China's Science and Technology Finance and Economic Corridor Development: A Coupling Relationship Analysis

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***Abstract*—This study aims to explore the coupling relationship between science and technology finance and economic corridor development in my country based on the life cycle theory of industrial clusters. By analyzing the interaction between science and technology finance and the development of economic corridors, our degree of correlation and influence mechanism at different stages are revealed. The main findings of this study include that at different stages of the life cycle of industrial clusters, there are differences in the effect of science and technology finance on the development of economic corridors, showing a gradually strengthening or decreasing trend; there is a strong positive relationship between science and technology finance and the development of economic corridors. Coupling relationship, the development of science and technology finance promotes the construction and development of economic corridors, and vice versa; the coupling relationship between science and technology finance and the development of economic corridors has important policy implications and provides useful information for government departments, business managers and scientific research institutions Reference and guidance. These findings are of great value to the formulation and implementation of science and technology finance policies, the planning and construction of economic corridors, and the cultivation and development of industrial clusters. Government departments can adjust science, technology, finance and economic corridor development policies based on the characteristics of the coupling relationship to promote their coordinated development and virtuous cycle. Based on the research results, business managers and scientific research institutions can optimize resource allocation, enhance innovation capabilities, and achieve sustainable development.**

Keywords*—*Technology finance; regional economic development; industrial clusters; life cycle theory

I. Introduction

Technological finance has received much attention in regional economic development because it integrates modern technology and advocates innovative financial and technological investment. In recent years, Chinese local governments have kept abreast of national policy trends and vigorously promoted the close integration of technology finance and regional economic development around regional innovation strategies. For one thing, local governments actively offer help in studying and improving science and technology, the change of accomplishment in science and technology, and the industrialization of high-tech. It has a diversified service system of science and technology finance with local characteristics. On the other hand, local governments set out to formulate guidelines for developing Internet finance and explore the path for the healthy and sustainable development of the local Internet finance industry. Technological and financial innovation is a crucial correlative factor for China's regional economy's current and future increase. Combining the two can bring about a qualitative leap in regional economic development. However, innovative elements such as technology, information, and talents tend to agglomerate in economically developed regions in recent years. This leads to a significant gap in innovation capability between regions in China. How to effectively and evenly combine technological finance and regional economic development in different regions has become a problem. Hence, it is of practical importance to study the coupling connection between technological finance and regional economic development.

Tracing the historical development track of science and technology finance and regional economy, financial technology can improve financial services through various technological innovations, so the research on financial technology is becoming increasingly new daily. Ra Jeswari R investigated the evolution of tech finance in global markets. He exposed issues like the driving factors of fintech, the disadvantages of conventional financial services, and technological advances [1]. His research can help us improve fintech innovations, but more experimental verification is needed. Golab P researched the role of technology finance and regional economy and proposed that technological innovation is one of the important factors of financial development [2]. His research can point out the development direction for us in a targeted manner, but more detailed verification is needed in the specific operation. Liu Z studied technology finance from the perspective of environmental protection and advocated its benefits for developing a green economy [3]. His research is very helpful for our sustainable development but lacks specific operational means. Arif M studied the status quo of fintech in the development of financial inclusion in China, and he proposed that although China's financial system has made great progress, the gap between developed and under-developed areas is still huge [4]. Boshkov T's research showed that tech finance improves data transmission and analysis. He also provided opportunities for small companies to build low-cost distribution models and risk administration applications [5].

Life cycle theory is widely used in various fields and solves different problems for different scholars. Oskouei Z H started with cash flow and used life cycle theory to predict a company's profitability [6]. His research can provide a reference for company operations, enhancing the growth of the regional economy. Besides that, scholars often mention the life cycle theory of industrial clusters. Yan S studied the development of population urbanization from the view of industrial cluster life cycle theory [7]. His research is conducive to the balanced growth of urban and rural areas, but whether it is effective still needs experimental verification. Starting from the life cycle theory, Cady SH put forward suggestions on the development of products [8]. His research contributed to better product building, advancing the social product economy. From the perspective of life cycle theory, Gao L H empirically analyzed the influence of innovation and development in technology and finance on industrial agglomeration [9]. His research shows that the government should further complete a coordinated growth strategy, promote regional innovation in technology for future consideration, and achieve integration with financial development. It has to be aware of risks in the process. From the perspective of technological finance development, previous research may have paid more attention to the analysis of technological finance development trends, policy support, financial innovation and other aspects. These studies may focus on the role of science and technology finance in promoting technological innovation and industrial development, as well as the innovation and application of science and technology finance products and services. From the perspective of economic corridor construction, past research may have focused on analyzing the impact of economic corridor construction on regional economic development and coordinated regional development. These studies may focus on the impact of economic corridors on regional industrial structure, industrial layout, talent flow, etc. In terms of the life cycle theory of industrial clusters, past research may have focused more on the characteristics and evolutionary rules of the formation, development, maturity and decline stages of industrial clusters. These studies may focus on the analysis of internal relationships within industrial clusters, industrial chains, technological innovation, etc. Current research focuses more on linking the life cycle theory of industrial clusters with technology finance and economic corridor development to establish a relevant theoretical framework. By integrating theories from different fields, we conduct an in-depth exploration of the impact mechanism of science and technology finance on the development of economic corridors at different stages.

This paper is divided into five sections. Section I introduces the background and significance of the research, summarizes the importance of science and technology finance and economic corridor development, and then briefly expounds the basic concept of industrial cluster life cycle theory and its application value in this study. Section II discusses the research methods of the coupling relationship between science and technology finance and regional economic development in China; Section III uses selected methods and data to analyze the coupling relationship between science and technology finance and economic corridor development. Section IV summarizes the results of empirical analysis, answers the research questions, and validates the hypothesis and finally Section VI concludes the paper.

This paper starts from the life cycle theory of industrial clusters and extracts features from different cycles as indicators to study technology finance and regional economy growth. It also analyzes the coupling degree of the two. The innovation of this paper is to integrate physics knowledge into economic research. Based on the CCD model and classification of physics, it determines the level of coupling and coordinated growth of regional economy growth and technology finance, thereby providing an intuitive basis for the comparative analysis of coupling and coordination degrees.

II. Methods of the Coupling Relationship between China's Science and Technology Finance and Regional Economic Development

A. Theory of Life Cycle of Industrial Clusters (LCIC)

The industrial cluster life cycle theory refers to the following. When people find that industrial clusters have their life course, just like creatures in nature, many economists apply life cycle theory to industrial clusters to analyze their development law more accurately [10]. There are various divisions for the life cycle of industrial clusters, most of which are divided into six stages by European SMEs. The United States divides it into five stages, with four and three-stage divisions [11]. This paper adopts China's usual division method and divides LCIC into four phases, as shown in Fig. 1.

According to Fig. 1, the life cycle of an industrial cluster can be grouped into a formation stage, a growth stage, a mature stage, and a decline stage. The characteristics of these four stages are described in detail below:

1) Formation stage: At the beginning of this stage, only a few related enterprises may gather together. These enterprises take advantage of local resources or locations to develop slowly. Since the aggregation in geographic space reduces the transaction cost and risk of cooperation between enterprises, there is a certain aggregation effect. However, the cluster's development momentum is still weak due to the lack of various factors, such as various markets, government policy support, and related support institutions. However, it is also because the starting point of the base of the company's sales revenue at this time is relatively low, so the development speed of the company at this stage is relatively fast.

2) Growth stage: In this stage, many enterprises bring capital, technology, human resources, management mode, etc., into the cluster. The supporting hardware facilities, regional innovation, and network environment have also greatly increased the internal enterprise's economic strength. Universities, research institutions, and industry associations also increase, making the cluster a strong driving force for development [12]. The economic effect produced by the industrial cluster has become the economic growth point of the region, and the government, therefore, gives more support in terms of policies and other aspects. Industrial clusters have entered a stage of rapid growth. Clusters also increase the entry threshold of enterprises due to the improvement of various internal levels.

3) Mature stage: In the mature stage, after the accumulation and precipitation of the formation stage and the growth stage, the scale of the industrial cluster begins to stabilize gradually. The development speed has also gradually slowed, and many funds, technologies, and human resources have gathered within the cluster. Still, the attractiveness of various external resources has begun to decline. It should be noted that the resources the developing enterprises rely on after the formation and growth period are gradually exhausted, and their efficiency begins to decrease. At the same time, the over-aggregation of enterprises in the cluster also led to the decline of the industrial cluster [13].

4) Recession stage: In the recession phase, many companies within the cluster relocate, and the problem of losing technical talents and funds of the remaining enterprises also becomes serious. Malicious competition within enterprises is becoming more and more frequent. If some new major changes, such as major innovations, can occur at this stage, the cluster can be transformed into a new life cycle stage. It would otherwise not change the recessionary trend [14].

B. Inflection Point of the LCIC

In the development course of the LCIC, three turning points of acceleration, consolidation, and control usually appear. Fig. 2 shows a schematic diagram of the inflection point in the life cycle of an industrial cluster.

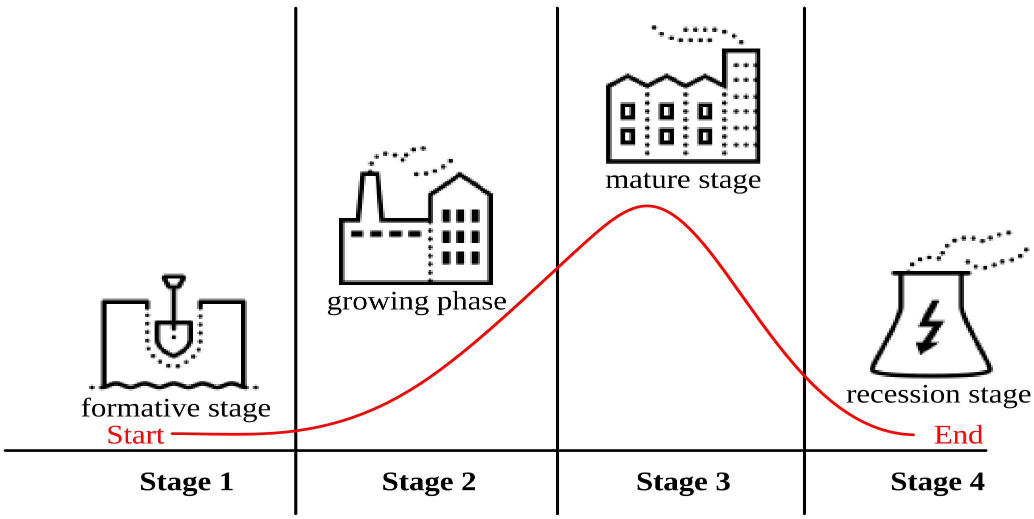


Fig. 1. Four stages of LCIC.

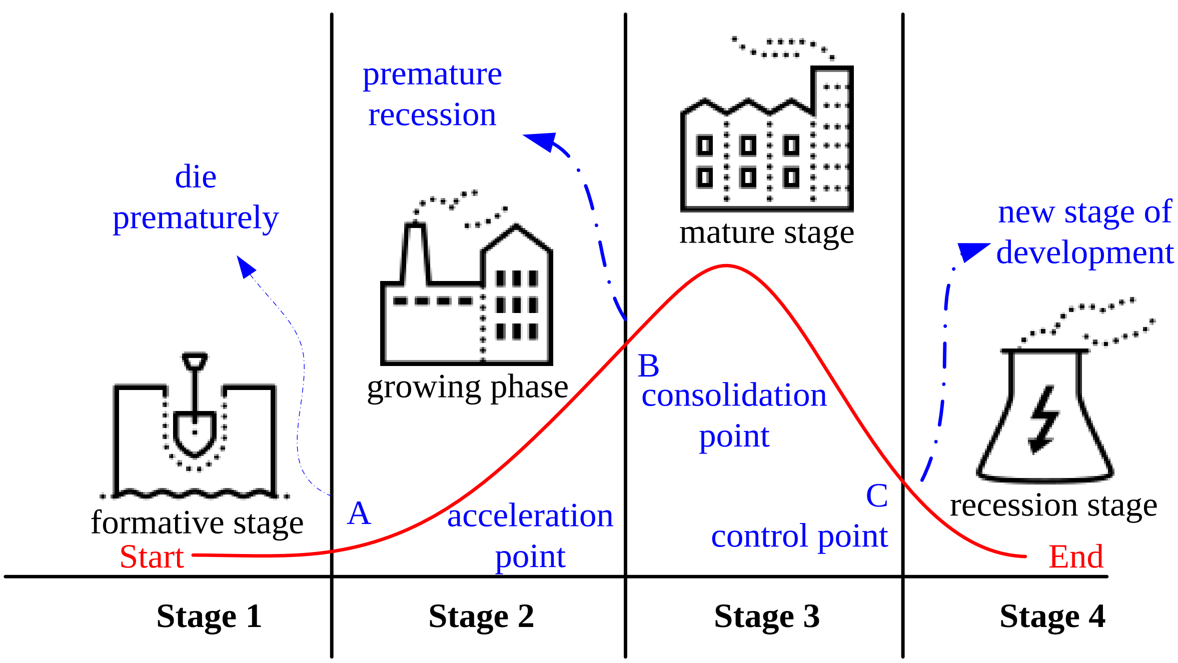


Fig. 2. Inflection points in LCIC.

As shown in Fig. 2, the four stages of LCIC and the three inflection points can be seen in the development process. From the mature phase of the industrial cluster, the mature stage can be classified into two parts: the upper-rush phase and the falling phase. Due to various reasons inside and outside the cluster, the cluster will have a decline stage until after the control point. Finally, the development of the industrial cluster will gradually decline, and it will enter the decline stage until it disappears.

The inflection points of acceleration, consolidation, and control mentioned above are a few special and critical periods in the life cycle development of industrial clusters. After different inflection points, the clusters will face different situations and characteristics. Whether these inflection points can be accurately judged plays an important role in judging the life stage of the industrial cluster and the possible future trend [15]. On the one hand, judging these inflection points can provide us with reasonable suggestions and measures to improve the overall competitiveness of the cluster and prepare for breaking through the inflection points to accumulate strength. On the other hand, according to the internal situation of the cluster after different inflection points, its characteristics can be extracted as an indicator of the coupling system of technology finance and regional economy growth.

C. Coupling and Coordinating Index System of Technological Finance and Regional Economy Growth

1) Index selection: According to the system coupling theory, this paper regards technology finance and regional economic development as two subsystems of system coupling $S = \{T, F\}$. Among them, T is technology finance, and F is regional economy. By dividing different inflection points in the life cycle of industrial clusters in the previous section, based on grasping the stage characteristics and influencing factors of technological finance and regional economic development, it comprehensively considers China's actual national conditions. It selects static and dynamic indicators and then scientifically and reasonably constructs an indicator system for the coupling and coordination degree of science and technology finance and regional economy suitable for panel data spanning two dimensions of time and space. Table I shows the contents of each indicator.

Science and technology finance support policies refer to the policies and measures introduced by the government in the region to support the development of science and technology finance, including tax incentives, loan support, entrepreneurial subsidies, etc.; regional economy measures the driving effect of the construction of economic corridors in the region on the surrounding regional economy, including employment growth, industrial upgrading etc.

2) Entropy weight determination: Determining the weight is a necessary link in the comprehensive evaluation process and a key step in quantifying the comprehensive evaluation index. The results of determining the weights can have an important impact on rationality and scientific evaluation. The entropy weighting method belongs to the objective weighting method. It generally uses mathematical operation technology to determine the weight, which can avoid the interference of human and subjective factors. It has been widely discussed and applied by academia in recent years [16].

First, it makes assumptions about the selected indicator variables. It represents the number of years, K means the number of indicators, and J means the number of regions. Then x_{ijk} stands for the k-th index variable in the j region of the ith year, and the value of the index variable is X. The specific calculation process is as follows:

a) Standardization of indicators: Since each evaluation index has different dimensions and units, it is necessary to continue to standardize the index variables, and the normalization method is used in this paper. The calculation process is shown in Formula (1):

$$x^{'}_{ijk} = x_{ijk} - xminmax_{min} \tag{1}$$

b) Calculate the index entropy value: After the standardization process, each index variable's weight 'y ijk is calculated, and the calculation process is shown in Formula (2). According to the weight results of the index variables, the entropy value e_k of the k-th index can be calculated, and the calculation process is shown in Formula (3), $k \geq 0$, $k = ln(IJ)$.

$$y'_{ijk} = x_{ijk} / \sum_i \sum_j x'_{ijk} \tag{2}$$

$$e_k = -k \sum_e \sum_j y'_{ijk} \, ln(y_{ijk}) \tag{3}$$

TABLE I. THE INDEX SYSTEM OF THE CCD OF SCIENCE AND TECHNOLOGY FINANCE AND REGIONAL ECONOMY

System Layer	Target Layer	Indicator layer	Variable explanation
Technology Finance (T)	Technology innovation investment	Human input	Full-time equivalent of R&D personnel (person-year)
		financial input	Fiscal spending on technology (%)
	Technological innovation output	Licensing	Number of Patents Accepted (%)
		technology export	Total merchandise exports (%)
Regional Economy (F)	economy of scale	Financial depth	Deposit and loan balance (%)
		financial competitiveness	Number of listed companies (s)
	economic performance	capital allocation ratio	Loan balance (%)
		Insurance depth	Premium income (%)

TABLE II. THE WEIGHT OF THE INDEX WEIGHT OF THE COUPLING AND COORDINATION DEGREE OF SCIENCE AND TECHNOLOGY FINANCE AND REGIONAL ECONOMY

Indicator variable	2016	2017	2018	2019	2020	2021
Human input	0.0658	0.062	0.0562	0.0636	0.0694	0.0714
financial input	0.0637	0.0674	0.0565	0.0755	0.0725	0.0969
Licensing	0.0832	0.0696	0.0583	0.0597	0.0674	0.0658
technology export	0.0267	0.0361	0.0303	0.0384	0.0636	0.0320
Financial depth	0.1335	0.1340	0.1496	0.1622	0.0864	O.1641
financial competitiveness	0.0739	0.0686	0.066 1	0.0722	0.0699	0.0638
capital allocation ratio	0.0771	0.0774	0.0708	0.0715	0.0696	0.0683
Insurance depth	0.0580	0.0582	0.0504	0.0597	0.0689	0.0496

c) Calculate the indicator weight: Then, through the entropy value of each index, the information entropy redundancy d_k of each index is calculated, and the calculation process is shown in the following formula:

$$d_k = 1 - e_k \tag{4}$$

$$\lambda_k = d_k / \sum_k d_k \tag{5}$$

Next, this article selects the panel data of six regions in China from 2016 to 2021. The professional programming software MATLAB2016 uses the entropy weighting approach to calculate the weight results of each index in the technological finance and regional economic index system. The clear results are in Table II.

3) Efficacy function: Based on the entropy weighting method, this paper continues to introduce the efficacy function. The power coefficient method can reduce the bias of a single approach, which is more suitable for analyzing complex systems. The power function can measure the function of the subsystem to the composite system from disordered to ordered evolution [17]. The degree of coupling coordination is just a measure of the degree of effect in the evolution of the system coupling from disorder to order. The specific calculation process of the power function model is as follows:

a) Efficacy coefficient: Assuming a variable, $u_{nm}(n = 1,2,3\ldots, p; m = 1,2,3\ldots q)$ is the contribution of the mth index in the nth subsystem to the coupling order degree of the system, that is, the efficiency coefficient of the subsystem. Among them, $u_{nm} \in [0,1]$, when the efficiency coefficient is closer to 1, indicates that the contribution of the subsystem to the system coupling is greater. Technological finance and regional economy, as two subsystems coupled by the system, can calculate the efficacy coefficient u_{nm} of technological finance and regional economy on the degree of order through the Formula (6) of the efficacy coefficient, that is, when $n = 1,2, m = 1,2,3\ldots7$.

$$u_{nm} = \begin{cases} \frac{Z_{nm}-b_{nm}}{a_{nm}-b_{nm}}, & proves\ \mathrm{u_{nm}}\ \text{positive} \\ \frac{a_{nm}-Z_{nm}}{a_{nm}-b_{nm}}, & \text{proves}\ \mathrm{u_{nm}}\ \text{negative} \end{cases} \tag{6}$$

In Formula (6), Z_{nm} stands for the value of the mth index of the nth subsystem, and a_{nm} and b_{nm} represent the upper and lower limits of each index variable in the subsystem, respectively.

b) Efficacy value: Through the efficacy coefficients of regional innovation in science and technology and regional financial innovation, and using the Formula (7) of the efficacy value, the efficacy values u_n of regional innovation in science and technology and regional financial innovation on the degree of order can be calculated, namely u_1 and u_2.

$$u_n = \sum_{m=1}^{q} \lambda_{nm} u_{nm}, \sum_{m=1}^{q} \lambda_{nm} = 1 \tag{7}$$

In Formula (7), λ_{nm} is the index weight calculated by the entropy weighting method in the previous section.

4) CCD function: The CCD model is an optimization and upgrade for the defects of the coupling degree model. This paper draws on scholars' research on the CCD of multiple systems, and firstly constructs the coupling degree model of regional innovation in science and technology and financial innovation. On this basis, it continues to develop the coupling coordination model of the two [18].

a) Coupling degree model: To measure the coupling degree of regional technological innovation and financial innovation, this paper adopts the interdisciplinary expansion model of the physical capacity system model. The specific model is shown in Formula (8). When p=2, it is the coupling degree model of regional technology and finance innovations, as shown in the following formulas.

$$C_p = \sqrt{\frac{(u_1 \cdot u_2 \cdot \ldots \cdot u_p)}{\prod(u_1 + u_2 + \ldots + u_p)}} \tag{8}$$

$$C_2 = \sqrt{\frac{(u_1 \cdot u_2)}{\prod_{n=1,2,m=1,2\ldots7} u_1 + u_2}} \tag{9}$$

In Formula (8) and Formula (9), p is the number of subsystems constituting the composite system. C is CCD between subsystems. The value range of CCD is $C \in [0,1]$. The larger the CCD value is, the stronger the CCD is. Among them, when $C = 0$, the CCD value is small, indicating no coupling between subsystems, and the composite structure tends to have a disordered structure. When $C = 1$, the value of CCD is large, indicating that the degree of coupling between subsystems is strong, and the composite system tends to be newly ordered.

b) Coupling coordination degree model

$$\begin{cases} T = \mathrm{au}_1 + \beta u_2 + \ldots + \pi \mu_p \\ D = \sqrt{C \cdot T} \end{cases} \tag{10}$$

Since the research objects of this paper are scientific and technological finance and regional economy, respectively, the CCD model of regional innovation of science and technology and financial innovation is deduced. The model is as follows:

$$\begin{cases} T = \mathrm{au}_1 + \beta u_2 \\ D = \sqrt{C \cdot T} \end{cases} \tag{11}$$

In the above formula, $D \in [0,1]$, the larger the value of coupling coordination degree, the stronger the CCD and coordination between regional technological innovation and financial innovation. Among them, when $D = 0$, it shows that there is no coupling relationship between the two systems, and there is no coordination; when $D = 1$, it means that the CCD in the two systems reaches a large value, and the coupling state presents a high level. Both systems develop in an orderly fashion [19]. Based on the actual situation of the research object in this article, only CCD $D \in (0，1]$ is considered here.

III. Coupling Experimental Design and Data Sources

This article uses the panel data of six regions in China (Northeast China, North China, Central South, East China, Southwest China, and Northwest China) from 2016 to 2021 as a sample. All data used in the study came from relevant statistical yearbooks for each year from 2016 to 2021. The indicator data comes from fiscal science and technology expenditures, public financial expenditures, technology market turnover, and total commodity exports in the "China Industrial Statistical Yearbook" of each year. In addition, due to changes in China's statistical caliber, the indicator data of "high-tech industry output value" from 2016 to 2021 is replaced by the main business income of high-tech industries. Statistics such as "technological market turnover" and "total commodity exports" in Tibet are missing. It was removed from this paper's research so as not to affect the overall results.

To realize the idea of the thesis, it is necessary to combine the relevant theoretical knowledge of industrial cluster life cycle theory, technology finance and economic corridor development, and use technical information for data collection, analysis and demonstration. The following is technical information that may be used:

1) Data collection technology: Web crawler technology: used to obtain a large amount of relevant literature, statistical data, policy documents and other information from the Internet to support the theoretical basis of research.

a) Database technology: used to establish and manage databases related to technology, finance, economic corridor development and other related data for data analysis and mining.

b) Questionnaire technology: used to survey relevant enterprises, government departments, experts and scholars, etc., to obtain their views and opinions on the coupling relationship between technology finance and economic corridor development.

2) Data analysis technology: Statistical analysis software: such as SPSS, R, etc., used to conduct descriptive statistics, correlation analysis, regression analysis, etc. on the collected data to discover the relationship between the data.

a) Data mining technology: such as cluster analysis, association rule mining, etc., used to mine hidden patterns and trends in data and reveal the potential correlation between technology finance and the development of economic corridors.

3) Model building technology: Industrial cluster life cycle model: Based on the industrial cluster life cycle theory, a life cycle model of technology finance and economic corridor development is established to describe and analyze the characteristics and development patterns of different stages.

a) Economic corridor input-output model: Based on the economic corridor theory, an input-output model is established to quantitatively evaluate the driving effect of economic corridor construction on the regional economy.

4) Visualization technology: Data visualization tools: such as Tableau, Power BI, etc., used to visually display research results in the form of charts, maps, etc., to improve the understandability and attractiveness of research results.

IV. Experimental Result

A. Calculation Results of Coupling Coordination Degree

Using MATLAB2016 software and the efficacy function formula in the second section, this paper can calculate the efficacy values of 6 science and technology finance and regional economies in China from 2016 to 2022. The coupling degree model formula in Section II can calculate the CCD of technology finance and regional economy. It can calculate the CCD index through the CCD formula. In terms of the CCD and CCD index, the coupling and coordination degree between technology finance and regional economy can be finally calculated, as shown in Table III.

B. Variation Trend of CCD

Based on the above empirical results, this article analyzes the growing tendency of CCD of scientific and technological finance and regional economy in the time dimension through the change of the mean value, ranking, and numerical value of CCD. In addition, through the consequences of efficacy value, this article compares and analyzes the development status between technology finance and the regional economy [20].

The mean is one of the important indicators reflecting the central tendency of the data, which can be used to describe the trend characteristics of the data. The mean analysis of different years can reflect the growing trend of the CCD of science and technology finance and regional economy over time. Fig. 3 shows the average change in CCD in technology finance and regional economy.

TABLE III. EMPIRICAL RESULTS OF THE CCD IN SCIENCE AND TECHNOLOGY FINANCE AND REGIONAL ECONOMY

Regions	2016	2017	2018	2019	2020	2021	2022
Northeast	0.4471	0.4408	0.4542	0.4511	0.4511	0.4440	0.4540
North China	0.2553	0.2478	0.2552	0.2751	0.2751	0.2594	0.2364
Central South	0.1531	0.1535	0.1840	0.1584	0.1584	0.1688	0.1620
East China	0.1732	0.1774	0.1907	0.1971	0.1971	0.1913	0.1133
Southwest	0.1245	0.1389	0.1465	0.1353	0.1353	0.1230	0.1530
Northwest	0.2552	0.2271	0.2169	0.2203	0.2203	0.2058	0.1098

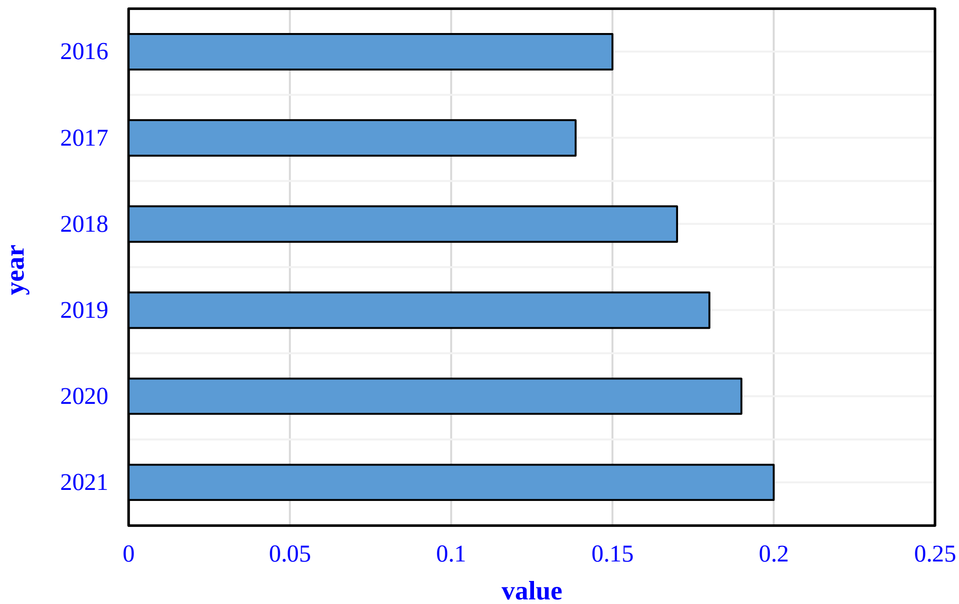


Fig. 3. The mean change of CCD between science and technology finance and regional economy.

According to Fig. 3, from 2016 to 2022, the average value of CCD in technological and financial innovation in China reached 0.1508. Among them, in 2017, the mean value of CCD is the smallest, and its value is 0.1386. In 2018 and 2019, the mean value of CCD was the largest, and its value was 0.1760, which was 0.0374 different from the small value. From 2016 to 2018, the mean value of CCD increased. After 2018, the average value of CCD is generally higher than other years in the past. Apart from a mild drop in individual years, the average value of CCD in scientific and technological finance and the regional economy maintains a slow increase trend.

C. Comparison of Efficacy Values

The efficacy value can reflect the development level of regional technological innovation and financial innovation. Fig. 4 compares the efficacy values of technology finance and the regional economy in each region from 2016 to 2022.

As shown in Fig. 4, the efficacy values of technology finance in the six regions have been higher than the regional economies in the past five years, and technology finance has always been in a leading position. In 2017, the efficacy value of science and technology finance was the largest, with a value of 0.1286, and the efficacy value of the regional economy was the smallest, with a value of 0.0809. The gap between the two was large, as high as 0.0477. The regional economic development momentum slowed down. The gap between the two slowly narrowed until the gap between the two was small, only 0.0172 in 2022. Regional science, technology, and finance innovation are developing in a more coordinated direction.

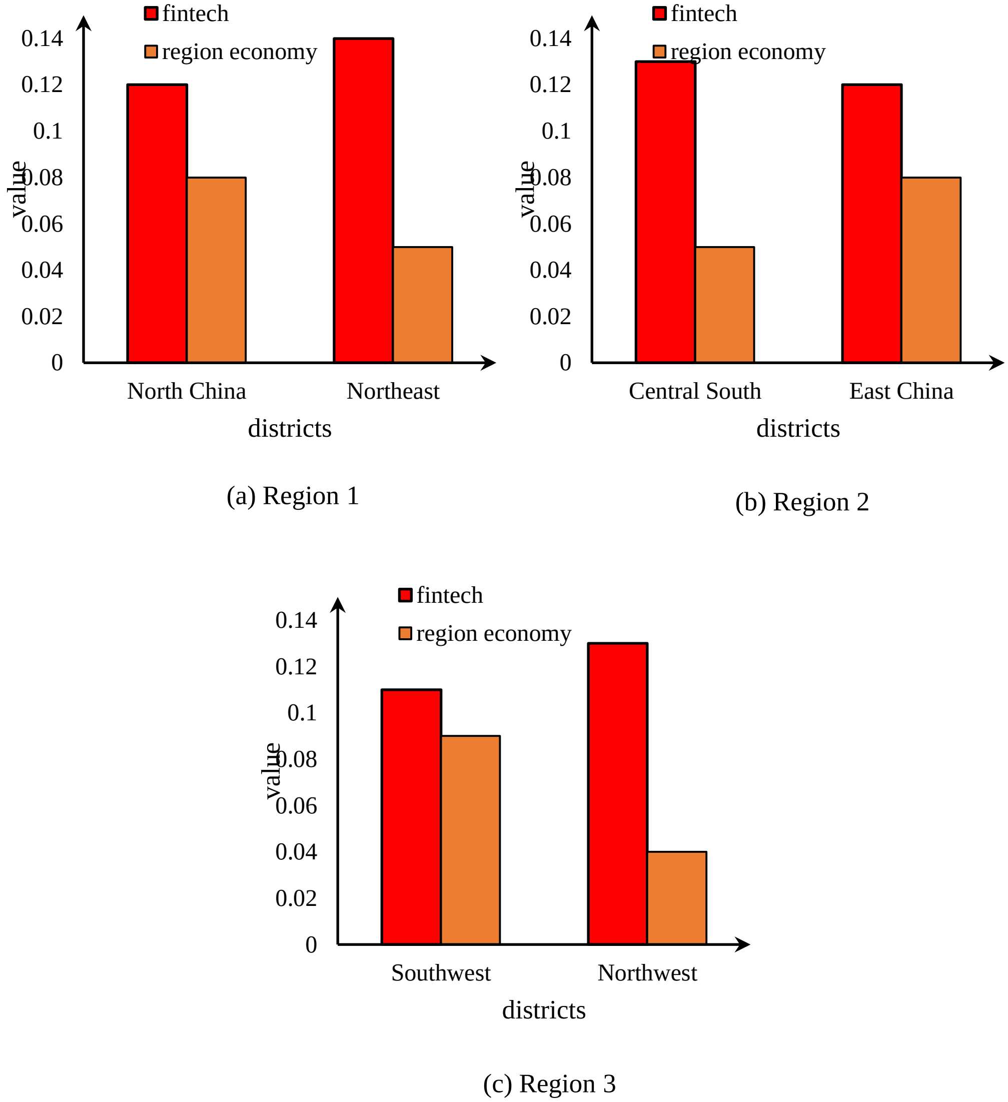
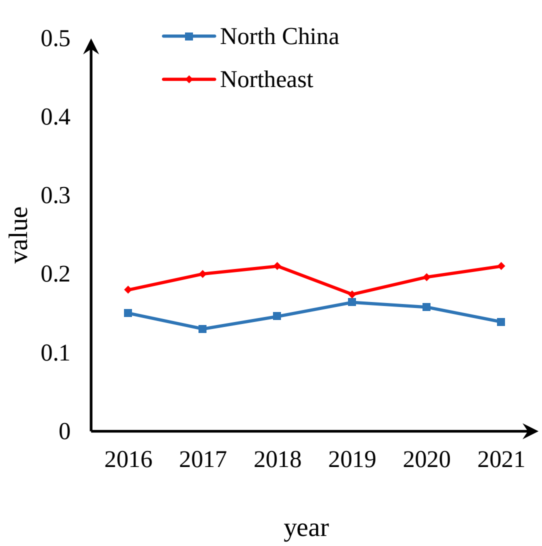


Fig. 4. Comparison of efficacy values between technology finance and regional economy.

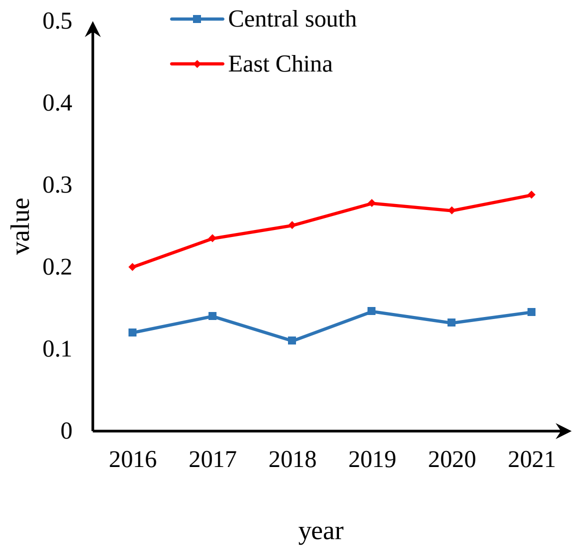
D. Variation Results of CCD in Different Regions

Based on the size of CCD, the changes in CCD in each of the six regions from 2016 to 2022 are counted, and the results in Fig. 5 are obtained:

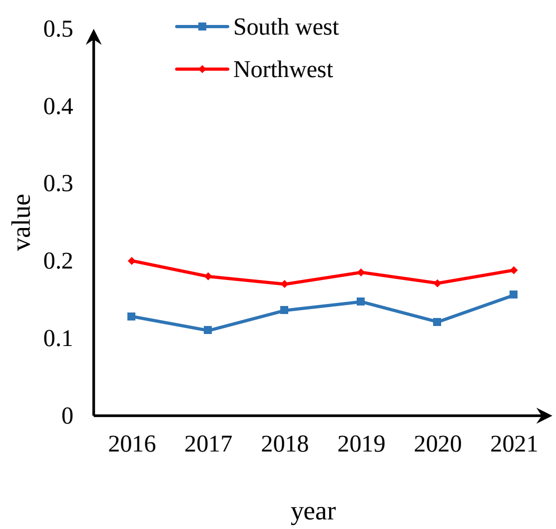
From the numerical change of CCD in Fig. 5, from 2016 to 2022, the value of CCD of innovation in science and technology and financial innovation in East China reaches an average of 0.2676. Except for occasional large fluctuations, the overall fluctuation of CCD in East China is not large, and the changing trend is relatively moderate. From 2016 to 2022, the value of CCD of innovation in science and technology and financial innovation in the central and southern regions reached an average of 0.1649. Compared with the eastern provinces, the variation range of the numerical fluctuation of CCD in the central and southern regions is obvious. The value of CCD of innovation in science and technology and financial innovation in the northwest region reaches an average of 0.1687. The numerical change of CCD in the northwest region fluctuates very obviously, and the changing trend generally shows a tortuous trend. Generally, CCD in East China is the most stable, maintaining a leading position in the country. The ranking of CCD in the central and southern regions fluctuates greatly and is the most backward overall. CCD in the western region also fluctuates greatly and is backward.



(a) Region 1



(b) Region 2



(c) Region 3

Fig. 5. Numerical changes in CCD in science and technology finance and regional economy in various regions.

V. Conclusion

Based on LCIC, this paper extracts features through different life cycle stages as indicators for studying the coupling connection between technology finance and regional economy. In the end, the coupling relationship between them is studied. Judging from the existing research on science and technology finance and regional economy, scholars have confirmed a dynamic relationship between the two: mutual demand, mutual promotion, and integrated development. Technological finance and regional economy are coupled through the connection between internal elements, and the degree of coupling between the two determines the properties of spillover effects. The positive spillover effect of coupling technology finance and regional economy can be 1+1>2. This paper regards China as a study of the whole region, which is more in line with the basic national conditions of China's uneven regional development and the current regional development pattern. In this paper, when investigating the course of the coupling and coordinated development of regional technological innovation and financial innovation, due to limited scientific research ability and theoretical foundation, the research on the characteristics and factors of the coupling and coordinated development stage is relatively simple. Individual views are yet to be discussed and discussed. In the future, it looks forward to further research and more profound views. In terms of in-depth study of the coupling relationship mechanism, further explore the coupling relationship mechanism between science and technology finance and the development of economic corridors, including the impact of different types of science and technology finance products on the development of economic corridors, the synergy between government policies and the development of industrial clusters, etc.; In addition, it is necessary to Strengthen interdisciplinary research cooperation with economics, management, finance and other related fields, and fully tap the application potential of industrial cluster life cycle theory in the development of science and technology finance and economic corridors. It is difficult to obtain data on science, technology, finance and economic corridor development, and problems such as insufficient data collection and uneven quality need to be overcome. At present, there are still limitations in research methods, and it is necessary to combine more quantitative and qualitative research methods to improve the scientific nature and accuracy of the research. The theoretical integration between science and technology finance, economic corridors and industrial cluster life cycle theory is not yet complete, and the construction and integration of theoretical frameworks need to be strengthened.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Rui Tian: Writing-Original draft preparation, Conceptualization, Supervision.

Birong Xu: Software, language review.

Availability of Data and Materials

On Request

Declarations

Not applicable.

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