Innovation and Development of Guangdong-Hong Kong-Macao Capital Market Based on Fintech

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Abstract. The development of the capital market will face challenges. Promoting the optimization of the capital market in the guangdong-hong kong-macao (CHM) Greater Bay Area (GBA) with the development of emerging FT is not only of practical significance to the development of the GBA, but also of great significance to promoting the country's overall economic competitiveness and realizing modernization. In the context of the rapid development of FT, the practical and theoretical significance of capital market optimization in the CHM GBA is analyzed. The new generation of FT means such as big data, cloud computing, artificial intelligence, blockchain, and Internet payment are the mainstays of CHM University. Possibilities analysis of Bay Area capital market optimization offers. Based on this background, this paper conducts research on the innovative development of capital markets in CHM based on financial technology (FT).This paper mainly studies the status quo of financial support for technological innovation in the CHM GBA, summarizes the main practices of financial support for technological innovation in the three major bay areas in the world, and draws the following points: First, it is necessary to establish a ST innovation system according to the national conditions of a country. financial support system. Second, policy finance plays a guiding role in the initial stage of ST innovation activities. Third, commercial banks play an important role as a booster in technological innovation activities. Fourth, a sound credit guarantee system provides a strong guarantee for technological innovation. Fifth, developed venture capital and perfect multi-level capital market can effectively speed up the development of ST innovation.

Keywords: Financial Technology, Guangdong-Hong Kong-Macao, Capital Market, Market Innovation.

1. Introduction

At present, the development of the capital market in CHM has problems such as unclear structure of various levels and weak liquidity of capital markets at all levels. Fintech means are used to further develop the on-site market centered on the Shenzhen Stock Exchange; improve the transfer mechanism; improve the transportation mechanism, to improve the liquidity of the capital market, provide intermediary services, and create a good financial environment; it will be of great significance to facilitate the construction of local market enterprises, promote progress, and ensure regulatory opportunities [1-2].

In related research, Sartori et al. introduced the lean management method of innovation research and development (BIIIR), an important part of which is the systematic and objective assessment of the project commercialization readiness [3]. The role of research directors and independent working groups (TRL committees) in implementing the BIIR principles is demonstrated, and a practical format for experts to assess development readiness is given. Anshari et al. discuss FinTech concepts, characteristics and some case studies of local FinTech in Indonesia [4]. Furthermore, text mining analysis is utilized to find correlations and patterns in FinTech features. The case study then highlights a comparative assessment between local fintechs in Indonesia and global fintech players in the local market completion. Rajeswari mainly discusses the drivers of fintech, the shortcomings of traditional financial services, and the role of technological advancement [5], addressing issues related to fintech investment and disruption, and also examining the evolution of fintech in global markets over time.

This paper empirically tests the supporting role of policy finance, bank loans, and venture capital in the CHM GBA on technological innovation, and finds that from the perspective of the Bay Area as a whole, the loan balance of financial institutions in the CHM GBA and government appropriations

are responsible for the current patent authorization. There is a significant positive impact on the number of patents granted by venture capital, while the rate of increase in the number of patent authorizations promoted by venture capital is lower than that of loans from financial institutions and government investment, and its supporting role in ST innovation is not prominent. From the perspective of regional differences in the level of scientific and technological (ST) development, regions with a higher level of ST mainly rely on government funding to develop technological innovation, while in regions with a lower level of technology, loans from financial institutions play a significant role in supporting technological innovation. The focus of urban finance to support technological innovation is different.

2. Design Research

2.1 Significance and Means of FT Development

The significance of fintech development is reflected in the following points: fintech has made financial services unprecedentedly popular [6]; fintech has driven the cost reduction of financial services; fintech is reliable in terms of security; Small and medium-sized enterprises develop; Fintech can help enterprises transform big data into meaningful data [7-8].

Technological finance is an effective means to break monopoly by encouraging innovation in economic competition during the industrialization period [9-10]. The first is to encourage innovation to build an effective means to break the monopoly of the industry from scratch and to fill the shortcomings of development; the second is to encourage innovation to catalyze the growth of the industry and to break the effective means of scale monopoly; the third is to encourage innovation and build technological transformation Mechanism, form new technologies and new industries to eliminate traditional products and technologies, and build effective means for backward countries and regions to take advantage of the latecomers [11-12].

2.2 Technological Financial Issues

(1) The function of the FT service platform is relatively simple

In recent years, the comprehensive campaign of the ST Economic Center has been carried out to vigorously promote economic innovation, relying on enterprise-high-tech work, focusing on ST innovation, and initially completed development. ST and economic development with "parks, platforms, policies" as the main line.

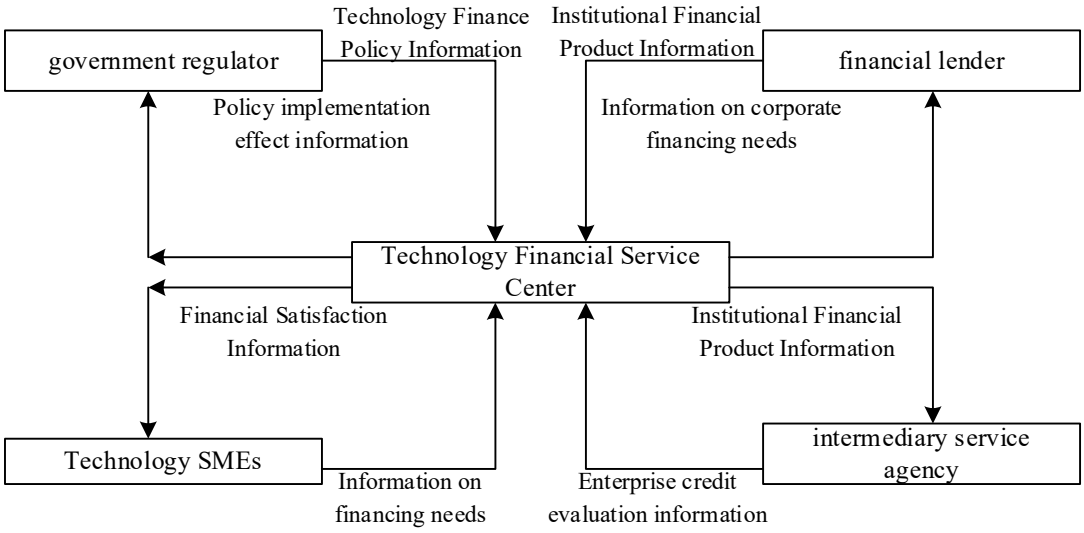

Figure 1. FT Service Center

First, in terms of FT service platform, establish a service platform. Second, in terms of financial institutions in ST, Rural Commercial Bank and the Municipal Bureau of Small and Medium Enterprises carried out the government-bank cooperation model, innovatively launched the

technology-reformed government-bank cooperation loan business, issued loans to qualified and promising enterprises, and supported the technological innovation of small and medium-sized enterprises. and technological upgrading, which to a certain extent promotes a new round of technological progress of enterprises and accelerates the upgrading of local industries. Third, the government has formulated a number of financial support policies such as intellectual property pledge loans, loan discounts, risk capital pools, credit risk compensation, technology insurance, investment and loan linkages, etc.; to help technology enterprises develop and promote the transformation of ST achievements.

However, from the perspective of the specific implementation effect, the function construction of the FT service platform needs to be improved. At present, relevant policy documents and news notices are released from the government website to apply for subsidies and rewards; each functional department uses different platforms for information release, lack of coordination and integration, and lack of a comprehensive and integrated FT service platform. The system can automatically recommend suitable banks, venture capital and other financial institutions to enterprises on the platform, improve the matching degree between enterprises and banks, achieve automatic connection, and accelerate the realization of artificial intelligence and technology of policy services.

In addition, a complete corporate credit rating system has not yet been established. At present, in addition to the credit evaluation of loan companies during bank credit, a unified credit rating platform for technology-based enterprises with complete data sources has not yet been formed. There is a lack of integration of multi-party data sources such as courts, public opinion, public security, and the People's Bank of China credit data, and there is no technology-based enterprise credit rating system that subdivides the business growth cycle and industry. The lack of credit evaluation of technology-based enterprises will lead to an increase in the non-performing loan ratio.

(2) There is a certain lag in the relevant policies of ST finance

First, the form of financial subsidies is single. At present, the financial subsidy method for small and medium-sized technology-based enterprises is relatively simple, and the subsidy from the provincial level to the municipal level is basically the same as the district level. There is a lack of new attractive subsidy models and mechanisms to attract more high-quality enterprises and high-end talents. With the continuous development of my country's economic construction in recent years, the simple financial subsidy policy has gradually been unable to meet the requirements of the new economic environment, and the positive benefits of financial subsidies are weakening. From the perspective of financial subsidy management, there are also some problems, especially in the subsidy management of some loss-making enterprises, the seriousness and effectiveness of financial subsidies cannot be guaranteed.

Second, regulatory policies are lagging behind. With the continuous development and changes of my country's financial environment in recent years, the continuous evolution and development of FT, and the continuous emergence of various cross-border and cross-border financial products, the speed of promulgating corresponding laws and regulations has not kept up with the pace of financial environment updates, which leads to product There is a contradiction between the need for innovation and the relatively lagging legal and regulatory environment, and enterprises have certain legal risks in the innovation of Internet financial products.

In addition, the docking mechanism between science and FT policies and the capital market needs to be strengthened. It needs multi-level financial system, diversified financial system, diversified financial product supply and diversified financing service support. However, the construction of China's multi-level capital market still needs to be strengthened. There are still many problems in the New Third Board and ChiNext. Therefore, in the face of many risk factors, its enterprise development is highly unstable.

Finally, there is a lack of targeted talent introduction policies. At present, in terms of the supply and demand of ST financial talents, there is a general "talent shortage", and there are a large number of existing ST and financial talents. In general, there is a shortage. In this context, targeted and attractive talent training and introduction policies are particularly important. At present, most of the

existing relevant talent policies focus on ST talents or financial talents, and there is a lack of targeted technology and financial talent introduction plans [13-14].

2.3 Analysis of the Mechanism of Capital Market Supporting Technological Innovation

The capital market can provide investors with necessary information about technology projects and investment decisions for reference, and help investors make more accurate judgments on technology projects. The trend of the stock price of technology companies is also an important aspect of reflecting the business situation of the company. The deterioration of business management will lead to a drop in the stock price of the company, which will increase the difficulty of the company's follow-up financing. On the contrary, a good operating situation will lead to a rise in the stock price, making the company more Easy access to refinancing. The information disclosure mechanism and elimination mechanism of the capital market have reduced investment costs and stimulated the enthusiasm of investors to invest funds in ST innovation projects. At the same time, through asset securitization and other means, the financial market can turn financial assets with low liquidity into liquid assets, combine assets with different risks and liquidity, reduce the profit risk of investors, and promote the investment activities of ST innovation projects. development. In addition, the incentive mechanism of the capital market, including equity and options, links the business performance of the enterprise with the income of the managers, and urges the managers to conduct better operation management [15-16].

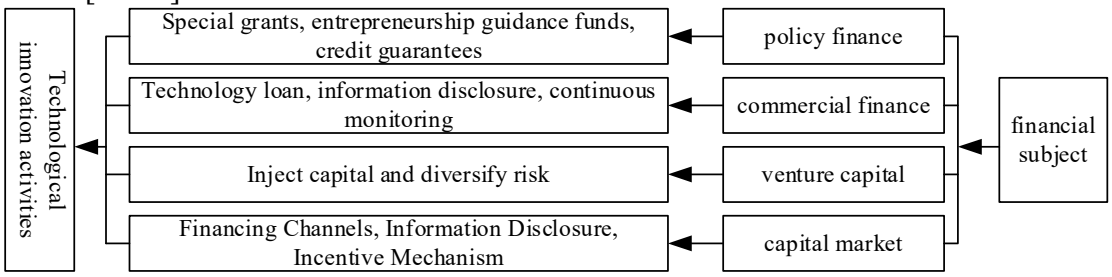

Figure 2. The main mechanism of financial support for technological innovation

2.4 Efficiency Measurement of Technology Finance

In 1957, Henry Farrell applied frontier theory to efficiency measurement, and used frontier production function to quantify efficiency indicators; among them, frontier production function can be determined mainly by two methods: parametric method and nonparametric method [17- 18].

The parametric method is to determine the frontier by establishing a specific production function between input and output, and then use the mathematical statistics method to measure the efficiency of different sample points. The efficiency measurement methods formed based on the principle of the parameter method mainly include three categories: stochastic frontier analysis method, post-frontier analysis method, and free step method.

Stochastic Frontier Analysis (SFA) is a parameter estimation method based on the Cobb-Douglas production function proposed by Aigner, Lovell, Schmidt and other scholars in 1977. The stochastic frontier model corresponding to this method is shown in formula (1):

$$\begin{cases} y_i = f(x_i, \beta)\xi_i e^{v_i} \\ f(x_i, \beta) = e^{\beta_0} x_{1i}^{\beta_1} \llcorner\ x_{ki}^{\beta_k} \end{cases} \tag{1}$$

In formula (1), yi is the actual output level, f(xi, β) is the maximum output of the kth input element xki under the given production scale, βk is the estimated parameter of the input element xki, and ζi is the actual production scale of the enterprise. Input-output level, and satisfy $0<\zeta i\leq 1$, if the value is equal to 1, it means that the production mode corresponding to the input-output level of the enterprise at this time is just on the production frontier, that is, the maximum output level is reached; evi means For the random shock in the model, take the logarithm of formula (1) and set $ui=-\ln\zeta i$ to obtain the expression shown in formula (2):

$$\ln y_i = \beta_0 + \sum \beta_k \ln x_{ki} + v_i - u_i \tag{2}$$

Among them, vi is the random error term, which represents the random change of the production frontier between the input and output of different manufacturers. This part of the error is based on the error term that cannot be eliminated at the enterprise level; ui is the actual output corresponding to the manufacturer under the given market conditions. The distance between the level and the frontier, this part of the error is based on the error term that can be subjectively eliminated at the enterprise level. The indicator ui is mainly used to calculate the technical efficiency of the enterprise's input and output.

The calculation idea of the stochastic frontier analysis method is to first assume a certain production function as the premise, and then measure the distance between the actual output level of the manufacturer and the production frontier through the measurement method, so as to obtain the technical efficiency. However, it is difficult to select a production function that is highly consistent with the actual input and output, and it is easy to produce a certain degree of subjectivity when determining the form of the production function artificially; There is the problem of efficiency of a single output factor, and the accuracy of efficiency measurement will also be affected by the correlation between indicators.

3. Experimental Study

3.1 Basic Service Platform of ST Finance

Technological innovation has an obvious agglomeration effect, which requires investment in scientific research, financial support and other elements. Finance is the core factor affecting the development of technological innovation and can provide financial support for technological enterprises to carry out R&D and innovation activities. The government can actively guide financial resources to promote the same Or a cluster of similar technology industries.

Integrating and building a basic service platform for ST finance, using the platform to gather resources from all parties and realizing extensive connection between investment and financing supply and demand has become an important development direction of the ST finance policy system. The advantages of the resources of venture capital institutions, other financial institutions and other parties will create a regional technological and financial innovation center with greater influence, and optimize the investment and financing environment.

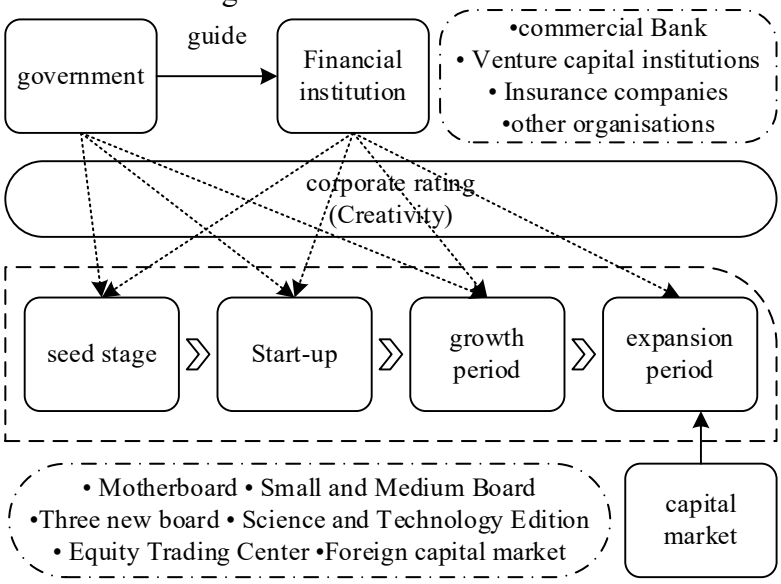

Figure 3. Concept of building a FT service platform

3.2 Model Introduction for the Empirical Analysis of the Efficiency of ST Finance in the CHM GBA

The DEA model is used to measure, but the DEA model still has two main limitations and shortcomings. The first limitation is that the original information and number of indicators in the input-output system will affect the results of the DEA model efficiency measurement. The second limitation is that the correlation between input (output) indicators will greatly reduce the accuracy of the DEA model's efficiency measures and the degree of discrimination between the measured efficiency indicators. Therefore, based on the above two limitations, the data envelopment analysis method based on principal component analysis (PCA) is used, that is, before the DEA model is used to accurately measure the efficiency index, the principal components extracted based on the PCA method are uncorrelated with each other., which can greatly improve the accuracy of the efficiency index measured by the DEA model.

The basic idea of the PCA method is: assuming that the research object contains n samples and p variables, the specific matrix representation is shown in formula (3):

$$X=\begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ x_{p1} & x_{p1} & \cdots & x_{pp} \end{bmatrix}=(X_1,X_2,\cdots,X_p) \tag{3}$$

Let, where i=1,2,...p, and then perform a linear transformation operation on X through the product between the matrix li and the matrix X to construct a new variable Y, the calculation expression is shown in formula (4):

$$\begin{cases} Y_1=l_1^TX=l_{11}X_1+l_{12}X_2+\cdots+l_{1p}X_p \\ Y_2=l_2^TX=l_{21}X_1+l_{22}X_2+\cdots+l_{2p}X_p \\ \vdots \\ Y_p=l_p^TX=l_{p1}X_1+l_{p2}X_2+\cdots+l_{pp}X_p \end{cases} \tag{4}$$

In order to ensure that the new comprehensive variable Yi constructed with the help of formula (4) has relatively less loss of information than the original p variables X1, X2,..., Xp, this requires a few extracted principal components The sum of variances should be as close as possible to the sum of variances of the original variables, expressed in mathematical expressions as shown in formula (5):

$$\max \quad Var(Y_i)=Var(l_i^TX)=l_i^T\sum l_i \tag{5}$$

In formula (5), if there is no restriction on li, the variable Yi constructed by linear transformation has innumerable situations.

3.3 Model Construction

In order to examine the total factor productivity (TFP) of technology finance under different dimensions, this chapter takes the amount of non-performing loans of commercial banks as the undesired output. Based on the directional distance function (SBM), this paper studies the temporal and spatial variation characteristics of the total factor productivity of technological finance considering undesired output.

The first step is to construct the production frontier function through the data envelopment analysis method.

$$P(x)=\{(x,y,b):x\rightarrow(y,b)\} \tag{6}$$

In formula (6), x represents the factor input vector; y represents the expected output vector; b represents the undesired output vector. Measure the distance between the actual output of the decision-making unit and the optimal production frontier, and examine the level of efficiency change.

The second step is to define a directional distance function based on the Shephard output distance function.

$$\overline{D}_0(x,y,b;g)=\sup\{\beta:(y,b+\beta g)\in P(x)\}=\frac{1}{\overline{D}_0(x,y,b-1)},g=(y,-b) \tag{7}$$

In formula (7), g represents the output direction vector; β is the directional distance function value.

According to the directional distance function and the mixed directional distance function, the t-period and t+1-period ML indices can be obtained. The change of total factor productivity of a decision-making unit (DMU) under environmental constraints can be reflected by the geometric mean of the ML index in the t period and the t+1 period.

The third step is to calculate the ML index, technical efficiency index, and technological progress index based on the directional distance function.

The ML index of the kth decision-making unit from period t to period t+1 is:

$$ML_t^{t+1}(x_{t+1}^k,y_{t+1}^k,b_{t+1}^k;x_t^k,y_t^k,b_t^k)=ML(EFFCH)_t^{t+1}\times ML(TECH)_t^{t+1} \tag{8}$$

In formula (8), ML(EFFCH) represents the technical efficiency under the ML index, and ML(TECH) represents the technological progress under the ML index. If the value of ML index, ML(EFFCH), and ML(TECH) in a certain region is greater than 1, it means that the total factor productivity, efficiency improvement and technological progress of technology finance in this region are improved under environmental constraints.

4. Experiment Analysis

4.1 Bottlenecks Facing Market Integration in the CHM GBA

The CHM GBA has good basic advantages. However, compared with the internationally developed Bay Area, the overall economic development of the Bay Area is not naturally driven by the market, and the integrated development of the Bay Area economy is facing a bottleneck.

Table 1. The economic proportions of the four major bay areas in each country in the past five years

	Tokyo Bay Area	New York Bay Area	San Francisco Bay Area	CHM GBA
first year	39.91%	8.94%	3.61%	12.84%
sixth year	40.43%	8.88%	3.98%	11.87%

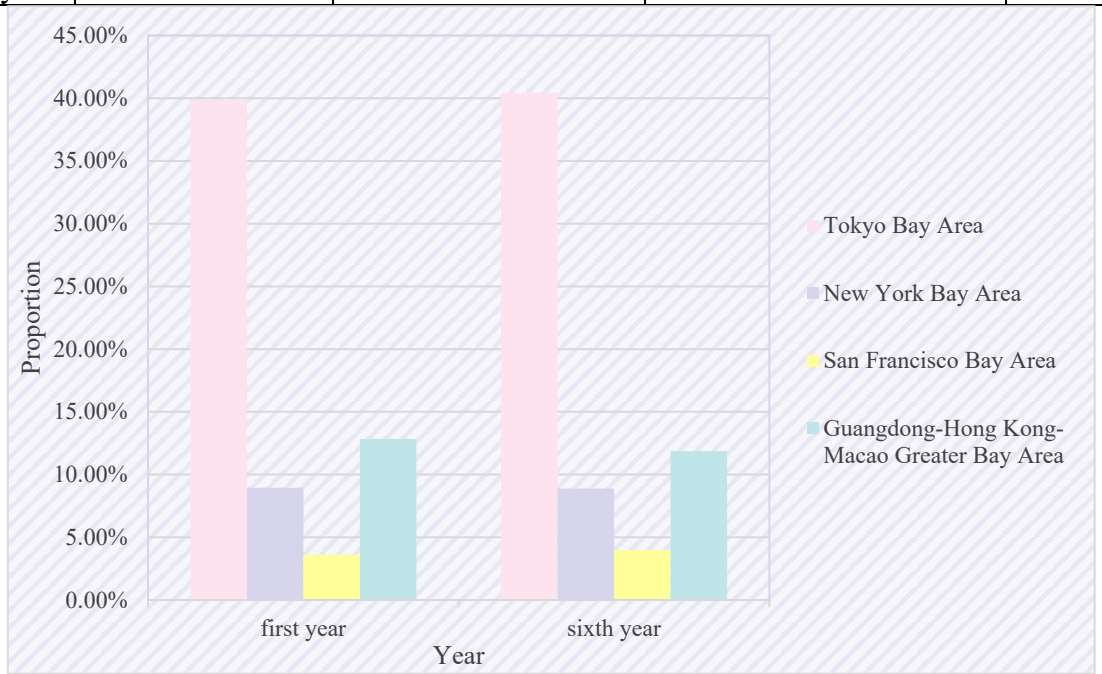

Figure 4. Analysis of the economic proportions of the four major bay areas in each country in the past five years

As can be seen from Figure 4, from the perspective of the economic proportion of the Bay Area in the host country, the Tokyo Bay Area accounts for 40% of the country's total economic output, which is the highest among the four Bay Areas. The Hong Kong-Macao GBA is similar to the New York

Bay Area. The CHM GBA has declined in the past five years, which shows that the CHM GBA's status as a growth pole in China's economy has declined, and the competition pressure it faces is intensifying.

4.2 PCA Analysis Results of Investment Indicators in ST Finance

Since the principal components extracted based on the PCA method are linear combinations of the original indicators, this paper firstly uses SPSS software to test the correlation between the investment indicators of ST finance in the CHM GBA. The corresponding correlation coefficient matrix is shown in Table 2.:

Table 2. Correlation coefficient matrix of financial investment in ST in the CHM GBA

Correlation coefficient	O1	O2	O3	O4	O5
O1	1.00	0.97	0.75	0.91	0.94
O2	0.97	1.00	0.80	0.88	0.94
O3	0.75	0.80	1.00	0.85	0.84
O4	0.91	0.88	0.85	1.00	0.97
O5	0.94	0.94	0.84	0.97	1.00

Figure 5. The correlation coefficient matrix analysis of the investment indicators of ST finance in the CHM GBA

It can be seen from Figure 5 that the correlation coefficients between the indicators of investment in ST finance in various regions within the Bay Area are all greater than 0.6, indicating that there is a strong correlation between the indicators, that is to say, there is repeated information between various types of investment indicators in ST finance. Therefore, it is necessary to carry out PCA analysis on various original investment indicators of ST finance in the efficiency evaluation system of ST finance in the CHM GBA. Next, the KMO and Bartlett tests are used to judge whether the selected technology finance investment indicators are suitable for PCA analysis. The test results are shown in Table 3:

Table 3. KMO and Bartlett test on the investment indicators of ST finance in the CHM GBA

KMO		0.714
Bartlett's sphericity test	Bangla	63.973
	degrees of freedom	10
	salience	0.000

From the test results in Table 3, it can be seen that the KMO value between various types of technology finance investment indicators in the technology finance efficiency evaluation index

system is 0.714, which is greater than 0.7; the significance of the Bartlett sphericity test between the Bay Area technology finance investment indicators is: 0.000, which is less than 10% significant, indicating that the selected technology finance investment index is suitable for PCA analysis.

5. Conclusions

How to make ST finance effectively promote the transformation of economic momentum, so that each region can use its own unique resource advantages to improve the quality of economic growth, is a problem that the relevant government departments of our country need to seriously consider and study. This paper analyzes how ST finance affects the transformation of local economic kinetic energy, explores the mode of ST finance to better serve local economic development, and formulates relevant science and FT policies, which have important practical significance for promoting the transformation of economic kinetic energy. There are still some shortcomings in this paper. The relationship between finance and technology is mutual. The focus of this paper is on the support of finance to technology, and the advancement of technology can in turn promote the development of the financial industry, which is also the focus of the next research. Due to the unavailability of some data and the differences in statistical calibers between the two sides of the Taiwan Strait and the three regions, the data used in the empirical test in this paper may have certain errors.

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