THE ECONOMIC IMPACT OF FINANCIAL INTEGRATION: A CASE OF CHENGDU-CHONGQING ECONOMIC CIRCLE

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Fulfillment of the Requirements for the Degree of
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ABSTRACT

Title of Thesis	THE ECONOMIC IMPACT OF FINANCIAL INTEGRATION: A CASE OF CHENGDU-CHONGQING ECONOMIC CIRCLE
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Finance is the general hub of modern market economy operation and plays a non-substitutable important position in economic progress. The fact of financial integration in promoting the economy has been confirmed in some places, but for the Chengdu-Chongqing Economic Circle, there is still little research for this "new topic", this field of research is still waiting for people to explore. This paper firstly combs the relevant theories of financial integration. On this basis, the sixteen cities that constitute the Chengdu-Chongqing Economic Circle are selected as the research areas. Financial integration is set as the main explanatory variable, and the GDP is chosen to be the main explained variable, then we collected and established the panel data for 2010 to 2019. By processing and testing the data, this paper constructs a fixed-effect model and spatial regression for analysis. The results show that the development of financial integration can promote economic development in Chengdu-Chongqing Economic Circle.

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CHAPTER 1

INTRODUCTION

1.1 The Background of Research

At the sixth meeting of the China Central Finance and Economics Commission in January 2020, General Secretary Xi Jinping put forward proposals for promoting the Chengdu-Chongqing Economic Circle known by the slogan "one pole, two centers, and two places". One pole is referred to the Chengdu-Chongqing Economic Circle, and the two centers and two places are referred to the two large cities of Chengdu and Chongqing. This year's "China Government Work Report" also made arrangements to promote the construction of the Chengdu-Chongqing Economic Circle. By the requirements of the central government, the National Development and Reform Commission is preparing relevant plans in conjunction with relevant departments and localities. Ultimately, Chengdu and Chongqing are strengthened to be the leading cities over the region.

The Sichuan Provincial Party Committee and the Chengdu Municipal Party Committee attach great importance to this strategic opportunity and have made a new plan for the development route of the Chengdu-Chongqing Economic Circle. Various departments of Sichuan Province are also actively exploring cooperation plans and signing cooperation agreements with relevant departments of Chongqing Municipality in areas such as ecology, human society development, and supervision.

Since the beginning of 2020, under the influence of the Covid-19 and the turbulent world's economy, Chinese macroeconomic policy has been facing a process of re-adjustment. The viable domestic economic structure is needed and the Chengdu-Chongqing Economic Circle has a great potential to reinforce Chinese economy even more.

1.2 The Significance of Research

Regional financial integration is carried out in the context of economic globalization and regional economic integration. It is the result of its development and the link that connects economic globalization and regional economic integration. It plays an important role in boosting regional economic development. The Chengdu-Chongqing Economic Circle is the core of western China which possess substantial resources. It has close economic connections to drive the surrounding region.

The development of financial integration attracted great attentions because it helps the economy to achieve the optimal allocation of resources. Therefore, the construction of the financial centers of Chengdu and Chongqing, and the strengthening of financial integration within the region must be carefully processed.

This thesis selects China's newly launched Chengdu-Chongqing Economic Circle to explore the role of regional financial integration in regional economic development. By measuring the current level of financial integration in the Chengdu-Chongqing economic circle, we can realize the current degree of financial integration in the Chengdu-Chongqing Economic Circle. At the same time, in view of the shortcomings in the development of financial integration, I will follow the actual situation, put forward effective solutions and countermeasures to further promote the development of financial integration in the Chengdu-Chongqing Economic Circle and the economic development of the Chengdu-Chongqing Economic Circle.

1.2.1 Theoretical Significance

As an important part of regional economic integration, regional financial integration has become an emerging financial development trend with broad prospects. It plays a very significant role in the process of stabilizing and developing the regional economy and enhancing regional influence. At this stage, the research on regional financial integration mostly crosses national borders. Internationally, the relatively successful financial integration of the European Union, North America, and East Asia all cross borders. However, there are few studies on financial integration in a small area like a province. This thesis enriches the theory of regional financial integration.

1.2.2 Practical Significance

As the center of western China, whether the Chengdu-Chongqing Economic Circle is successful has an important influence on the implementation of China's western development strategy. Its economic and financial issues have always attracted attention. On one hand, its degree of financial integration has great strategic significance for its own regional economic development; on the other hand, the development of financial integration in the Chengdu-Chongqing Economic Circle also has become the key reference for the development of other regional economies.

1.3 The Introduction of the Chengdu-Chongqing Economic Circle

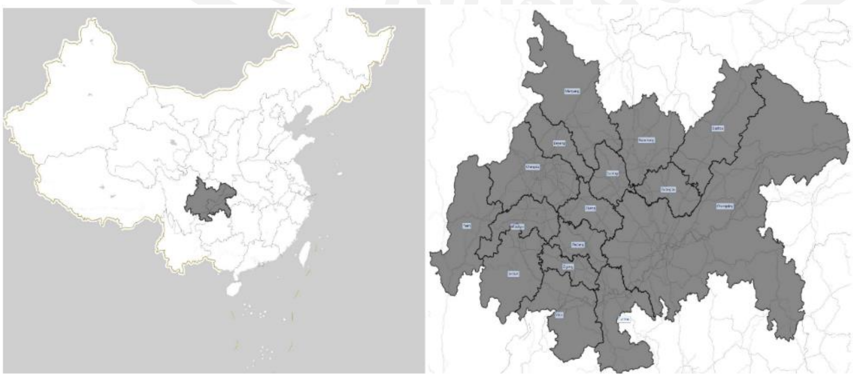

Figure 1.1 The Position of Chengdu-Chongqing Economic Circle in China

The Chengdu-Chongqing Economic Circle mainly refers to the two big cities which are Chengdu（the capital of Sichuan Province）and Chongqing (the only municipality directly under the Central Government in western China), and other 14 cities in Sichuan province which are Deyang, Mianyang, Meishan, Ziyang, Suining, Leshan, Yaan, Zigong, Luzhou, Neijiang, Nanchong, Yibin, Dazhou, and Guangan. We can see from Figure 1.1 that this economic circle is located in the southwestern region of China. The topography is mainly composed of the Sichuan Basin and its marginal hills. Because of the special topography of the basin and a long distance from the coastal areas, the Sichuan Basin in ancient China was relatively closed, with inconvenient transportation and fewer economic and cultural exchanges with the outside.

With the western development implement in the nearest ten years, this region has further developed in the areas of roads, railways, aviation, inland water transport, ports, and pipeline transportation, forming a relatively complete modern transportation system. The functions of distribution and channel of logistics, people flow, capital flow, and information flow in the connecting area are continuously enhanced, and the geographical advantages of the transportation hub and the whole are constantly highlighted.

In the Chengdu-Chongqing Economic Circle and even the entire western part of China, both Chengdu and Chongqing are in a significant leading position. In the "National Urban System Planning" issued by the National Development and Reform Commission in 2012, Chongqing was selected as one of the five major national central cities. In 2016, the number of national central cities was expanded to nine. Chengdu and Xi'an were selected as representatives of the west. We can see the GDP of Chengdu and Chongqing from Figure 1.2. In 2019, Chongqing’s local GDP reached 2,360,577 million yuan, which increased by 6% from 2018. By industry, the added value of the primary industry was 155,142 million yuan, 4.4% increase; the added value of the secondary industry was 949,684 million yuan, 3.0% increase; the added value of tertiary industry was 1,255,715 million yuan, 9.1% increase. Based on the permanent population, the city’s per capita GDP reached 65,933 yuan, 5.1% increase over the previous year, the total GDP ranked fifth in China and the first in the west.

Chengdu has been known as the land of abundance since the ancient time because it has a superior climate, geographical conditions and developed agriculture. In 2019, Chengdu's GDP reached 1,701,265 million yuan, 8.0% increase over the same period last year, and the growth rate was 1.4 percentage points higher than that of the country. Among them, the primary industry achieved an added value of 61,218 million yuan, 2.5% increase; the secondary industry achieved an added value of 524,462 million yuan，7.0% increase; the tertiary industry achieved an added value of 1,115,586 million yuan, 8.6% increase, and the total GDP was eighth in the country, which is the second in the west and the first in Sichuan province. Per capita disposable income reached 39,503 yuan, a year-on-year increase of 8.9%, and the per capita GDP reached 103,400 yuan. Chengdu and Chongqing are both big cities in the west region, the two cities are economically highly complementary. Chengdu has obvious advantages in technology, finance, commerce, culture, and education, and plays an important role in leading the small and medium-sized cities in Sichuan province. Chongqing has a strong manufacturing base and a high industrial level. It is also a transportation hub and trade port in the west region. It is a hub connecting central and southern China in the western region.

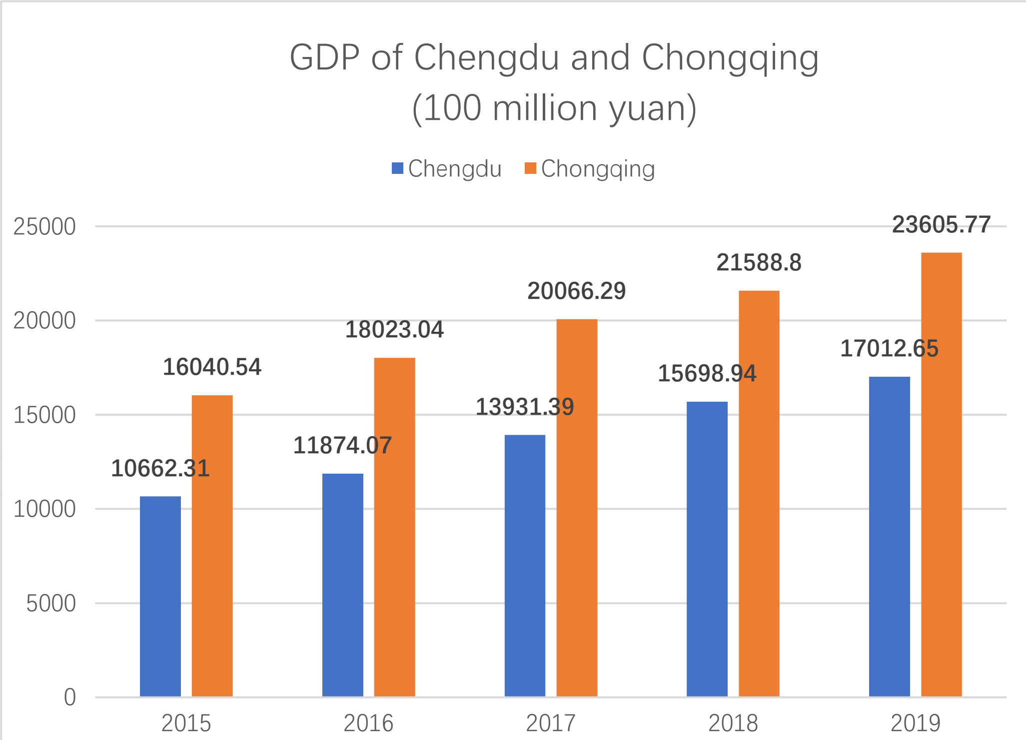

Figure 1.2 GDP of Chengdu and Chongqing

We can see from Figure 1.3 that the economic aggregates of other cities in the Chengdu-Chongqing Economic Circle have a big gap with Chengdu and Chongqing. In 2019, the total GDP of the cities in the Chengdu-Chongqing Economic Circle reached 7,022,195 million yuan, Chengdu accounted for 24.23% of the total GDP, and Chongqing accounted for GPD 33.62% of the total, the other 14 cities combined accounted for only 42.15%. Take Mianyang, the third-largest economic aggregates city in the Chengdu-Chongqing Economic Circle, as an example. Chengdu's GDP in 2019 was 5.99 times that of Mianyang, and Chongqing was 8.26 times. To balance the development, the "Chengdu-Chongqing Economic Circle Regional Planning" took into account economic and geographic factors and selected Dazhou, Leshan, Mianyang, Nanchong, and Yibin as the five regional sub-central cities while determining the central status of Chengdu and Chongqing.

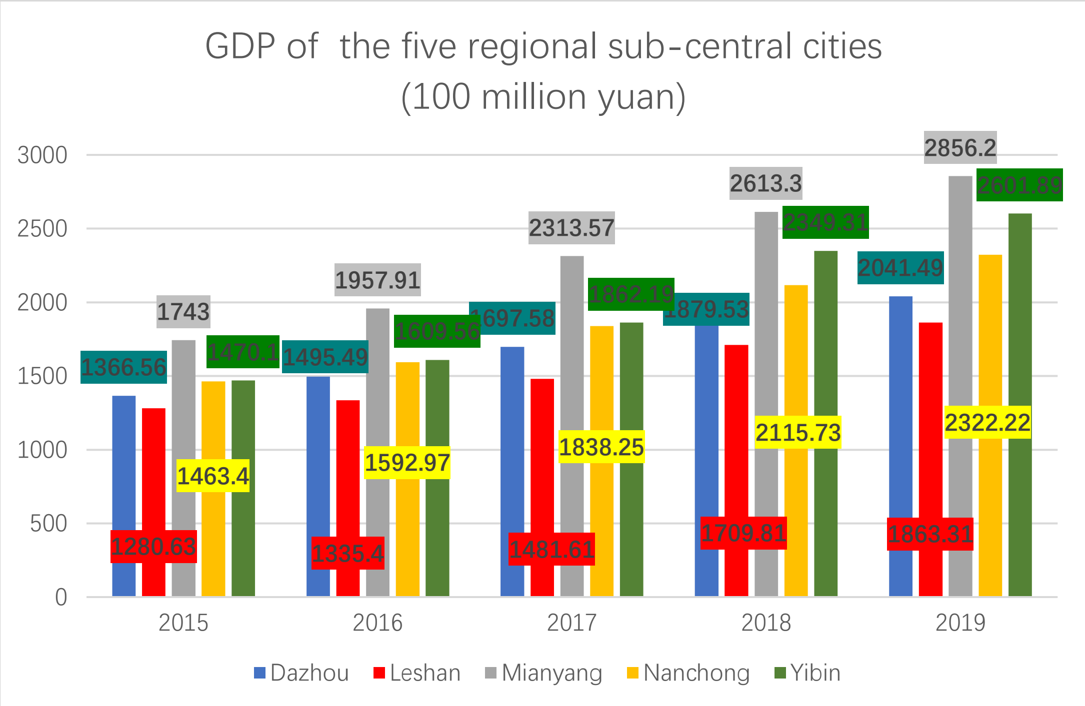

Figure 1.3 GDP of the Five Regional Sub Central Cities

1.4 Research Objectives

Since China acceded to the WTO, the pace of economic development has further accelerated, not only driving the economic development of the eastern coastal areas but also improving the economic situation in the inland areas of the southwest. However, due to the geographical location of the inland and the distribution of natural resources, the southwestern inland areas still have slow development and uneven development.

After China proposed and successfully developed the three eastern economic circles of the Yangtze River Delta Economic Circle, the Pearl River Delta Economic Circle, and the Beijing-Tianjin-Hebei Economic Circle, the Chengdu-Chongqing Economic Circle became the fourth economic circle in the country and the first economic circle in the west region. Its purpose is to promote the development of the southwest region and the entire western region through the development of the

Chengdu-Chongqing Economic Circle, to alleviate China's long-standing uneven development between the east region and the west region, and to narrow the development gap between the east and the west. China attaches great importance to the construction and development of the Chengdu-Chongqing Economic Circle. Not only has the Chengdu-Chongqing Economic Circle listed into the national agenda, but China has also issued many subsequent policies to support it. Since the project is relatively new, the researches on the Chengdu-Chongqing Economic Circle is still limited. This thesis aims to fill this gap by showing the significant benefits of the Chengdu-Chongqing Economic Circle; particularly, its financial contribution towards economic growth. The research questions are explicitly written as follows;

1) What is the degree of financial integration in the Chengdu-Chongqing Economic Circle? What is worth learning and improving?

2) To study the impact of financial integration on economic growth in the Chengdu-Chongqing Economic Circle.

This research intends to use quantitative analysis and use econometric knowledge for scientific assessment. At the same time, the indicators recommended by the relevant literature and the indicators selected in this thesis are selected respectively when conducting principal component analysis to construct financial agglomeration variables. Bring them into the regression model for regression. Finally, I compare which variable is better through regression results, which variable is more in line with the research of this thesis.

This thesis is composed of five parts. I present the literature review in chapter 2, then is chapter 3, methodology. I will get and analyze our results and make suggestions in chapter 4. A conclusion section summarizes this study in chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 The Theory of Financial Integration

In the 18th century, with the rapid economic growth and the development trend of globalization, economic integration was widely studied by scholars. Tinbergen (1954) gave a clear view on economic integration for the first time: economic integration must eliminate the human factors that hinder economic operation, build the most effective and reasonable international economic structure through coordination between countries. Balassa (1962) further defined economic integration as "a process aimed at using various measures to eliminate economic differences between countries, but also a state in which economic discrimination among countries disappears." Lindert (1978) regarded the integration of macroeconomic policies and the free flow of production factors as a manifestation of economic integration. He thought that economic integration can be divided into preferential trade arrangements, free trade zones, customs unions, common markets, economic unions, and prefect economic integration by stages. The first three stages focused more on trade integration. After the common market, financial integration has become an important part of economic integration. In the 1960s, the integration represented by the European Union caused heated discussions on financial integration around the world. Due to the complexity of finance itself, scholars from various countries explain the connotation of financial integration from different angles, leading to certain differences in the definition of financial integration.

1) The theory of unification of financial markets. This view believes that the core of financial integration is financial market integration. According to the definition of the European Union, financial integration refers to “driven by market forces, the financial markets of different countries or regions compete with each other and eventually form a unified financial market. It is characterized by the convergence of prices of financial service providers, the convergence of products provided, and the convergence of efficiency and profit rate." Baeleetal (2004) defined financial integration as if the financial market is potentially unified, then all market participants will face the same situation: 1) When using financial tools and enjoying financial services, what they face is a series of uniform rules; 2) They have equal access to financial instruments and financial services; 3) They receive the same treatment when trading in the financial market. Oxelheim (1990) and Guhaetal (2004) divided financial market integration into three categories: overall financial integration, direct financial integration, and indirect financial integration. Among them, direct financial integration can be regarded as capital market integration. Brower (2005) argued that financial integration is a process. In this process, as a country's financial market is more closely linked with other countries or regions, the prices and profit rate of financial assets in different countries tend to be the same. Japelli and Pagano (2008) proposed that financial market integration is closely related to the law of one price. The law of one price means that if assets have the same risks and returns, the prices of these assets are the same no matter which market is traded. This indicator is used as an important indicator to measure the integration of financial markets. Baltzeretal (2008) also supported Jappelli and Pagano’s view that if the financial market is unified, that is, all financial institutions will face the same rules and investors will be treated indiscriminately. This means that the same financial products may have different prices at the beginning, but under the influence of financial market integration, the prices of financial products will converge. Besides, asset stock or flow

indicators can also be used as supplementary indicators of prices to measure the degree of financial market integration together.

2) The theory of the degree of financial openness. The essence of this view is to equate financial opening with financial integration, emphasizing that the free flow of capital and the high degree of substitution of financial assets are important manifestations of financial integration: 1) liquidity, financial integration means that domestic and foreign investors can conduct financial asset trading activities without any restrictions; 2) substitutability, it refers to the high degree of similarity between domestic financial assets and foreign financial assets, can replace each other. Montiel (1994) divided financial integration into weak financial integration and strong financial integration. Weak financial integration means that there are no obstacles to the cross-border flow of financial assets. Marston (1995) based on the perspective of financial liberalization, believed that financial integration is to realize the deregulation of financial control in the national market and the free flow of international capital. When these two elements are realized at the same time, then the national market and the international market will form a common trading environment, and the interest rate expressed in a unified currency will tend to be consistent. Quan (2008) argued that financial integration is caused to a certain extent by financial globalization. When countries generally loosen capital controls, capital can basically flow freely, while the fungibility of assets between countries increases and asset prices tend to be the same, that is, financial integration is achieved.

3) The theory of integration of finance and geography. Fengchao (2005) argued that the difference in financial resources is the reason for the formation of financial integration leading to Pareto improvement. Therefore, financial integration is defined as "the general law that reveals the growth trend of the financial industry within the financial geographic system."

4) The theory of government-led, rules and the institutional convergence. This view is the essential difference between financial globalization and financial integration. Some early scholars usually equated financial globalization with financial integration without distinction (Tennenbaum, 1999), but there are essential differences between the two. Financial globalization is a situation of financial opening and financial liberalization passively formed based on the emergence and development of economic globalization. Financial integration is led by the government, through consultation among countries, formulating rules and systems to ensure the smooth implementation of financial integration. Guichang (2001) argued that financial integration is an institutional arrangement made to meet the requirements of the development of financial globalization. It is often a process that is formulated and implemented under the conditions of voluntary participation of governments around the world. Ho (2009) pointed out that financial market integration is "a formal international treaty" signed by member states. In the implementation process, two elements are needed to achieve: First, countries or regions can respond to the "financial crisis" through political cooperation. Second, countries or regions can remove restrictions on cross-border financial services of members in the region and achieve coordinated control of the financial system.

According to the above definition, financial integration has the characteristics of capital account liberalization, financial market unification, cross-regionalization of financial institutions and financial services, and coordination of systems and rules. In short, financial integration is a process starting from financial opening and financial market cooperation to the unification of the financial system and financial policies.

2.2 The Theory of Financial Center

The financial center is the product of the development of financial integration to a certain stage. The definition of a financial center in academia can be earliest traced back to the top economist in the United States (Kindleberger, 1963), who through in-depth research on the emergence of financial centers and the functions of financial centers, he defined financial center as a large gathering area with multiple functions such as the circulation of funds in the bank industry, underwriters, and dealers in the securities industry. The financial center essentially acts as an intermediary for enterprises and individuals, helping to achieve the rapid flow and re-allocation of funds between different individuals or enterprises. The financial center ensuring funds flow from the surplus side with high liquidity to the demand side with the shortage of funds. At the same time, the financial center can conduct real-time, inter-time fund settlement in the process of fund circulation.

After Charles, David J Porteous (1993) argued that the financial center is where high-end financial functions and financial services are gathered. Thomas Gehrig (1998) expounded the meaning of financial centers from a geographical perspective and argued that the status of financial centers would be improved with the rapid development of computer networks and communication technologies in modern society. Hong Kong scholar Yuqing (1997) also studied the connotation of financial centers from a geographical perspective and defined a financial center as a city with extremely high or highest financial efficiency in the region and gathered a large number of financial institutions of various sizes. Financial activities are very active and frequent. Nianlu and Haiping (2008) also studied the functions of financial centers, pointing out that “the financial center is a comprehensive transaction gathering place and the financial activities in the financial center enjoy the unique advantages of low transaction costs and high efficiency.” Financial capital has the characteristics of profit-oriented, so the financial center is sufficient to attract all kinds of financial capital to flow into it, and accordingly, there will be a large number of financial talents gathering here. Based on the analysis of many authoritative definitions of financial centers at home and abroad, a financial center has the following characteristics: "a gathering of resources such as financial institutions, talents, and capital; rapid circulation of funds and information; active financial activities; complete financial services; usually located in a geographic center".

Combining the theories of many scholars, the main characteristics of financial centers can be summarized into the following four points: First, financial centers are usually economic centers or geographic centers; Second, various financial institutions of different sizes will gather and settle in financial centers under the guidance of high profitability.; Third, the financial center has the best-related support facilities, unique policy advantages, and complete financial service functions; Fourth, the financial center can collect and process information efficiently in real-time; The center is the hub of the entire financial system and affects the financial system in the entire region and even outside the region.

The core function of the financial center is the agglomeration function and the radiation function. The two complement each other and are indispensable, fundamentally ensuring the steady and rapid development of the regional economy. The agglomeration function of the financial center is the prerequisite foundation. It helps to establish a growth pole in the region, and only then the subsequent financial radiation function can be produced and played. At the same time, the radiation function is also indispensable. If there is no radiation function, excessive financial agglomeration will lead to waste of resources and inefficiency. Besides, there are information processing functions and innovative functions, both of which help ensure the normal performance of the core functions of the financial center.

Regarding the financial agglomeration, the financial center theory argues that financial centers are usually economic development centers or geographic centers. Various financial institutions and financial resources will flow to the financial center due to the guidance of high profitability, and these financial institutions and financial resources will radiate to the surroundings after agglomeration. In the development process of the financial center, since its economic development level has been higher than that of its surrounding areas, it has prompted the financial capital, financial institutions, and enterprises in the surrounding areas to converge in the financial center under the guidance of high profitability. In the process of large amounts of funds flowing into the financial center, the financial center gradually developing into a substantial capital flow transit point. On one hand, the financial center provides diversified investment channels for the surplus of funds to meet the investment needs of various investors; on the other hand, the financial center also provides various financing channels for the capital demanders to protect business operations. It can be seen that the financial center plays the function of centralized allocation of funds. Through the agglomeration and optimization of funds or resources, the transaction efficiency of various financial participants in the region has been improved, and the economic development of the financial center and surrounding radiation areas has been strongly promoted.

For financial radiation, the financial center is a bridge connecting the financial system inside and outside the central area. It connects various financial institutions inside and outside the area and controls the flow of financial resources. The process from the outside to the inside is the above-mentioned aggregation, and the corresponding process from the inside to the outside is the radiation. From inside the region, some financial institutions with strong and well-developed strengths will use the financial resources attracted by the agglomeration of financial centers to further develop to a certain extent. They will be accompanied by financial development, then radiate to the surrounding areas through multiple channels, drive the development of financial institutions and enterprises in the surrounding areas. Ultimately, they will improve the development level of the entire financial center. For outside the region, better financial institutions or enterprises in the financial center area can promote financial institutions outside the region by opening branches, cooperating with local institutions or enterprises, and providing capital for institutions or enterprises outside the region to push the development of participants in financial activities.

The financial center also has other functions. It plays the role of an information intermediary. By collecting, processing, and disseminating various information, which helps to reduce the asymmetry of information inside and outside the area. Information is extremely important for participants in the entire financial system. For example, financial institutions need to analyze the trading conditions of the financial market and then adopt appropriate business strategies. Regulators need to supervise the operating conditions of various financial activities participants and maintain financial legitimacy and security cannot do without the support of a large amount of information. The development of the financial center provides more channels and opportunities to get information for various participants in financial activities, financial institutions, enterprises, individuals, organizations, and financial markets.

Besides, the long-term development and progress of finance in any region are inseparable from the support of financial reform and innovation. Financial innovation is also a source of power for financial institutions in the region to build their core competitiveness. The financial center is the region with the highest degree of financial development and innovation capability. Also, financial institutions in the financial center will continue to make financial innovations in terms of improving the efficiency of financial services, improving financial service functions, updating financial products and trading methods to maintain their existing advantages. Not only does it significantly improve the innovation capability of the financial center, but also enhances the two core functions of the financial center's agglomeration and radiation.

2.3 The Impact of Financial Integration on Economic Growth

Edison, Levine, Ricci, and Slok (2002) and Eswar (2007) empirically tested the relationship between financial integration and economic growth, and the study found that financial integration can promote economic growth through different channels, as shown in Figure 2.1.

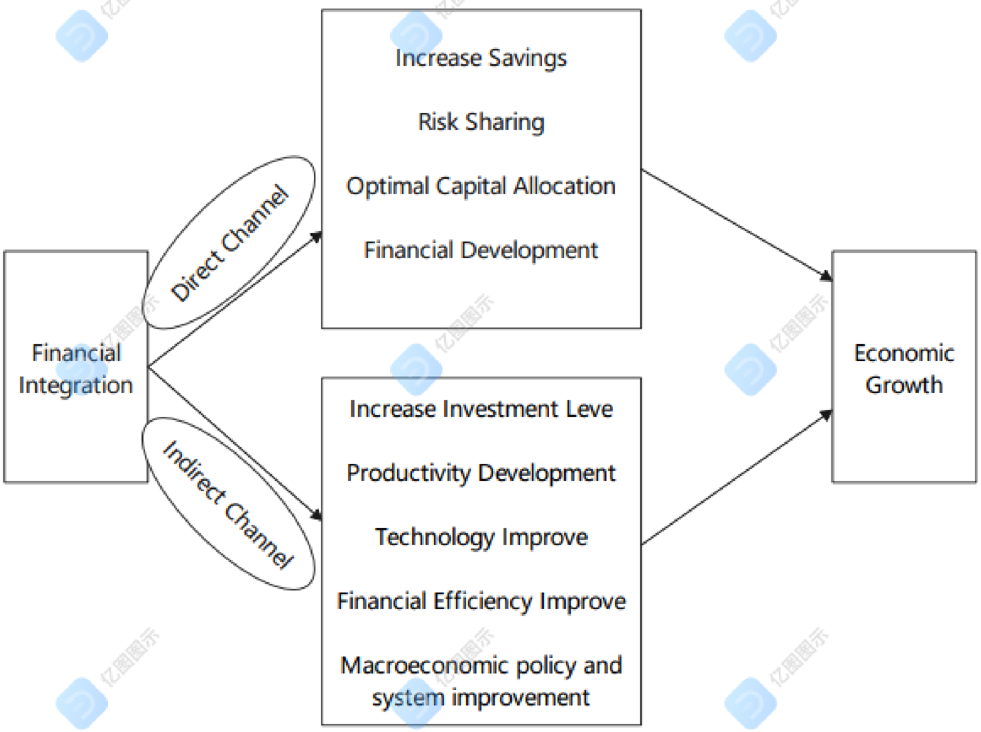

Figure 2.1 The Impact of Financial Integration on Economic Growth

According to the neoclassical economic model, the source of economic growth is mainly technological progress and capital accumulation. Financial integration can gather idle funds, increase savings, and promote the accumulation of capital. At the same time, relaxing the restrictions on capital can make it easier for less developed countries and regions to obtain capital, accelerate economic development, thereby narrowing the gap between economies within the region. In addition to the free flow of capital, financial integration can also trigger the flow of production factors such as information, technology, and labor to sectors that are conducive to social development and economic growth. At the same time, the unrestricted flow of capital, seeking better investment opportunities in the region, improves investment efficiency. Whether it is the development of productivity or the improvement of investment levels, it will ultimately promote economic growth. Furthermore, financial integration provides enterprises, residents, and financial institutions with opportunities for intertemporal risk-sharing and consumption smoothing. The diversified investment portfolio has increased the income levels of enterprises, residents, and financial institutions to a certain extent, thereby promoting economic growth. Besides, while financial integration promotes domestic financial development and improves the financial system, the government formulates reasonable macroeconomic policies based on market conditions, which will help maintain long-term sustainable economic growth.

Different from Edison, Levine, Ricci, Slok and Eswar, Li (2017) believes that financial integration has a positive U-shaped curve for the growth of GDP. The shape of the positive U-shaped curve shows that when the degree of financial agglomeration is low, the agglomeration effects such as the economies of scale of financial agglomeration have not yet occurred, and the real economy and related supporting industries are underdeveloped. And there may even be a phenomenon of relatively excessive financial agglomeration such as the excessive occupation of the already extremely scarce social production factors by the financial industry. At this stage, the financial agglomeration has a negative inhibitory effect on economic growth; After the financial industry agglomeration further increased and exceeded the turning point of the positive U-shaped curve, the financial agglomeration began to play a positive role in promoting economic growth. This is because the financial industry's economies of scale and other agglomeration benefits began to emerge and the financial industry became specialized. With the improvement of the development degree, the ability of financial services to serve the real economy has been enhanced. At the same time, the real economy and supporting industries have developed and improved accordingly. The agglomeration of the financial industry has achieved a coordinated match with the development of the economy, which can further promote regional economic growth.

2.4 The Relationship Between Economic Integration and Financial Integration

Economic integration includes trade integration, financial integration, technological integration, and other factors, among which financial integration is an important part of economic integration. Financial integration is an inevitable product of the development of economic integration to a certain extent, and financial integration has further provided strong support for economic integration. Regional finance and regional economic development interact and influence each other to promote the development process of regional economic integration.

CHAPTER 3

METHODOLOGY

3.1 Selection of Indicators and Data Sources-Financial Agglomeration

From the relevant literature, I can see that the indicators for measuring financial agglomeration cannot be unified. Aiyan and Junming (2008) selected location entropy indicators to analyze the degree of financial agglomeration in the Pearl River Delta region and concluded that the financial agglomeration in the region is the main influencing factors of regional economic development. Xingshan, Zefen, and Hong (2003) selected ten cities in the Yangtze River Delta for analysis using three indicators of financial agglomeration, financial resources, and financial location. They believed that the improvement of regional financial competitiveness depends on the demand for funds and financial services in the process of regional economic development. Policy promotion is also important factor for regional financial development. Based on the above literature and the actual situation of the Chengdu-Chongqing economic circle, this thesis selects 8 indicators to calculate the degree of financial agglomeration, as shown in Table 3.1:

Table 3.1 Selection of Indicators

Indicator name	Indicator code
Local General Public Budget Revenue (100 million yuan)	X_1
Total Deposits of Financial Institutions (100 million yuan)	X_2

Indicator name	Indicator code
Total Loans of Financial Institutions (100 million yuan)	X_3
Premium Income (100 million yuan)	X_4
Total Export-Import Volume (10 thousand dollars)	X_5
Foreign Direct Investment (10 thousand dollars)	X_6
Number of Employees in the Financial Industry（Ten thousand people）	X_7
Financial Interrelations Ratio(%)	X_8

All data are from the China National Bureau of Statistics website (NBS), China Statistical Yearbook (2009-2019), Chongqing Statistical Yearbook (2009-2019), Sichuan Statistical Yearbook (2009- 2019), and China Financial Yearbook (2009-2019).

3.2 Empirical Method of Financial Agglomeration

The current researches on financial agglomeration analysis mainly include three methods: analytic hierarchy process, principal component analysis, and factor analysis. This thesis intends to select principal component analysis to test the degree of financial agglomeration. The principal component analysis method was proposed by Hotelling(1933) with the purpose of "dimensionality reduction". The original indicators are linearly combined and new variables are obtained as indicators. This method can replace more variable information with fewer principal component factor variables, which is generally represented by the following model:

$$X_n = a_{n1}F_1 + a_{n2}F_2 + \cdots + a_{nm}F_m \tag{1}$$

Where

$$F_m = b_{m1}X_1 + b_{m\,2}X_2 + \cdots + b_{mn}X_n \tag{2}$$

At the same time, due to the difference in measurement methods between the variables, the data is standardized here to make the variables comparable.

$$z = \frac{\mathrm{X} - \overline{X}}{S} \tag{3}$$

Where x_t represents the original data, $\overline{X}$ represents the mean value of the sample data, and S represents the standard deviation of the sample data. After this processing, the original variables X_1, X_2, …, X_p ,…X_n. The mean values are 0, and the standard deviation is 1. F_1, F_2,…, F_m are m principal component factor variables, m is less than n.

The main steps for principal component analysis of data are:

1) Test the data to determine whether the original variables are suitable for principal component analysis. Before performing principal component analysis on the data, it is necessary to standardize the original data, and then perform a correlation test, and then use other test methods to determine whether the variable is suitable for principal component analysis. Usually, the inspection methods provided are the KMO test and the Bartlett test. Among them, the KMO test is mainly to analyze the correlation coefficient and partial correlation coefficient between variables. Generally, when the KMO value exceeds 0.5, the group of variables can be considered for principal component analysis, and when it is greater than 0.7, the group is considered variables are suitable for principal component analysis; another method is the Bartlett test, which is used to analyze whether there is a correlation between variables. The covariance matrix whose original hypothesis is the variable is the identity matrix, so it can be concluded that when the null hypothesis is rejected the principal component analysis can be performed.

2) Construct principal component variables. Normally, the selection of the number of principal component factors is determined by the characteristic value and cumulative contribution rate of the factor. Also, try to explain more information with fewer factors. In this thesis, the selection of the number of principal component factors is based on the principle of factor eigenvalue greater than 1 or the cumulative contribution rate exceeds 80 %.

3) Calculate the principal component score. Principal component scoring is an important step in the principal component analysis. It can interpret the information of the original variable in the new variable. By changing the common principal component factor into a linear combination of the original variable, assign a certain value can be assigned to each common principal component. At this time, principal component scores can be used to replace the original data for analysis.

4) The financial agglomeration score selected in this thesis and the financial agglomeration score selected in the relevant literature are respectively brought into the regression equation for comparison, and the most efficient financial agglomeration score is selected as the variable used in this paper.

3.3 Empirical Method of Financial Radiation

The Wilson model is a relatively classic model for studying financial radiation between cities or regions in geographic economics. The Wilson model believes that there are frequent flows of financial resources between two regions, and the two regions can interact with each other in space. This effect is affected by distance as well as the scale of regional development and resources. According to the Wilson model, the resource attraction ability of region j to region k can be expressed as follows:

$$T_{jk} = KO_jD_k \exp\left(-\beta Fin\_radia_{jk}\right) \tag{4}$$

Among them, T_{jk} represents the number of resources attracted by area j from area k, K as a normalization factor, and generally, set it equal to 1, O_j represents the resource intensity of area j, and D_k represents the total financial resources of area k. $\exp(-\beta Fin\_radia_{jk})$ represents the interaction power between city j and city k, Fi_radia represents the financial radiation distance between the two cities and is the attenuation factor.

Zheng (2002) further simplified the Wilson model:

$$T_{jk} = D_k \exp(-\beta Fin\_radia_{jk}) \quad (5)$$

The above formula means that the attractiveness of a city will decrease with distance. Consider θ as threshold value of T_{jk}, which represents the largest radiation power of a city. It is generally believed that if the financial strength of a city decays below this numerical value can be considered that this financial center city does not have a financial radiation effect on places outside its scope.

Take the logarithm of both sides of the above formula and transform it into:

$$Fin\_radia_{jk} = \frac{1}{\beta} \times \ln \frac{D_k}{\theta} \quad (6)$$

This formula can be used to calculate the financial radiation distance between two cities or regions. Furthermore, Wang Zheng (2002) simplified the attenuation factor β as:

$$\beta = \sqrt{\frac{2T}{t_{max}D}} \quad (7)$$

In the above formula, D is the area of the interaction area, and T is the average number of transfer factors in the area, and t_{max} is the maximum number of cities with diffusion function in the element.

3.4 Panel Regression Analysis Method of the Relationship between Financial Integration and Economic Growth in the Chengdu-Chongqing Economic Circle

Finance serves the economy and plays a very important role in the development of the modern economy. This thesis applies the time series method to analyze the relationship between financial integration and economic growth in the Chengdu-Chongqing Economic Circle, to explore the functions and effects of financial integration in serving the real economy, which has certain practical significance.

The classic Cobb-Douglas production function is the most widely used form of production function in economics. This section refers to the Cobb-Douglas production function to construct an economic growth model. At the same time, in order to eliminate the influence of the autocorrelation and heteroscedasticity existing in the equation on the regression results, I change the variables to logarithmic form.

Taking into account the non-linear relationship between financial industry agglomeration and economic growth, the first and square terms of the financial agglomeration index to measure the degree of financial industry agglomeration are added. The model of this thesis is set as:

$$
\begin{aligned}
\ln GDP_{it} = {} & A_0 + A_1 \ln Fin\_agglo_{it} + A_2 \ln Fin\_radia_{it} + A_3 \ln K_{it} + A_4 \ln L_{it} \\
& + A_5 \ln Uni\_stu_{it} + A_6 \ln Patent_{it} + A_7 \ln R\_d_{it} \\
& + A_8 (\ln Fin\_agglo)^2{}_{it} + \mu_{it}
\end{aligned}
$$

The explained variable GDP: Real GDP of each city. Real GDP is an inflation-adjusted measure that reflects the value of all goods and services produced by an economy in a given year. Therefore, real GDP makes comparing GDP from year to year and from different years more meaningful because it shows comparisons for both the quantity and value of goods and services.

Explanatory variable Fin_agglo: The financial agglomeration score of each city is added to the model as an explanatory variable of the study. For specific calculation methods and calculation results, please refer to the "Empirical Analysis of Financial Agglomeration" in this thesis.

Explanatory variables Fin_radia: The financial radiation of each city is added to the model as the explanatory variables of the study. For the specific calculation methods and calculation results, please refer to the "Empirical Analysis of Financial Radiation" in this thesis.

Control variable K: The amount of capital stock. The calculation method of capital stock is based on the method proposed by Zhang Jun (2020) , and it is added to the model based on the Cobb-Douglas production function.

Control variable L: The sum of the number of employees in the three major industries in each city. The total number of employees in the primary, secondary, and tertiary industries in each city represents the level of human capital, that is labor input, and is added to the model based on the Cobb-Douglas production function.

Control variable Uni_stu: The number of university students in each city. According to relevant literature, the number of university students can better measure the level of education. Education can promote the development of the regional economy. I put it into the model as a control variable.

Control variable $Patent$: The number of approved patents in each city. The biggest feature of patents is innovation, it represents the result of innovation. Innovation can promote the development of the regional economy. I put it into the model as a control variable.

Control variable R_D: R&D expenditure of each city. Expenditure for research and development can promote the development of technology. Technology is the primary productive force, and technology is one of the most important factors driving economic growth. I put it into the model as a control variable.

This part uses 10-year panel data from 16 cities in the Chengdu-Chongqing Economic Circle to conduct an empirical analysis. All data are from the statistical yearbooks of each city, and Stata 15.1 is used to analyze the data.

3.5 Spatial Panel Regression Analysis Method of the Relationship between Financial Integration and Economic Growth in the Chengdu-Chongqing Economic Circle

When analyzing economic problems with spatial effects, traditional regression models may have large errors between the results and actual results. Spatial econometric models can allow us to circumvent this problem. It can solve the problem of spatial correlation, which is an improvement on the traditional measurement model. Spatial econometrics is the measurement of spatial economy. Traditional econometric methods are helpless when solving spatial problems that need to consider geographical factors. However, spatial econometrics can give play to its strengths. In this thesis, the theory of financial center points out the radiating impact across regions which naturally calls for the spatial regression analysis.

The theory believes that spatial data has its unique characteristics. It is spatially interdependent. This feature makes the analysis of spatial data different from traditional quantitative analysis methods.

This section uses the same data as in the previous section and designs a spatial measurement model based on spatial considerations, then analyzes the relationship between financial integration and economic growth.

Currently, the following three spatial panel regression models are mainly used:

Spatial Autoregressive Model (SAR)

$$y = \rho W_1 y + X\beta + \varepsilon, \varepsilon \sim N(0, \sigma^2 I_n) \tag{8}$$

Among them, y is the dependent variable, X is the explanatory variable and control variable, W is the spatial weight matrix. ρ is the coefficient of the spatially lagging dependent variable $W_1 y$, which is used to express whether there is a significant spatial correlation between different sample individuals, and β reflects the influence of the explanatory variable on the dependent variable y.

When $W_1 = 0$ in SAR model, will get Spatial Error Model (SEM)

$$y = X\beta + \xi \,, \xi = \lambda W_2 \xi + \varepsilon \tag{9}$$

Unlike the SAR, the spatial correlation between different units in the SEM is not manifested in the spatial lag of the explained variable but manifested in the model error.

Spatial Durbin Model (SDM)

Based on the SAR and SEM, the SDM adds the spatial lag term of the explanatory variable and the spatial lag term of the dependent variable.

$$y = \rho W y + X\beta + WX\theta + \varepsilon, \varepsilon \sim N(0, \sigma^2 I_n) \tag{10}$$

Compared with the SAR and SEM, the SDM can express the dependence of independent variables and dependent variables between regions.

CHAPTER 4

EMPIRICAL ANALYSIS

4.1 Empirical Analysis of Financial Agglomeration

First, a descriptive statistical analysis is performed on all selected indicator data. The results are shown in Table 4.1.

Table 4.1 Descriptive Statistics

Var	Obs	Mean	Std. Dev.	Min	Max
X_1	160	242.3366	496.818	15.65	2265.54
X_2	160	4903.943	9126.876	454	40029.37
X_3	160	3613.584	7798.923	221.19	37142.16
X_4	160	100.2715	185.9264	9.25	951.05
X_5	160	781118.2	2018309	1333	9545024
X_6	160	115489.1	301026.5	241	1227500
X_7	160	2.0856	3.248366	.176	15.19
X_8	160	2.423563	0.7270604	1.32	5.02

This part uses SPSS17.0 to analyze the data of 16 cities and obtains the empirical results of Principal Component Analysis. The first step is to standardize the original data, then perform the KMO test and the Bartlett test to analyze whether the variables are suitable for the Principal Component Analysis method.

Table 4.2 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.830
Bartlett's Test of Sphericity	Sig.	0.000

It can be seen from Table 4.2 that its KMO value is 0.830, and the Bartlett test is also statistically significant. As a result, this set of data is suitable for Principal Component Analysis. Through Principal Component Analysis of the standardized data, principal components of this input set are calculated. Their eigenvalues, variance contribution rate, and cumulative variance contribution rate are shown in Table 4.3.

Table 4.3 Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.631	95.386	95.386	7.631	95.386	95.386
2	0.336	4.195	99.581	0.336	4.195	99.581
3	0.022	0.279	99.860			
4	0.008	0.104	99.964			
5	0.002	0.028	99.993			
6	0.000	0.005	99.997			
7	0.000	0.002	99.999			
8	7.339 E-05	0.001	100.000			

It can be seen from Table 4.3 that the cumulative variance contribution rate of the first two principal components obtained is 99.581%, Component 1 is 95.386% and Component 2 is 4.195%. The cumulative percentage of principal component 1 is higher, and I will further compare these two principal components to find the principal component that best fits the theory of financial agglomeration.

Table 4.4 Component Matrix

Var	Component 1	Component 2
X_1	0.973	-0.199
X_2	0.998	-0.044
X_3	0.999	-0.044
X_4	0.998	-0.042
X_5	0.998	-0.041
X_6	0.996	0.034
X_7	0.990	-0.116
X_8	0.851	0.624

It can be seen from Table 4.4 that the correlation between each component and the original variable, and from this, component 1 mainly contains most of the original variable information. Component 2 only contains extremely low information. So, in this thesis I choose principal component 1 to represent the degree of financial agglomeration.

Table 4.5 Component Score Coefficient Matrix

Var	Component 1
X_1	0.128
X_2	0.131

Var	Component 1
X_3	0.131
X_4	0.131
X_5	0.131
X_6	0.131
X_7	0.130
X_8	0.111

Combining the component score coefficient matrix Table 4.5, the financial agglomeration score of each city can be calculated.

$$F = 0.128 \times X_1 + 0.131 \times X_2 + 0.131 \times X_3 + 0.131 \times X_4 + 0.131 \times X_5 + 0.131 \times X_6 + 0.130 \times X_7 + 0.111 \times X_8$$

The financial agglomeration score F is the standardized financial agglomeration score, which is greater than 0 above the average, and less than 0 is below the average. In this thesis, in order to avoid log being 0, add 2 to financial agglomeration F score, and bring it into the model for regression.

$$Fin\_agglo = F + 2$$

At the same time, we use indicators selected by relevant literature to get：

$$Fin\_agglo2 = F2 + 2$$

I can see from Table 4.3, Table 4.4, and Table 4.5 that component 1 contains most of the elements and has a positive effect on financial agglomeration. Here I consider choosing component 1 to represent the degree of financial agglomeration. The results are shown in Table 4.6.

Table 4.6 Financial Agglomeration Score of Chengdu and Chongqing

Years\Cities	Chengdu	Chongqing
2010	2.3502	2.5845
2011	2.3779	2.3205
2012	2.2920	2.3678
2013	2.3655	2.4905
2014	2.3077	2.4244
2015	2.2470	2.3949
2016	2.2397	2.4592
2017	2.3963	2.4406
2018	2.5661	2.3771
2019	2.3502	2.3132

4.2 Empirical Analysis of Financial Radiation

According to the Wilson model (6) and (7), when studying the financial radiation in the Chengdu-Chongqing Economic circle, the area D of the interaction area is represented by the average administrative land area of the 16 sample cities in the city circle, and T is represented by the number of sample cities. t_{max} is represented by the number of cities in the sample with financial radiation power.

According to the relevant data of Sichuan and Chongqing Municipal Statistical Yearbook, the average administrative land area of 16 cities in the Chengdu-Chongqing Economic circle is 14,971.75 square kilometers, that is, $D = 14971.75$. Obviously, here $T = 16$ and $t_{max} = 2$. Substituting the values of D, T and t_{max} into the above equation, the attenuation factor β =0.0327 is obtained.

Regarding existing research, this thesis also selects principal component scores to represent the financial resource intensity D_K of the financial center city. Taking 2019 as an example, Chengdu City $D_K = 2.4937$, Chongqing City $D_K = 2.6210$, assuming the threshold $\theta = 0.01$, The β, specific values of D_K and θ are substituted into the above formula.

I can get the financial radiation radius of Chengdu and Chongqing, the financial center cities of the Chengdu-Chongqing Economic Circle. The results are shown in Table 4.7.

For cities where there is no financial radiation, its radiation radius is zero. In this thesis, in order to avoid log being 0, financial radiation radius is added by 1, and then it is brought into the model for regression.

$$Fin\_radia = R_{jk} + 1$$

Table 4.7 The Financial Radiation Radius of Chengdu and Chongqing(km)

Years	Chengdu	Chongqing
2010	165.35	172.86
2011	165.50	172.78
2012	164.34	173.48
2013	166.07	172.41
2014	164.78	173.26
2015	163.24	174.11
2016	162.99	174.26

Years	Chengdu	Chongqing
2017	165.04	173.11
2018	168.45	170.60
2019	168.77	170.30

4.3 Panel Regression Analysis of the Relationship between Financial Integration and Economic Growth in the Chengdu-Chongqing Economic Circle

4.3.1 BP Test and Hausman Test

First, according to the selected model and data, use the BP test to compare the mixed OLS model and the random effect model which is better. The null hypothesis of the BP test is that there is no random effect. The test results are shown in Table 4.8:

Table 4.8 BP Test

BP Test:	Prob = 0.0000

From the P-value of Table 4.8, it can be seen that the null hypothesis should be rejected, and the test concludes that the random-effects model is better than the mixed OLS effects model.

Next, use the Hausman test to determine whether the fixed effects model or the random-effects model is better. The original hypothesis of the Hausman test is that there is no essential difference between random effects and fixed effects (that is, random effects can be used). The test results are shown in Table 4.9:

Table 4.9 Hausman Test

Hausman Test:	Prob = 0.0000

From the P-value of Table 4.9, it can be seen that the null hypothesis should be rejected, and a test concludes that the fixed effects model is better than the random effects model.

Combining the results of the above-mentioned BP test and the Hausman test, it can be seen that among the mixed OLS model, fixed-effect model, and random-effect model, the fixed-effect model should be the best model for this study.

4.3.2 Regression

First, a descriptive statistical analysis is performed on all selected variables. The results are shown in Table 4.10.

Table 4.10 Descriptive Statistics

Var	Obs	Mean	Std. Dev.	Min	Max
GDP	160	2.68e+07	4.42e+07	2967100	2.36e+08
Fin_agglo	160	2.000187	9126.876	1.49	4.58
Fin_radia	160	22.13563	56.11271	1	175.26
K	160	1.94e+07	3.26e+7	2433200	1.75e+08
L	160	3514722	3777427	952800	1.72e+07
Uni_stu	160	138695	277650.1	200	1111900
$Patent$	160	5110.188	11642.71	74	57460
R_d	160	401187.9	808680.2	5287	4102094

According to the "4.3.1 BP test and Hausman test", the fixed effects model is the optimal model studied in this thesis. Therefore, this section will analyze and calculate based on the regression results of the fixed effects model and obtain empirical conclusions.

First, perform regression on all selected control variables to see the relationship between them and the explained variables.

$$\ln GDP_{it} = A_0 + A_3 \ln K_{it} + A_4 \ln L_{it} + A_5 \ln Uni\_stu_{it} + A_6 \ln P_{it} + A_7 \ln R\_d_{it} + \mu_{it}$$

Table 4.11 Fixed Effect Model Regression of Control Variables

Var.	Coef.	Std. Err.	t	P>|t|
$\ln K$	0.0446684	0.0220812	2.02	0.045
$\ln L$	0.4250199	0.0883453	4.81	0.000
$\ln Uni\_stu$	-0.305703	0.0155484	-1.97	0.051
$\ln Patent$	-0.0591429	0.0171614	-3.45	0.001
$\ln R\_d$	0.0216924	0.0110444	1.96	0.052
_cons	11.18218	1.54656	7.23	0.000

I can see from Table 4.11 that all the control variables are significant at the 10% level, but the coefficients of control variables the number of university students and the number of approved patents are negative, showing a negative correlation.

$$\ln GDP_{it} = A_0 + A_1 \ln Fin\_agglo_{it} + A_2 \ln Fin\_radia_{it} + A_3 \ln K_{it} + A_4 \ln L_{it} + A_5 \ln Uni\_stu_{it} + A_6 \ln Patent_{it} + A_7 \ln R\_d_{it} + A_8 (\ln Fin\_agglo)^2{}_{it} + \mu_{it}$$

Table 4.12 Fixed Effect Model Regression

Var.	Coef.	Std. Err.	T	P>|t|
$\ln Fin\_agglo$	-0.3382536	0.6815576	-0.50	0.621
$\ln Fin\_radia$	2.221112	2.53019	0.88	0.382
$\ln K$	0.0820055	0.0264272	3.10	0.002
$\ln L$	0.4126797	0.0868071	4.75	0.000
$\ln Uni\_stu$	-0.0378805	0.0195077	-1.94	0.054
$\ln Patent$	-0.0562386	0.015995	-3.52	0.001
$\ln R\_d$	0.0230062	0.0102167	2.25	0.026
$(\ln Fin\_agglo)^2$	-0.1666998	0.625835	-0.27	0.790
_cons	0.369527	11.63596	0.03	0.975

I can see from Table 4.12 that the significance and positive and negative correlations of all control variables do not change. But the explanatory variable is not significant. According to the relevant literature, the variance inflation factor of financial agglomeration and financial radiation is tested, and it find that financial agglomeration and financial radiation has strong multicollinearity. Stepwise regression is performed in Table 4.13.

$$\ln GDP_{it} = A_0 + A_1 \ln Fin\_agglo_{it} + A_3 \ln K_{it} + A_4 \ln L_{it} + A_5 \ln Uni\_stu_{it} + A_6 \ln P_{it} + A_7 \ln R\_d_{it} + A_8 (\ln Fin\_agglo)^2{}_{it} + \mu_{it}$$

Table 4.13 Stepwise Fixed Effect Model Regression

Var.	Coef.	Std. Err.	t	P>|t|
$\ln Fin\_agglo$	-0.8653212	0.278861	-3.10	0.002
$\ln K$	0.0810906	0.0263235	3.08	0.003
$\ln L$	0.3921996	0.0821816	4.77	0.000

Var.	Coef.	Std. Err.	t	P>|t|
$\ln Uni\_stu$	-0.037243	0.0184591	-2.02	0.046
$\ln Patent$	-0.053201	0.0157987	-3.37	0.001
$\ln R\_d$	0.0224909	0.0102776	2.19	0.030
$(\ln Fin\_agglo)^2$	0.3211101	0.1631733	1.97	0.051
_cons	11.75507	1.418602	8.29	0.000

I see that the explanatory variable financial radiation is eliminated, and all the remaining explanatory variables and control variables are significant at the 10% level.

$$\ln GDP_{it} = A_0 + A_2 \ln Fin\_radia_{it} + A_3 \ln K_{it} + A_4 \ln L_{it} + A_5 \ln Uni\_stu_{it} + A_6 \ln Patent_{it} + A_7 \ln R\_d_{it} + \mu_{it}$$

Table 4.14 Fixed Effect Model Regression of Financial Radiation

Var.	Coef.	Std. Err.	t	P>|t|
$\ln Fin\_radia$	0.5562754	0.9707879	0.57	0.568
$\ln K$	0.0440097	0.0221683	1.99	0.049
$\ln L$	0.418108	0.0893901	4.68	0.000
$\ln Uni\_stu$	-0.0310478	0.015611	-1.99	0.046
$\ln Patent$	-0.05895	0.0172092	-3.43	0.001
$\ln R\_d$	0.0218168	0.0110752	1.97	0.051
_cons	8.459466	4.998159	1.69	0.093

I can see from Table 4.14 that all control variables are significant at the 10% level, but financial radiation is not significant. Combining relevant literature, I can see that financial radiation does not play a role in promoting economic growth. Financial integration promotes economic growth mainly due to the impact of financial agglomeration.

Since the number of university students and the patents may lag behind the promotion of technology and GDP, the lag term is brought into the model for regression. The regression results show that the two variables are not significant. The data selected in this thesis is the data of the Chengdu-Chongqing Economic Circle in the past 10 years, the impact of the number of college students and patents on GDP may be more lagging. Relevant data does not support further research on these two variables, so this thesis eliminates these two variables and then performs regression again.

$$\ln GDP_{it} = A_0 + A_1 \ln Fin\_agglo_{it} + A_3 \ln K_{it} + A_4 \ln L_{it} + A_5 \ln Uni\_stu_{it} + A_6 \ln Patent_{it} + A_7 \ln R\_d_{it} + A_8 (\ln Fin\_agglo)^2{}_{it} + \mu_{it}$$

Table 4.15 Fixed Effect Model Regression Without U Z

Var.	Coef.	Std. Err.	t	P>|t|
$\ln Fin\_agglo$	-0.927084	0.2634072	-3.52	0.001
$\ln K$	0.0820667	0.026555	3.09	0.002
$\ln L$	0.4225968	0.0778691	5.43	0.000
$\ln R\_d$	0.0262684	0.0105658	2.49	0.014
$(\ln Fin\_agglo)^2$	0.3733239	0.1533304	2.43	0.016
_cons	5.742336	1.091647	5.26	0.000

In the regression results of Table 4.15, the regression coefficients of all explanatory variables and control variables are significant at the 5% level. Among them, the coefficient of the square term of financial agglomeration is positive and of financial agglomeration is negative, which shows that financial industry agglomeration has a significant impact on the growth of the city's economy, and the regression curve is an upward parabola, showing a positive U-shaped relationship between the two. The shape of the positive U-shaped curve shows that when the degree of urban financial industry agglomeration is low, the agglomeration effects such as the economies of scale of financial agglomeration have not yet occurred, and the real economy and related supporting industries are underdeveloped. And there may even be a phenomenon of relatively excessive financial agglomeration such as the excessive occupation of the already extremely scarce social production factors by the financial industry. At this stage, the financial agglomeration has a negative inhibitory effect on economic growth; After the financial industry agglomeration further increased and exceeded the turning point of the “positive U-shaped” curve, the financial industry agglomeration began to play a positive role in promoting economic growth. This is because the financial industry’s economies of scale and other agglomeration benefits began to emerge and the financial industry became specialized. With the improvement of the development degree, the ability of financial services to serve the real economy has been enhanced. At the same time, the real economy and supporting industries have developed and improved accordingly. The agglomeration of the financial industry has achieved a coordinated match with the development of the city's economy, which can further promote regional economic growth.

Among the control variables, the regression coefficients of capital stock, labor input, and R&D expenditure are also significant at the 5% level, and their coefficients are all positive values, indicating that capital stock, labor input, and R&D expenditure have a positive impact on the cities GDP in the Chengdu-Chongqing Economic Circle. It is necessary to further increase technological research and development, optimize capital investment, and enhance the quality and ability of the labor and forced to give full play to their role in driving economic growth.

However, ordinary panel regression cannot discover the spatial relationship of financial integration, so I introduce a spatial measurement model for analysis in the next section.

4.4 Spatial Panel Regression Analysis of the Relationship between Financial Integration and Economic Growth in the Chengdu-Chongqing Economic Circle

4.4.1 Setting of Spatial Weight Matrix

In spatial econometrics, the setting of spatial weight matrix is very important, which can quantitatively display the spatial relationship of geographical location elements which is the precondition of spatial autocorrelation analysis. To carry out the spatial autocorrelation test, the spatial weight matrix must be determined first. There are many measurement methods of the spatial weight matrix. Based on relevant research, this section considers to constructing the spatial distance weight matrix for 16 cities.

$$W_i = \text{ spatial distance weight matrix}$$

4.4.2 Spatial Autocorrelation Analysis

Spatial autocorrelation is a measure of the degree of numerical aggregation in space. In this section, Lagrange Multiplier Test and its Robust test method are used. Anselin (1996) developed the SAR and the SEM based on cross-sectional data. Based on this, he proposed the LM test and its Robust test method. After that, Anselin (2004) further extended the LM test to the framework of the spatial panel model. Elhorst (2010) gave the LM test statistics of the SAR and the SEM. If both LM-lag and LM-error are not significant, then consider that there is no spatial autocorrelation; if both LM-lag and LM-error are significant, then consider the SDM. If the significance level of LM-lag is higher than LM-error, and Robust LM-lag is significant but Robust LM-error is not significant, the SAR should be selected; if the significance level of LM-error is higher than LM-lag, and Robust LM-error is significant but Robust LM-lag is not significant, then it should be used the SEM.

Table 4.16 LM and RLM Inspection Results

Test	Statistic	P-value
Spatial error:		
Lagrange multiplier	2.853	0.091
R Lagrange multiplier	10.833	0.001
Spatial lag:		
Lagrange multiplier	15.885	0.000
R Lagrange multiplier	23.864	0.000

According to the LM and RLM test results of Table 4.16, it can be known that the LM and RLM results have passed the robust test at a significance level of 10%. The selected model has spatial autocorrelation, and the SDM is considered.

4.4.3 Selection of Spatial Regression Model

Since the SAR and the SEM are special forms of the SDM, in order to further verify the selection of the spatial regression model, the LR test and Wald test are introduced here to confirm whether the SDM can be reduced to the SEM or the SAR.

Table 4.17 LR Test and Wald Test

	P-value
LR_spatial_lag	0.0000
LR_spatial_error	0.0000
Wald_spatial_lag	0.0000
Wald_spatial_error	0.0880

Wald and LR test results of Table 4.17 show that the simplification of the SDM to the SAR rejects the null hypothesis. The simplification of the SDM to the SEM also rejects the null hypothesis. Therefore, choosing the SDM for the empirical analysis is sound.

4.4.4 Regression of Spatial Durbin Model

For panel data, it is necessary to use Hausman's test to determine the fixed effects and random effects of the spatial panel model. Fixed effects are divided into space fixed effects, time fixed effects, and time and space fixed effects. Among them, the spatial fixed effect measures the geographic and spatial characteristics, reflecting the interaction of the spatial dimensions between various variables; the temporal fixed effect measures the phase characteristics of time, reflecting the interaction of the time dimensions between the various variables; time and space two-way fixed effects consider the effects of space and time dimensions at the same time.

After regression of the three models, the coefficient of determination R^2 and the modified coefficient of determination R^2_{corr} of the SDM under the two-way fixed effects of time and space are 0.9755 and 0.9292, respectively, which are larger than those of the SDM under the fixed effects of time or space. The log-likelihood function also shows the same trend. The value of the log-likelihood function under the two-way fixed effect of time and space is 323.83, which is much larger than the fitting values of other SDM. Therefore, the SDM under the two-way fixed effects of time and space can be used for further analysis. The regression results of the model are shown in Table 4.18.

$$
\begin{aligned}
\ln GDP_{it} = \rho \sum_{i=1}^{16} W_i \ln GDP_{it} &+ \beta_1 \ln Fin\_agglo_{it} + \beta_2 \ln Fin\_radia_{it} + \beta_3 \ln K_{it} \\
&+ \beta_4 \ln L_{it} + \beta_5 \ln Uni\_stu_{it} + \beta_6 \ln Patent_{it} + \beta_7 \ln R\_d_{it} \\
&+ \beta_8 (\ln Fin\_agglo)^2{}_{it} + \varepsilon_{it}
\end{aligned}
$$

Table 4.18 Spatial Fixed Effects Regression

Var.	Coef.	Std. Err.	z	P>|z|
$\ln Fin\_agglo$	-0.7188333	0.6230527	-1.15	0.249
$\ln Fin\_radia$	1.445108	2.1694	0.67	0.505
$\ln K$	0.0659065	0.0250426	2.63	0.008
$\ln L$	0.3276764	0.0890344	3.68	0.000
$\ln Uni\_stu$	-0.0416691	0.0140515	-2.97	0.003
$\ln Patent$	-0.0683912	0.0155014	-4.41	0.000
$\ln R\_d$	0.036006	0.0102466	3.51	0.000
$(\ln Fin\_agglo)^2$	-0.0799975	0.4885108	-0.16	0.870
Spatial effect				
$\ln GDP$	0. 6619503	0.054846	12.07	0.000

I can see from Table 4.18 that the regression results of spatial SDM are consistent with the results of ordinary panel regression. Due to the existence of multicollinearity, the significance of the explanatory variables has been affected.

$$\ln GDP_{it} = \rho \sum_{i=1}^{16} W_i \ln GDP_{it} + \beta_1 \ln Fin\_agglo_{it} + \beta_3 \ln K_{it} + \beta_4 \ln L_{it} + \beta_5 \ln Uni\_stu_{it} + \beta_6 \ln Patent_{it} + \beta_7 \ln R\_d_{it} + \beta_8 (\ln Fin\_agglo)^2{}_{it} + \varepsilon_{it}$$

Table 4.19 Stepwise Spatial Fixed Effects Regression

Var.	Coef.	Std. Err.	z	P>|z|
$\ln Fin\_agglo$	-1.082753	0.3223713	-3.36	0.001
$\ln K$	0.0655736	0.0250086	2.62	0.009
$\ln L$	0.3137481	0.0873137	3.59	0.000

Var.	Coef.	Std. Err.	z	P>|z|
$\ln Uni\_stu$	-0.0409998	0.0140358	-2.92	0.003
$\ln Patent$	-0.0666936	0.015353	-4.34	0.000
$\ln R\_d$	0. 355153	0.0102294	3.47	0.001
$(\ln Fin\_agglo)^2$	0.5976412	0.2326228	2.57	0.010
Spatial effect				
$\ln GDP$	0.6661876	0.0538609	12.37	0.000

I can see from Table 4.19 that the financial radiation is eliminated after the stepwise regression, and all other variables are significant at the 5% level. Financial agglomeration , the number of university students and the number of approved patents show a negative correlation, which is consistent with the results of the ordinary panel.

Since the number of university students and the patents may lag behind in promoting economic development, the lag term is brought into the model for regression. The regression results show that the two variables are not significant. The data selected in this thesis is the data of the Chengdu-Chongqing Economic Circle in the past 10 years, the impact of the number of college students and patents on GDP may be more lagging. Relevant data does not support further research on these two variables, so this thesis eliminates these two variables and then performs regression again.

$$\ln GDP_{it} = \rho \sum_{i=1}^{16} W_i \ln GDP_{it} + \beta_1 \ln Fin\_agglo_{it} + \beta_3 \ln K_{it} + \beta_4 \ln L_{it} + \beta_7 \ln R\_d_{it} + \beta_8 (\ln Fin\_agglo)^2{}_{it} + \theta_1 \sum_{i=1}^{16} W_i \ln Fin\_agglo_{it} + \theta_8 \sum_{i=1}^{16} W_i (\ln Fin\_agglo)^2{}_{it} + \varepsilon_{it}$$

Table 4.20 Spatial Fixed Effects Regression without University Students and Patents

Var.	Coef.	Std. Err.	z	P>|z|
$\ln Fin\_agglo$	-1.191159	0.3502316	-3.40	0.001
$\ln K$	0.0755266	0.0269789	2.80	0.005
$\ln L$	0.3788984	0.0853445	4.44	0.000
$\ln R\_d$	0.0410172	0.0109507	3.75	0.000
$(\ln Fin\_agglo)^2$	0.6314574	0.2551261	2.48	0.013
Spatial effect				
$\ln GDP$	0.6033308	0.0586069	10.29	0.000
$\ln Fin\_agglo$	-2.03437	0.8470169	-2.40	0.016
$(\ln Fin\_agglo)^2$	0.4460451	0.2279894	1.96	0.050

In order to further explore the spatial effects of financial agglomeration, we will construct a financial radiation weight matrix based on the financial radiation radius in Table4.7.

$$W_f = \text{ financial radiation weight matrix}$$

$$\ln GDP_{it} = \rho \sum_{i=1}^{16} W_i \ln GDP_{it} + \beta_1 \ln Fin\_agglo_{it} + \beta_3 \ln K_{it} + \beta_4 \ln L_{it}$$

$$+ \beta_7 \ln R\_d_{it} + \beta_8 (\ln Fin\_agglo)^2{}_{it} + \theta_1 \sum_{i=1}^{16} W_f \ln Fin\_agglo_{it}$$

$$+ \theta_8 \sum_{i=1}^{16} W_f (\ln Fin\_agglo)^2{}_{it} + \varepsilon_{it}$$

Table 4.21 Spatial Fixed Effects Regression with Double Weight Matrix

Var.	Coef.	Std. Err.	z	P>|z|
$\ln Fin\_agglo$	-1.624495	0.539123	-3.01	0.003
$\ln K$	0.3038198	0.0325725	9.33	0.000
$\ln L$	0.534826	0.1452069	3.68	0.000
$\ln R\_d$	0.0891426	0.0151937	5.87	0.000
$(\ln Fin\_agglo)^2$	0.3905987	0.4078569	0.96	0.034
Spatial effect				
$\ln GDP$	0.0796034	0.0113518	7.01	0.000
$\ln Fin\_agglo$	-0.6105676	0.4823356	-1.27	0.008
$(\ln Fin\_agglo)^2$	0.4362654	0.2503802	1.74	0.084

Analyzing the regression results of the SDM under the two-way fixed effects of time and space. Table 4.20 and Table 4.21 shows that at the level of 5%, the GDP of each city in the region is not only affected by variables such as the degree of financial agglomeration, capital stock, labor force, and R&D expenditure in the region, but also by the GDP and explanatory variables of the neighboring region.

First of all, consistent with the results of the ordinary panel regression, the coefficient of the square term of financial agglomeration is positive and financial agglomeration is negative, which shows that financial industry agglomeration has a significant impact on the growth of the city's economy, and the regression curve is an upward parabola, showing a positive U-shaped relationship between the two. Among the control variables, the regression coefficients of capital stock, labor force, and R&D expenditure are also significant at the 5% level, and their coefficients are all positive values, indicating that capital stock, labor force, and R&D expenditure have a positive impact on the cities GDP in the Chengdu-Chongqing Economic Circle.

Second, the spatial effect coefficient of GDP on this region is 0.6033 which pass the significance test at the 1% level, indicating that GDP has obvious spillover effects between regions. The GDP of neighboring cities can have a positive impact on the GDP of the city. That is, areas with higher GDP like the surrounding areas invest resources to drive economic growth to form the GDP development of the entire region, and the spillover effect of the GDP of each city has a direct impact on the GDP of the surrounding cities. Due to the geographical proximity, there are more possibilities for direct communication, which creates a competitive advantage in terms of efficiency and benefit, realizes economies of scale, and promotes the growth of the entire region's GDP.

Final, the square term of the degree of financial agglomeration of neighboring cities has a positive influence on the GDP of the city, and the degree of financial agglomeration of neighboring cities has a negative influence on the GDP of the city. This shows that when the degree of financial agglomeration is not enough, the financial agglomeration of neighboring cities will absorb a certain city's resources, which will hinder the city's GDP to a certain extent. When the financial agglomeration in the surrounding cities has formed a scale, the financial agglomeration in the surrounding cities will drive the GDP and the development of financial resources in the city. The regression curve is an upward parabola, showing a "positive U-shaped" relationship. I can see from Figure 4.1 that only Chengdu and Chongqing located on the right side of the U-shaped curve which show a positive effect.

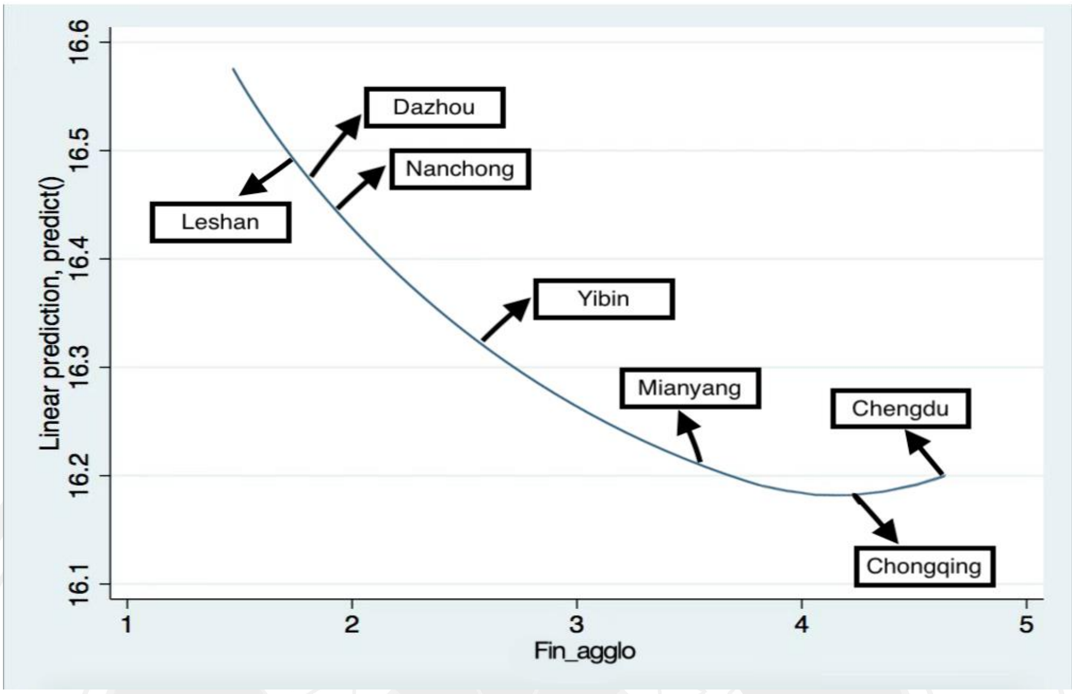

Figure 4.1 The impact of financial agglomeration in the central and sub-central cities of the Chengdu-Chongqing Economic Circle on GDP (2019)

4.5 Performance of the Newly Proposed Financial Agglomeration Calculation.

This section aims to evaluation the performance of the newly proposed financial agglomeration indicator used in this thesis. Recall that in there are two financial agglomeration indicators defined in Section 4.1: Fin_agglo and Fin_agglo2 are respectively calculated from the set of inputs newly proposed here and the set of inputs previously proposed in the literature. The strategy is to compare their outputs of regression on GDP to see the difference and judge them based on the theoretical basis.

Table 4.22 Regression Using the Financial Agglomeration Indicator Calculated from Inputs Suggested by the Literature

Var.	Coef.	Std. Err.	z	P>|z|
$\ln Fin\_agglo\,2$	1.898152	1.432684	1.32	0.185
$\ln K$	0.2208148	0.0701331	3.15	0.002
$\ln L$	0.3788129	0.0828695	4.57	0.000
$\ln R\_d$	0.0418023	0.0108305	3.86	0.000
$(\ln Fin\_agglo2)^2$	-0.5786091	0.5624811	-1.03	0.304
Spatial effect				
$\ln GDP$	0.6096726	0. 0582195	10.47	0.000
$\ln Fin\_agglo2$	-18.19617	3.386648	-5.37	0.000
$(\ln Fin\_agglo2)^2$	6.836196	1.308359	5.23	0.000

I can see from Table 4.21 that the financial agglomeration and the square of financial agglomeration in this region are not significant. The financial agglomeration and the square of financial agglomeration of the surrounding cities have an impact on GDP, and it conforms to a positive u-shaped curve. However, the regression results of the financial agglomeration indicators selected in this thesis show that both the financial agglomeration in the region or the financial agglomeration in surrounding cities have a positive U-shaped curve in terms of their impact on the region's GDP. Compared with related literature, the indicators selected in this thesis not only confirm the influence of financial agglomeration in the city on GDP, but also the influence of financial agglomeration in surrounding cities on GDP. This result enriches the relevant theories.

In summary, I can say that the financial agglomeration indicators calculation selected in this thesis is richer than the financial agglomeration calculation indicators recommended in the relevant literature and more effective. Therefore, I use the financial agglomeration calculation indicators selected in this thesis as the basis for analysis and research.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the relevant theories of financial integration, this thesis draws on the literature about financial integration and economic growth, combines the specific conditions of Chengdu-Chongqing Economic Circle to construct an index system for measuring financial agglomeration, and then uses principal component analysis to calculate the degree of financial agglomeration in the 16 cities of Chengdu-Chongqing Economic Circle from 2010 to 2019. Then I use Wilson's model to measure the financial radiation range of cities in the region. In this way, I can know the development status of financial integration in Chengdu-Chongqing Economic Circle. After that I use the panel data, through the Hausman test, BP test, multicollinearity test, and the establishment of individual fixed effect model to do quantitative research on financial integration to boost economic development. Then using the panel data and spatial weight matrix, through the LM test, LR test, Wald test, and the establishment of SDM to do quantitative research on financial integration to boost economic development, the following conclusions are drawn:

First, it can be seen from the financial agglomeration value F that in the Chengdu-Chongqing economic circle, the degree of financial development in Chengdu and Chongqing is relatively high and far exceeds that of other cities in the economic circle, and the degree of development is uneven.

Second, according to the regression results of the fixed effects panel, it can be seen that the promotion of economic development by financial agglomeration presents a positive U-shaped curve trend. When the degree of financial agglomeration is not high, financial agglomeration will hinder economic development. After the degree of financial agglomeration reaches a certain scale, financial agglomeration will promote economic development.

Third, according to the regression results of the SDM, it can be seen that the square term of the degree of financial agglomeration of neighboring cities has a positive influence on the GDP of the city, and the degree of financial agglomeration of neighboring cities has a negative influence on the GDP of the city. When the degree of financial agglomeration of neighboring cities are not high, financial agglomeration will hinder the city's economic development. After the degree of financial agglomeration of neighboring cities reaches a certain scale, financial agglomeration will promote the city's economic development.

Fourth, according to the comparison with the financial agglomeration calculation indicators selected in the relevant literature, it can be found that the financial agglomeration calculation indicators selected in this thesis are better. The results of this thesis show that both the financial agglomeration in the region or the financial agglomeration in surrounding cities have a positive U-shaped curve in terms of their impact on the region’s GDP.

This thesis uses empirical analysis to evaluate and explore the degree of financial integration in Chengdu-Chongqing Economic Circle. This move fills the gap in financial integration for the study of the Southwest Inland. The empirical results show that financial integration can indeed promote economic growth, which provides new ideas for the government to promote economic growth and also confirms the importance of promoting the concentration of financial institutions. In the study, I found that the development of financial institutions in the Chengdu-Chongqing

Economic Circle is unbalanced at this stage, which shows that there is still much room for further development.

5.2 Recommendations

5.2.1 Limitation of Study

Of course, there are still many limitations in this thesis:

1) By reason of the difficulty of data collection, this thesis' sample size is small, which may affect the results. In the future research, the sample capacity should be expanded as much as possible. At the same time, the measurement units used by the individual data are different between cities, and the accuracy of the data is also affected during the conversion.

2) Since the city-level data is selected, many data are difficult to obtain, and I hope to enrich relevant data in the future.

3) This research only studies the development of financial integration in Chengdu-Chongqing Economic during 2010-2019. Since the development of the Chengdu-Chongqing Economic Circle is dynamic, the impact of financial integration in the Chengdu-Chongqing Economic Circle on GDP may be different in the future.

5.2.2 Policy Implications

The outcomes of this study reveal that financial integration does exist in the Chengdu-Chongqing Economic Circle. Financial integration plays a positive U-shaped curve role in economic growth. Therefore, for purpose of the rapid progress of the financial industry in the Chengdu-Chongqing Economic Circle, it is necessary to enhance the level of integration in the financial industry. From the current point of view, there are still many things that can do to promote the development of the financial industry in the Chengdu-Chongqing Economic Circle. Therefore, based on the research conclusions of this thesis and the actual situation in the Chengdu-Chongqing Economic Circle, the following suggestions are proposed:

First, the results show that when the degree of financial agglomeration is high, financial agglomeration can promote the GDP of cities, and it will also promote the GDP of surrounding cities. Therefore, the government should formulate policies to promote the integrated financial development of all cities in the region. The first step is to promote the construction of financial centers in the two major cities of Chengdu and Chongqing, because they have more powerful radiation capabilities. At the same time, due to the scarcity of resources, the government cannot invest a lot in every city, but it can cultivate more regional financial sub-central cities and better promote the economic development of the entire region.

Second, through the research on the total amount of financial agglomeration, this thesis finds that the degree of financial agglomeration in the Chengdu-Chongqing Economic Circle is very uneven. Therefore, this thesis believes that the government should increase support for the financial industry in the Chengdu-Chongqing Economic Circle to fill the shortcomings of financial supply in this region.

Third, the role of financial agglomeration in promoting economic growth is a positive U-shaped curve. This means that the government needs to invest enough in financial development to show its positive effects. The government can formulate policies to make full use of private investment, foreign investment and other resources to increase investment in the financial industry.

On July 20, 2019, the Office of the Financial Stability Development Committee of the State Council of China launched 11 measures for opening up the financial industry, including: 1) The government would encourage overseas financial institutions to participate in the establishment and investment of commercial banking financial subsidiaries; 2) Overseas financial institutions are allowed to invest Establish or participate in a pension management company; 3) Support foreign investment to establish or participate in a currency brokerage company; relax the entry conditions of foreign insurance companies, cancel the 30-year business life requirement; 4) Allow foreign institutions to obtain the A-type license lead underwriting in the inter-bank bond market; 5) Further, facilitate the investment of foreign institutional investors in the inter-bank bond market. These measures can strengthen financial integration in the Chengdu-Chongqing Economic Circle.

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