Quantitative Research on the Science and Technology Investment and Economic Growth of Guangdong Province from the Perspective of Intelligent Data Analysis

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Abstract. Intelligent data analysis can use data analysis tools such as statistics and data abstraction to discover the correlation between variables in the data. Use the relevant principles of intelligent data analysis to quantitatively research the relationship between Guangdong Province's financial technology investment, R&D expenditure and economic development. The quantitative results show that both government financial investment in science and technology and R&D expenditure have an important impact on economic development. Among them, the influence of R&D expenditure is more significant, and there is also a clear positive relationship between government financial investment in science and technology and R&D expenditure. Based on the results of intelligent data analysis, it is proposed that Guangdong Province should make great breakthroughs in the leveraging of financial science and technology funds, the implementation of the main role of enterprises in science and technology investment, and strengthening of scientific research capabilities of scientific research institutions to provide new momentum for achieving high-quality economic development.

1. Introduction
At present, the world economy has entered a period of differentiation and adjustment, and technological innovation is the most important driving force for national economic development. Leading the high-quality development of China’s economy with the support of scientific and technological innovation is an inevitable choice to solve the deep-seated contradictions and problems in current economic and social development. It is also an important measure to accelerate the transformation of economic development mode and improve the quality and efficiency of development. As one of the regions with the most active innovation atmosphere in China, Guangdong Province has thoroughly implemented the innovation-driven development strategy and accelerated the comprehensive innovation with technological innovation as the core. The level of investment in science and technology has increased year by year, and the supporting and leading role of science and technology in economic development has become more apparent. Through in-depth study of the relationship between Guangdong's science and technology investment and economic growth, this article provides certain theoretical support for Guangdong Province to further increase investment in science and technology, cultivate new momentum for economic development, and promote the economy to take a high-quality development path.
2. Research Status

Scholars at home and abroad have carried out a large number of fruitful researches on technological innovation. Eric C Wang and Weichiao Huang used the DEA method to study the efficiency of production frameworks for scientific and technological innovation activities in different countries, and analyzed them in three stages with indicators such as R&D capital stock, R&D personnel input, and the number of patents \(^{[1]}\). Myers et al. (1984) believe that technological innovation activities are prone to inducing moral hazard due to their professionalism and particularity, and the Internet can reduce the supervision cost of technological innovation \(^{[2]}\). Liu Ruiyu et al. (2016) used the BCC model to measure the technological innovation efficiency and total factor productivity rate of change in six provinces in central China, and analyzed the factors affecting technological innovation efficiency \(^{[3]}\). Hong Yinxing (2011) believes that my country's heavy investment in technological innovation has strengthened the transformation of technological innovation from enterprises to various stages including production, education and research, and promoted the multi-faceted development of technological innovation in my country \(^{[4]}\). Pang Ruizhi et al. (2014) found that the level of scientific and technological innovation in various provinces in my country is insufficient, and the transformation efficiency of innovation achievements is low, which leads to the insignificant role of scientific and technological innovation in stimulating economic growth \(^{[5]}\). Zhang Ke (2019) believes that there is a mutual promotion mechanism between industrial agglomeration and technological innovation, and industrial agglomeration can promote technological innovation through technology spillovers and economies of scale \(^{[6]}\). Li Shuangjie et al. (2017) based on the data of my country's large-scale scientific research instruments and scientific and technological activities personnel, the study found that the provincial and regional innovation output is uneven \(^{[7]}\). Tao Xuefei et al. (2013) constructed a supporting system from five aspects: technology, knowledge, subject, government management and service, and measured the technological innovation capabilities of different cities \(^{[8]}\).

The research results at this stage show that technological innovation has an obvious supporting effect on social and economic development, and the deep integration of technology and economy can greatly enhance the stamina of economic development.

3. An Empirical Analysis of the Correlation between Science and Technology Input and Economic Growth in Guangdong Province

3.1 Variable selection

This paper selects the level of financial investment in science and technology and the level of investment in R&D in Guangdong Province as independent variables of science and technology investment, which are represented by FTI and R&D respectively. As a dependent variable, the total value of the nominal area generated can measure the economic development level of Guangdong Province, expressed by GDP. The data comes from the statistical yearbook of Guangdong Province over the years, and the time span is 2000-2019, a total of 20 years. Taking into account the possible heteroscedasticity of time series data, this paper will logarithmize all the data and record them as LOG (FTI), LOG (R&D), and LOG (GDP). The data analysis software used is Eviews10.0.

3.2 Trend description of each variable

After 20 years of development, Guangdong's financial investment in science and technology has increased from 3.882 billion yuan in 2000 to 116.879 billion yuan in 2019, R&D expenditure has increased from 10.712 billion yuan to 309.849 billion yuan, and GDP has increased from 1.08 trillion yuan to more than 100,000 yuan. The annual average growth rate of the representative variables of science and technology investment is nearly 20%, and the average annual growth rate of GDP is about 12%. All variables have achieved rapid growth. As shown in Figure1.
3.3 Correlation analysis between variables

Using data analysis software, the correlation coefficients among FTI, R&D, and GDP can be obtained, as shown in Table 1. The correlation coefficient between FTI and R&D is 0.9309, which shows that government financial investment in science and technology can greatly promote the level of social R&D expenditure and enhance the overall technological competitiveness of society. The correlation coefficient between R&D and GDP is as high as 0.9809, which shows that there is a highly positive correlation between technological progress and economic development in Guangdong Province.

### Table 1 Correlation coefficient table among various variables

| Correlation coefficient | FTI | R&D | GDP |
|------------------------|-----|-----|-----|
| FTI                    | 1   | —   | —   |
| R&D                    | 0.9309 | 1   | —   |
| GDP                    | 0.8788 | 0.9809 | 1   |

3.4 Build a linear equation

According to the relevant methods of econometrics, the linear equations between Log(FTI), Log(R&D) and Log(GDP) can be established respectively, as shown in equations (1) and (2), the relevant statistics of the fitting equation The results are shown in Table 2.

\[
\text{Log(GDP)} = 0.6614 \text{ Log(FTI)} + 1.0783
\]

\[
\text{Log(GDP)} = 0.6666 \text{ Log(R&D)} + 0.7109
\]

### Table 2 Test results of fitting equation

| Fitting equation | Intercept | X Variable | F value | R² | AdjR² | P value |
|------------------|-----------|------------|---------|----|-------|---------|
|                  | Coefficients | Standard error | t Stat | Coefficients | Standard error | t Stat | 317.8297 | 0.9464 | 0.9434 | 0.0000 |
| Formula (1)      | 1.0783 | 0.0861 | 12.5165 | 0.6614 | 0.0371 | 17.8277 | 0.9464 | 0.9434 | 0.0000 |
| Formula (2)      | 0.7109 | 0.0421 | 16.8726 | 0.6666 | 0.0147 | 45.0709 | 0.9912 | 0.9907 | 0.0000 |

It can be seen from the results in Table 2 that the goodness of fit of Equation 2 is better than that of Equation 1. The R² of Equation 2 is as high as 0.9912, and the F statistic is 2031.393. It can be seen that compared with the government's financial investment in science and technology, Guangdong's R&D investment can significantly promote economic development. Therefore, the government must fully consider the linkage relationship between R&D funding and economic development when formulating...
relevant policies for technological development. At the same time, the positive relationship between government financial investment in science and technology and R&D should also be considered. Under the top-level design of the government, the government and the private sector jointly promote the advancement of social science and technology and realize sustainable economic development.

4. Policy Suggestion

From the results of the empirical analysis, it can be seen that the level of investment in science and technology, especially the level of R&D expenditure, has an obvious promotion effect on the economic development of Guangdong Province, and the economic development mode of Guangdong Province has gradually changed to innovation-driven. In order to further consolidate the important position of Guangdong Province in the high-quality development of the national economy and highlight the new economic development thinking with science and technology as the core, the following policy recommendations are proposed:

4.1 Give full play to the leverage of financial technology funds
First of all, Guangdong Province should continue to increase government funding for science and technology, promote communication and coordination between the Department of Finance and the Department of Science and Technology, and jointly promote the implementation of Guangdong Province’s science and technology plans. Second, Guangdong Province should optimize the structure of financial investment in science and technology, increase financial support for the transformation of results, and strengthen investment in cutting-edge technology. Finally, it is necessary to establish a sophisticated management mechanism for science and technology projects to continue to support the research on key industrial technologies.

4.2 Implement the main role of enterprises in science and technology investment
As the most developed city in Guangdong Province for technological innovation, Shenzhen has long established a technology investment mechanism with enterprises as the main body. Other cities in Guangdong Province should learn from the successful experience of Shenzhen, build a development model of "the government creates the market and the market encourages enterprise innovation", and establish the dominant position of enterprises in technological innovation. Guangdong Province should improve the management methods for the identification of high-tech enterprises, innovative enterprises, and intellectual property superior enterprises, strengthen the standard requirements for R&D expenditures, improve the incentive mechanism, and encourage enterprises to strengthen R&D activities.

4.3 Strengthen the construction of scientific research capabilities of universities and research institutes
As the cultural, scientific and educational center of South China, Guangzhou should play a leading role in the construction of innovation platforms for universities and research institutes, the cultivation of national key laboratories, and the management system of innovative universities and research institutes to improve the scientific research work environment in Guangdong Province, improve scientific research initiative of scientific researchers and provide inexhaustible source of power for scientific and technological innovation.

5. Conclusion

It can be seen that Guangdong Province needs to increase investment in science and technology from both scientific research institutions and enterprises, and promote the transformation of scientific and technological achievements into real productivity, in order to realize the transformation and upgrading of the economic structure and enhance the stamina for high-quality economic development.

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