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Integrating Technological Innovation and Finance in Maoming: Analysis, Challenges, and Policy Recommendations

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Abstract:

We firstly established a principal component analysis model, analyzed the ranking of Maoming City's scientific and technological innovation capabilities in Guangdong Province from 2017 to 2019, and further discussed the constraints of Maoming 's scientific and technological innovation. On this basis, policy recommendations were put forward to promote the organic integration of science and technology finance and technological innovation in Maoming.

Keywords:

Tchnological Innovation, Technological Finance, Principal Component Analysis.

1. Introduction

Bencivengu Bencivenga and Smith, through their generational alternation model, demonstrated that economic systems prioritize the research and development cycle and the transaction costs of innovative technologies when selecting which technologies to adopt. They further argued that enhancing the operational efficiency of financial markets helps to shorten the technological development cycle. Therefore, in scenarios where transaction costs in the financial market are high, economic systems tend to favor innovative technologies with shorter development cycles. Conversely, as financial market efficiency improves, there is a shift towards investing in technologies with longer development cycles . In the same year, Enrico analyzed the interplay between financial and technological innovation, positing that there is a reciprocal relationship between the two. He suggested that each technological innovation or set of innovations within the technological innovation system is linked to a particular method of financing, thereby illustrating the symbiotic nature of technological and financial innovations .

C. Freeman emphasized the critical role of government science and technology policies in promoting technological innovation. He argued that such policies are crucial for economic growth, as they stimulate technological advancements. Freeman outlined three key science and technology policy initiatives: the promotion of fundamental technologies by the government, the effective and rapid dissemination of essential technical information, and the introduction and domestic application of advanced foreign technological achievements. He contended that key technologies are central to innovation projects and highlighted the need for government intervention to support enterprises facing challenges in capital investment and research and development due to their scale and strength. This government-led investment model is particularly significant for fostering scientific and technological innovation in developing countries .

Stulz proposed that banks are well-suited to provide financial support for innovative projects funded in stages. Banks can monitor the progress and potential risks of these projects in real time, promptly identify risk factors, and take corrective measures to minimize credit losses. Based on the financial requirements of viable innovative projects, banks can then decide whether to extend loan services .

Tadesse conducted an empirical analysis comparing the impact of market-led and bank-led financial systems on technological progress in various countries. His findings indicated that market-led financial

systems have a more pronounced effect on promoting technological advancement .

Research by Canepa and Stoneman revealed a positive correlation between financial development and innovation activities . Benfratello, Schiantarelli, and Sembenelli's empirical analysis of data related to corporate technological innovation in Italy showed that the development of Italian banks positively influences the innovation and growth of small and medium-sized enterprises and high-tech firms .

In the same period, Schinckus explored the impact of technological progress on the financial industry using computer simulation applications . Ang's empirical examination of South Korea's financial sector and R&D institutions, based on time series data, found a strong correlation between financial liberalization and technological innovation .

2. The status of scientific and technological innovation capacity in Maoming

2.1. Calculation of scientific and technological innovation capacity of 15 cities in Guangdong Province

We selected 15 cities in Guangdong Province to calculate and analyze the scientific and technological innovation capabilities. The data comes from the 2017-2019 Guangdong Statistical Yearbook, so the data is relatively scientific, complete and accurate. The 15 cities are Guangzhou, Zhuhai, Shantou, Foshan, Shaoguan, Dongguan, Zhongshan, Jiangmen, Yangjiang, Zhanjiang, Maoming, Qingyuan, Meizhou, Zhaoqing, and Jieyang. This article selects and collects the 2017, 2018 and 2019 data of these 15 cities for research and analysis of technological innovation capabilities.

2.2. Establishment of the evaluation index system for scientific and technological innovation capability

2.2.1. Comprehensive economic strength of the city

The use of these indicators such as total sales of goods and average wages of employees is beyond doubt. Because the following comparison designs coastal cities, the annual increase in port cargo throughput and throughput is specifically to reflect the throughput and production efficiency of urban ports. The indicators are as follows:

1. Per capita gross domestic product (GDP) X;
2. GDP growth rate (%);
3. The proportion of tertiary industry in GDP (%);
4. Annual average salary of employees;
5. Total sales of goods;
6. Total industrial output value;

2.2.2. Industrial strength and management

The total industrial output value, the annual industrial growth rate, the total output value provided by the original value of 100 yuan fixed assets of independent accounting industrial enterprises, and the annual growth rate of the realized output value of the original value of 100 yuan fixed assets not only show the industrial scale of a city, but also reflect the city enterprises Benefits.

2.2.3. Culture and Education

Culture and education are a powerful source of power to support regional social and economic development, as well as the power to realize technological progress. We use the following indicators:

1. Number of colleges and universities per 10,000 people;
2. The proportion of scientific and technological workers in all employees;
3. Comprehensive index of research institutes (number of universities and research institutes);
4. Per capita expenditure on education;
5. Expenditures for scientific undertakings/expenditures in local fiscal budgets;
6. Comprehensive Index of Cultural Facilities;

2.2.4. Infrastructure and municipal facilities

Indicators such as telephone availability, electricity consumption, domestic water usage, the number of hospital beds per 10,000 people, the number of doctors, urban maintenance and construction funds per capita, road area per capita, and the number of buses per 10,000 people illustrate the convenience of urban life. One can imagine the psychological burden on residents living in a city plagued by various infrastructural issues. The indicators considered are as follows:

1. Comprehensive Index of Health Infrastructure: This includes the number of doctors per 10,000 people and the number of hospital beds per 10,000 people.
2. Comprehensive Index of Municipal Infrastructure: This comprises the per capita paved road area, the number of buses per 10,000 people, the total number of public transport passengers, and the number of taxis at the end of the year.
3. Comprehensive Index of Communication Infrastructure: This covers the per capita total post and telecommunications business and the number of telephones per 100 people.
4. Per Capita Housing Area.
5. Comprehensive Index of Living Infrastructure.

2.2.5. Government role

Research indicators in this area take into account that policy-related soft environmental factors are difficult to quantify and compare, and use other data instead to enhance the operability of the indicators. The indicators included are:

1. Enterprise economic efficiency indicators (independent accounting of 100 yuan of funds for industrial enterprises to achieve profits, 100 yuan of fixed assets to achieve profits and taxes);
2. Per capita CDP of agency staff;
3. The proportion of government employees in all employees;
4. Urban employment rate;
5. Comprehensive social security index (discount for fire losses, traffic accidents);

2.2.6. Environmental Quality

People-oriented cities are the latest requirements of sustainable development for urban construction. The environmental quality index of each city indicates whether the city provides a living environment with shades of trees, birds and flowers, blue sky and clean water. The indicators included are:

1. Urban environment comprehensive index (SO2 emissions per square kilometer, industrial wastewater discharge compliance rate, environmental noise compliance area);
2. Comprehensive index of urban landscaping (green coverage in built-up areas, per capita landscaping area, urban landscaping area);

3. Principal Component Analysis

We mainly used the principal component analysis method to analyze the scientific and technological innovation capabilities of 15 cities in Guangdong Province. The principal component analysis is a statistical analysis method that divides the original multiple variables into a few comprehensive indicators. From a mathematical point of view, this is a dimensionality reduction processing technique. The calculation steps are as follows:

[1]. Calculate the correlation coefficient matrix:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ \vdots & \vdots & & \vdots \\ r_{p1} & r_{p2} & \cdots & r_{pp} \end{bmatrix} \tag{1}$$

is the correlation coefficient, the calculation formula is as follows:

$$r_{ij} = \frac{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)(x_{kj} - \bar{x}_j)}{\sqrt{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)^2 \sum_{k=1}^{n}(x_{kj} - \bar{x}_j)^2}} \tag{2}$$

[2]. Calculate eigenvalues and eigenvectors:

Solve the characteristic equation $|\lambda I - R| = 0$, commonly used Jacobi method (Jacobi) to find the eigenvalue.

[3]. Calculate the score of each principal component:

$$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \vdots & \vdots & & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix} \tag{3}$$

According to the above principles and steps, SPSS statistical software is used for principal component factor analysis and the following results are obtained:

Table1: Test results of scientific and technological innovation capabilities in 2017

KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		.959
Bartlett's sphericity chi-square test	test approximate	413.065
	df	3
	Sig.	.000

It can be seen from Table 1 that the KMO metric is 0.959, which is relatively close to 1, which means that the correlation between variables is relatively strong, and the original variables are

suitable for Principal Component Analysis. And the Sig value of 0 is less than 0.05, indicating that the data is distributed in a spherical shape.

Table2: Test results of scientific and technological innovation capabilities in 2018 KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		.967
Bartlett's sphericity chi-square test	test approximate	413.073
	df	3
	Sig.	.000

It can be seen from Table 1 that the KMO metric is 0.967, which is relatively close to 1, which means that the correlation between variables is relatively strong, and the original variables are suitable for Principal Component Analysis. And the Sig value of 0 is less than 0.05, indicating that the data is distributed in a spherical shape.

Table3: Test results of scientific and technological innovation capabilities in 2019 KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		.986
Bartlett's sphericity chi-square test	test approximate	413.092
	df	4
	Sig.	.000

It can be seen from Table 1 that the KMO metric is 0.986, which is relatively close to 1, which means that the correlation between variables is relatively strong, and the original variables are suitable for Principal Component Analysis. And the Sig value of 0 is less than 0.05, indicating that the data is distributed in a spherical shape.

Comparing the rankings of the comprehensive competitiveness of the fifteen cities longitudinally according to the passage of time, it is very intuitive to see the ranking of the comprehensive competitiveness of these fifteen cities from 2017 to 2019.

Table 4: Changes in the overall competitiveness of the fifteen cities over the years

City	Ranking of technological innovation capabilities		
	2017	2018	2019
Guangzhou	1	1	1
Zhuhai	4	4	3
Shantou	12	6	4
Foshan	3	2	2
Shaoguan	13	15	14
Dongguan	2	3	4
Zhongshan	6	8	5
Jiangmen	7	11	7
Yangjiang	8	5	12
Zhanjiang	10	9	9
Maoming	9	10	8
Qingyuan	14	14	10
Meizhou	15	12	11
Zhaoqing	5	7	6
Jieyang	11	13	15

In 2019, Maoming ranked ninth among the fifteen cities comprehensively, and it was in the middle reaches. However, Maoming still ranks first in the areas north of western Guangdong and the Beibu Gulf rim. Compared with cities in the Pearl River Delta, there is still much room for improvement in technological innovation capabilities.

4. Suggestions on the Combination of Technological Innovation and Technological Finance in Maoming

4.1. The current problems of Maoming's science and technology finance

[1]. The financial system is not perfect. The financial system here refers to the development system that affects the coupling relationship between financial innovation and technological innovation, such as insufficient credit system, insufficient government support from guarantee companies, relatively rigid financial systems and mechanisms, lack of strong government support, and lack of effective mortgage guarantees. It has not yet established an effective financial ecological environment.

[2]. The coupling relationship between financial innovation and technological innovation is not deep enough. Financial institutions in Guangdong Province lack individuality and flexibility in financial product innovation. This may be affected by various factors such as the legal system, social environment, technical environment, and management system. The overall plan failed to meet the needs of technological innovation, resulting in insufficient development of financial products by most financial institutions. On the other hand, the boosting effect of Guangdong's science and technology finance on technological innovation is not obvious enough, and the capital structure and regional distribution of venture capital is still unbalanced.

4.2. Suggestions

Science and technology finance provided a certain amount of funds to support science and technology innovation activities, and financial innovation entities select and screen science and technology innovation investment projects according to the review mechanism of science and technology innovation. For investment projects of scientific and technological innovation, financial innovation will supervise and manage the whole process afterwards, so as to ensure that the investment effect is carried out as expected without deviation. For financial innovation, through the promotion of scientific and technological innovation, financial innovation can obtain better development space. The level of scientific and technological innovation determines the performance of financial innovation investment, and at the same time provides more advanced technical means for financial innovation. Therefore, the two can be regarded as a coupled collaborative system, that is, through the collaboration of the coupling relationship, a technological innovation subsystem and a financial innovation subsystem with different attributes are formed.

The science and technology innovation subsystem is composed of three main elements: scientific research institutes, universities, and enterprises. According to the logical sequence of time, scientific and technological innovation is divided, including three different stages of knowledge innovation, technological innovation, and industrialization. Knowledge innovation is the use of scientific research to obtain new technologies and new knowledge, among which major scientific research institutes and many universities are the main body of knowledge innovation. The essence of technological innovation is the research and development of new products, and enterprises in various industries are the main body of technological innovation. The essence of industrialization is to carry out the production process and sales process of new products, and enterprises are the main body of industrialization innovation. Major scientific research institutes and many universities are the leading force and power source of scientific and technological innovation. They support the process of products by providing enterprises with technological innovation.

The financial innovation subsystem is a public financial innovation input subject with science and technology management departments, government finance departments, and the National Development and Reform Commission as the main supply body, and a market financial innovation main body with banks, venture capital institutions, capital market investors, and

angel investors as the supply main body. By indirectly regulating the financial entities of market technology and entities that directly fund scientific and technological innovation, the purpose of government financial innovation investment is to maintain the sustainability and efficiency of the investment, rather than profit-oriented. The main purpose of the supply of market financial innovation is to maximize profits.

As shown in the first feedback loop in Figure 1, it mainly reflects the process in which the government's public financial innovation entities invest in promoting technological innovation. With the expansion of the government's public financial innovation investment, the scientific research funds of scientific research institutions, universities and other scientific and technological innovation subjects have increased, which has increased scientific research results, and consequently the scale of enterprise scientific and technological innovation output has also been expanded, thus forming Innovating tax revenue will increase government fiscal revenue, which will further increase the capital investment in public financial innovation. In this way, a virtuous circle is formed. To run the first feedback loop benignly, on the one hand, science and technology management departments and financial departments must not only have high management capabilities, but also improve the guiding effect of financial capital.

5. Conclusion

If you follow the “checklist” your paper will conform to the requirements of the publisher and facilitate a problem-free publication process.

[1]. Promote the deep integration and development of financial innovation and technological innovation, vigorously build innovative products and credit models, in order to stimulate the innovative work ideas, workflows, financial products and services of various financial institutions in Maoming, and actively research and promote technological financial services.With the support of the government, we will open up a smooth channel for innovative technology-based enterprise credit, and strengthen high technology around the model of "venture investment + guarantee + loan", "recommended government + guarantee + loan" and "unified loan support" The financial support of enterprises has enabled the main body of the technological innovation subsystem to actively develop new financial innovation products.

[2]. Promote the creation and R&D of technology-based banks or departments and technology-based credits. Maoming City should actively support banks in accelerating the establishment of the "Small and Medium-sized Enterprise Information System Pilot Zone", creating and promoting the integration and implementation of credit information for scientific and technological enterprises, and reducing the problem of asymmetry and asymmetry between financial support and scientific and technological development information. Actively promote the construction of an intermediary

service platform for science and technology finance, and increase the scale of financial investment in science and technology finance and the construction of mechanisms. Governments at all levels should put the investment in science and technology finance as the focus of financial budget protection to ensure that the growth of science and technology and financial support funds exceeds the growth of regular fiscal revenue.

[3]. We must improve the ability of market technology financial entities such as venture capital institutions and commercial banks to screen technology innovation projects, risk assessment and control capabilities, and post-event supervision and management capabilities, so as to improve the investment performance of market technology financial entities in Maoming. Strengthen the supervision of technology-based listed companies and strengthen the information disclosure system to protect the rights and interests of investors in the technology capital market. Through the wealth demonstration effect of market technology financial investment performance, promote the accumulation of social capital in the field of innovation.

[4]. We should further improve the science and technology property rights trading market, not only

to improve the liquidity of science and technology property rights, but also to actively promote the construction of a property rights trading platform for strategic emerging industries, high-tech industries, and innovative enterprises in Maoming. Emerging industry companies provide equity financing services. The Guangdong science and technology property rights trading market should speed up the cooperation with other domestic property rights, while optimizing processes, enhancing functions, and expanding the transaction volume, so as to form a regional science and technology property rights trading market.

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