality of economic growth with the help of systematic GMM method and panel threshold regression model. The main conclusions are summarised as follows: firstly, the overall quality of economic growth in the Guangdong-Hong Kong-Macao Greater Bay Area shows an upward trend, in which Hong Kong, Shenzhen and Guangzhou, as the core cities, play a leading role in economic growth; secondly, technological innovation shows a significant role in promoting the quality of economic growth in the Guangdong-Hong Kong-Macao Greater Bay Area.

Lin Li and Chen Huixian (2021)^[2], In Exploring the Effect of Technological Innovation on Regional Economic Growth in Zhejiang Province, the authors analyse the impact of the correlation between technological innovation and FDI on the economic development of different regions of Zhejiang Province based on the panel data of Zhejiang Province from 2013 to 2019 by incorporating foreign direct investment (FDI) and its interaction term with technological innovation. The study reveals that technological innovation has a significant driving effect on economic growth in Zhejiang Province, and this driving effect is different in the northeast and southwest of Zhejiang Province; moreover, the role of FDI on economic growth shows a 'U' trend, and the synergistic effect of technological innovation and investment has a positive catalytic effect on the growth of the regional economy.

Feng Hua and Wang Zhiyu (2018)^[3] co-authored 'An Empirical Study on the Relationship between China's Science and Technology Service Industry and Economic Growth', The study adopts the industry's direct contribution rate and indirect pull rate as analytical tools, combines nationwide time-series data from 1991 to 2013, and explores in depth the interaction between the science and technology service industry and economic growth through cointegration analysis techniques and Granger causality tests. The findings show that a positive interaction mechanism has been initially established between China's science and technology service industry and economic growth. In the short term, attention should be paid to the cultivation and support of the S&T service industry in the economic development environment; in the medium and long term, more attention should be paid to the role of the S&T service industry in promoting economic growth and coordinating the economic structure.

The current research object of domestic research is mostly developed coastal cities, and there are fewer researches on underdeveloped areas. Due to the great reality of developed and underdeveloped cities, it is difficult to guide the development of scientific and technological innovation in underdeveloped cities with the thesis for developed areas. Less developed regions urgently need some articles on the impact of science and technology innovation on economic development to guide practice. Moreover, the data used in the current domestic papers on the impact of science and technology innovation on economic growth are relatively old and cannot reflect the current economic development. As socialism with Chinese characteristics enters into a new era, the social environment has changed radically, and the use of data before the new era is obviously not a good verification of the impact of science and technology innovation on economic development. Therefore, I will adopt the latest data to study the impact of science and technology innovation on the economic growth of the Pearl River West Economic Belt in the new era. From the patent authorisation data of the Pearl River-West River Economic Belt, it can be seen that there is an east-west gap in the level of science and technology in the Pearl River-West River Economic Belt, with the western

region having a lower level of scientific and technological innovation and the eastern region having a higher level of scientific and technological innovation. According to the Gerschenkron doctrine of latecomer advantage, the eastern region of the Pearl River-West River Economic Belt is in the leading position in terms of scientific and technological innovation, while the western region of the Pearl River-West River Economic Belt is on the science and technology is on the side of catching up, and the latter region learns the advanced technology of the first region through imitation, introduction, purchase and other means to realise the science and technology innovation of the latter region.

According to Ji Yushan and Wu Yongmin (2008)^[4], S&T innovation can promote economic growth. Firstly, S&T innovation can maximise the cost of researching the technology. In addition, through technological innovation, an enterprise will gain a competitive advantage in the cost and quality of its products, which will attract other enterprises to imitate its advanced science and technology, thus bringing about the development of the whole industry. Finally, the results of scientific and technological innovation will be passed from one industry to another, thus forming a multiplier effect, which will lead to the technological progress of the whole society, and finally to the economic growth of the whole region. Therefore, the Pearl River-West River Economic Belt has had a certain amount of S&T innovation outputs, which in turn have contributed to economic growth.

2. Method

The consequences of the presence of heteroskedasticity can be minimised by using the method of taking logarithms of the variables and modelling them as such:

$$\ln gdp_{it} = C + \beta_1 \ln patent_{it} + \beta_2 \ln fdi_{it} + \beta_3 \ln fix_{it} + \beta_4 \ln budget_{it} + \beta_5 \ln sci_{it} + \beta_6 \ln loan_{it} + \delta \quad (1)$$

where $\ln gdp_{it}$ is the explanatory variable, i.e. the gross regional product of city i in year t , and $\ln patent_{it}$ is the core explanatory variable, i.e. the level of science, technology and innovation in city i in year t . i is the city, t is time, C is the constant term, β_1 to β_6 are the parameters to be estimated, and δ is the residual term.

In this paper, the Gross Domestic Product (GDP) of the 11 major cities involved in the Pearl River-West River Economic Belt (i.e., Guangzhou, Foshan, Zhaoqing, Yunfu, Nanning, Liuzhou, Wuzhou, Guigang, Baise, Laibin, and Chongzuo) is selected as an indicator of the economic growth of the Pearl River-West River Economic Belt for the period from 2000 to 2022. The number of patents granted from 2000 to 2020 in the 11 major cities involved in the Pearl River-West River Economic Belt (i.e., Guangzhou, Foshan, Zhaoqing, Yunfu, Nanning, Liuzhou, Wuzhou, Guigang, Baise, Laibin, and Chongzuo) is selected to measure the scientific and technological innovation of the Pearl River-West River Economic Belt. The control variables selected in this paper are: the amount of foreign investment in the city (fdi); the amount of investment in fixed assets in the city (fix); the budget expenditure of the city government ($budget$); the expenditure on science and technology in the city (sci); and the state of financial development in the city ($loan$).

3. Results

3.1 Benchmark Regression Results

In this paper, a benchmark regression analysis of the model was conducted. Table 1, column (1), is the regression of only STI on economic growth, and the study found that STI in the Pearl River-West River Economic Belt significantly promotes the economic growth of the Pearl River-West River Economic Belt. Table 1, column (2), is a regression that adds control variables to the regression and finds that STI in the Pearl River-West River Economic Belt still significantly promotes economic growth in the Pearl River-West River Economic Belt. From Table 1, columns (1) and (2), it can be seen that the STI of the cities within the Junction Pearl River-West River Economic Belt can significantly contribute to the economic growth of the cities within the Pearl River-West River Economic Belt at the 1% significance level.

Table 1. Results of empirical tests (1)

VARIABLES	(1) loggdg	(2) loggdg
logpatent	0.532*** (49.31)	0.096*** (4.73)
logfdi		0.084*** (8.29)
logfix		-0.089 (-1.64)
logbudget		0.341*** (5.37)
logsci		0.015 (0.77)
logloan		0.345*** (10.25)
Constant	12.551*** (162.50)	5.312*** (12.47)
Observations	246	143
R-squared	0.909	0.983

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.2 Robustness Check

In order to verify the robustness of the benchmark regression results in this paper, two methods are used to conduct robustness tests.

3.2.1 Replacement of Explanatory Variables

In this paper, the measure of the explanatory variables is changed to the per capita gross regional product of each city. Replacing the new explanatory variables with the old ones, the results of the empirical study are shown in column (1) of Table 2, which shows that science and technology innovation of the cities in the Pearl River West Economic Belt can still significantly promote the economic growth of the cities in the Pearl River West Economic Belt. And this significance is significantly positive at the 1% level. This result indicates that the benchmark regression results of this paper are robust.

3.2.2 Core Explanatory Variables Lagged by One Period

This paper takes into account that there may be a certain lag in the promotion effect of STI on economic growth, therefore, this paper lags the core explanatory variables by one period. The core explanatory variables lagged one period are brought into the model for regression, and the empirical results are shown in column (2) of Table 2, which shows that the STI of the cities in the Pearl River West Economic Belt in the previous year can promote the economic growth of the cities in the Pearl River West Economic Belt in this year at the 1% significance level.

3.3 Heterogeneity Analysis

The cities within the Pearl River West Economic Zone (PRWEZ) are divided administratively, with some belonging to the Guangxi Zhuang Autonomous Region and others to Guangdong Province. Significant differences exist between Guangxi and Guangdong in terms of economic development and technological innovation. In 2023, Guangdong Province's GDP was 13.57 trillion RMB, while Guangxi's GDP was 2.72 trillion RMB. To study the heterogeneity between these regions, the sample cities were categorized into those belonging to Guangxi Zhuang Autonomous Region and Guangdong Province. The cities in Guangxi include Nanning, Liuzhou, Wuzhou, Guigang, Baise, Laibin, and Chongzuo, while the cities in Guangdong include Guangzhou, Foshan, Zhaoqing, and Yunfu.

The results of the heterogeneity regression, as shown in columns (3) and (4) of Table 2, indicate that technological innovation in cities within the PRWEZ, whether in Guangxi or Guangdong, promotes the economic growth of the PRWEZ. However, coefficient tests reveal that the technological innovation in Guangdong's PRWEZ cities has a stronger positive impact on economic growth than that in Guangxi's cities.

Table 2. Results of empirical tests (2)

(1)	(2)	(3)	(4)
logper_gdp	loggdp	loggdp	loggdp
0.146***	0.052**	0.116**	0.072***
(7.03)	(2.28)	(2.46)	(5.37)
0.098***	0.088***	0.212***	0.039***
(9.50)	(7.81)	(6.35)	(6.21)
0.057	-0.063	0.017	0.349***
(1.03)	(-1.04)	(0.13)	(7.82)
0.361***	0.281***	0.018	-0.087
(5.57)	(4.00)	(0.11)	(-1.35)
0.116***	0.035	0.036	0.048**
(5.86)	(1.64)	(1.16)	(2.63)
-0.210***	0.395***	0.343***	0.226***
(-6.14)	(10.86)	(3.57)	(10.79)
4.086***	5.170***	6.056***	6.789***
(9.32)	(8.66)	(7.03)	(14.81)
142	136	56	87
0.966	0.980	0.992	0.991

t-statistics in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4. Discussion

By combing the literature and summarizing the previous studies, this paper finds that scientific and technological innovation in the Pearl River West Economic Zone can promote the economic growth of the Pearl River West Economic Zone. Moreover, this paper uses the authoritative data of China Urban Statistical Yearbook to construct an econometric model for empirical testing, and it is found that S&T innovation in the cities of the Pearl River West Economic Belt can promote the economic growth of the Pearl River West Economic Belt, and this promotion effect is significantly positive at the level of 1 per cent. This conclusion still holds after the robustness test.

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