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The Economic Impact of Financial Integration: A Case of Chengdu-Chongqing Economic Circle

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Abstract

To explore the relationship between financial integration and economic growth in the 16 cities within China's Chengdu-Chongqing Economic Circle (CCEC) from 2010 to 2019, this paper utilizes the Principal Component Analysis (PCA) to identify the degree of financial agglomeration, the Wilson Model (WM) to compute the financial radiation radius, and the Spatial Durbin Model (SDM) to conduct spatial association analysis. Results show a positive U-shaped relationship and spatial association between financial integration and economic growth. At a lower level of financial integration, it appears to hinder the economic growth of both the local and neighbouring areas, while at a higher level, it can promote regional economic growth.

Keywords: Economic Growth; Financial Integration; Financial Agglomeration; Financial Radiation

JEL Classifications: E23, G28, O11, R11

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1. Introduction

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 and uneven development.

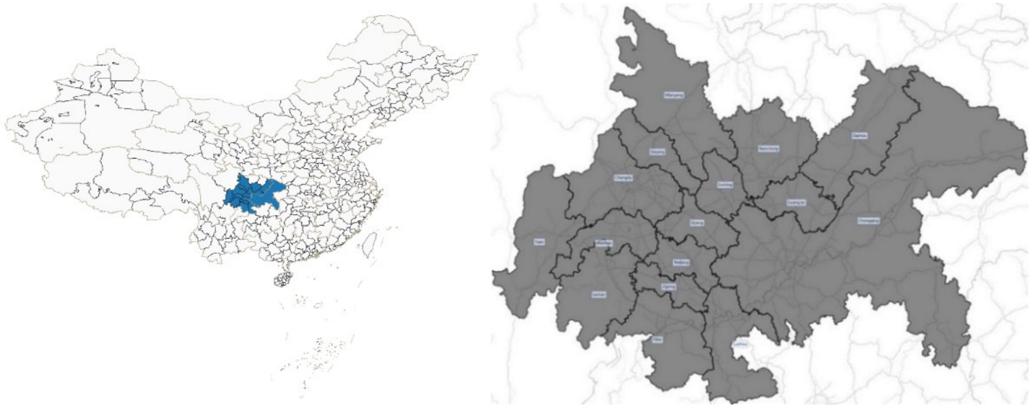
After China developed the three eastern economic circles of the Yangtze River Delta Economic Circle, the Pearl River Delta Economic Circle, and the Beijing-Tianjin-Hebei Economic Circle, the Chengdu-Chongqing Economic Circle was designated as the fourth national economic circle in China and the first in the west region. From Figure 1, the CCEC 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 the other 14 cities in Sichuan province, which are Deyang, Mianyang, Meishan, Ziyang, Suining, Leshan, Yaan, Zigong, Luzhou, Neijiang, Nanchong, Yibin, Dazhou, and Guangan. To enhance the development of the CCEC, China proposed a plan for Financial Integration System Construction in 2021. The objective of this plan is to integrate regional financial resources to promote the economic development of the CCEC. Simultaneously, it can alleviate China's long-standing uneven development between the east 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 CCEC. Not only has the CCEC been listed into the national agenda, but China has also issued many subsequent policies to support it. Existing research on regional integration has mainly focused on regions with a higher degree of integration development, with some studies extending their attention to the CCEC (Wang et al., 2019; Ren et al., 2022). However, these studies are often confined to the field of urban integration and do not consider the impact of financial industry integration (Jian et al., 2023). Moreover, considering the strong spatial correlation inherent in regional integration development (Krugman, 1991; Niebuhr, 2004), this paper aims to fill this gap by showing the spatial association between financial integration and economic growth in the CCEC. The research questions are explicitly written as follows:

1) What is the degree of financial agglomeration in the CCEC? What is worth learning and improving?

2) To study the financial radiation radius of the central cities in the CCEC.

3) To explore the impact of financial integration on economic growth in the CCEC.

Figure 1: CCEC Location Diagram



Source: Authors' compilation

2. Literature Review

The concept of financial integration originated from economic integration and is one aspect of economic integration manifestation. 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 and 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 manifestations 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. Nguyen et al. (2019) divided economic integration into three aspects: global integration, trade integration, and financial integration. They believe that financial integration has the most significant impact on economic development.

Combining the theories of many scholars, 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 (Imbs, 2006; Park & Lee, 2011).

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 traced back to the economist in the United States (Kindleberger, 1963), who, through in-depth research on the emergence of financial centers and the functions of financial centers, 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 core functions of the financial center are the agglomeration function and the radiation function (Zhao et al., 2004; Bourgain & Pieretti, 2003). 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.

Krugman (1991) analyzed the factors affecting industrial agglomeration by proposing a two-region model. He believed that in industries with lower transportation costs and a higher degree of economies of scale, they will tend to concentrate in regions that are economically more advanced. The financial center theory also argues that financial centers are usually economic development centers or geographic centers (Reed, 1980). 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. On one hand, the financial center provides diversified investment channels for the surplus of funds to meet the investment needs of various investors. Thus, an efficient service system can improve the ability of regional resource allocation (Durusu-Ciftci et al., 2017), guide limited resources to flow more into the efficient industry (Levine & Zervos, 1998); On the other hand, the agglomeration center not only has sufficient financial support and information assurance but also has a strong technology talent market and strong government support. High innovation efficiency and rapid information flow can stimulate regional innovation vitality and promote rapid economic development (Sun et al., 2018).

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 (Feng et al., 2022). Financial center through the flow and diffusion of various production factors such as labor, capital, resources, information, and technology to radiate the surrounding areas (Deng et al., 2019). It can accelerate the construction and investment of surrounding branches through the extension of the financial service network, and on the other hand, it can promote cross-cooperation between financial institutions in neighbouring regions so that financial resources can circulate across regions and industries and improve the efficiency of resource utilization between cities (Benfratello et al., 2008).

Levine (1998) theoretically analyzed the relationship between financial integration and economics. Results showed the integration of financial resources can influence regional economic expansion, driven by its ability to enhance capital accumulation, promote productivity improvement, and improve information sharing capabilities, thereby reducing risks and increasing economies of scale. Empirical studies have further confirmed that there exists a strong correlation between financial integration and economic growth, and different levels of financial development exert different impacts on economic growth (Gong & Ban, 2016). Wang et al. (2023) empirically analyzed the relationship between financial integration and economic development using provincial-level data from China, and the results showed financial integration does not render a statistically significant impact on economic growth. Contrarily, the spillover effect of financial integration can amplify the growth of the neighbouring economy. The authors suggested that this might be due to the trickle-down effect and the interconnected financial network.

3. Data and Methodology

3.1 Financial Agglomeration

The Principal Component Analysis (PCA) is a statistical technique proposed by Hotelling (1933) for dimensionality reduction, data compression, visualization, and feature extraction. In PCA, the original variables are transformed into a new set of variables called principal components. These principal components are linear combinations of the original variables and are orthogonal to each other, meaning they are uncorrelated. The first principal component captures the maximum amount of variance in the data, followed by the second component, and so on. Due to the inability to standardize indicators measuring financial agglomeration (Bro & Smilde, 2014), the evaluation index system of financial agglomeration in this study is constructed using PCA across four dimensions: financial scale, financial environment, financial depth, and financial openness, as shown in Table 1.

Table 1: Indicator System of Financial Agglomeration

Indicator name	*Indicator code*	*Subsystem*
Total Deposits of Financial Institutions *(100 million yuan)*	X_1	*The Scale of Financial Industry*
Total Loans of Financial Institutions *(100 million yuan)*	X_2	
Premium Income *(100 million yuan)*	X_3	
Local General Public Budget Revenue (100 million yuan)	X_4	*The Environment of Financial Industry*
Number of Employees in the Financial Industry (10 thousand people)	X_5	
Financial Interrelations Ratio (%)	X_6	*The Depth of Financial Industry*
Total Export-Import Volume *(10 thousand dollars)*	X_7	*The Level of Financial Openness*
Foreign Direct Investment *(10 thousand dollars)*	X_8	

Source: Authors' compilation

3.2 Financial Radiation

The Wilson model is a relatively classic model for studying financial radiation between cities or regions in geographic economics (Yi et al., 2020). 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:

$$T_{jk} = KO_j D_k \exp\left(-\beta {Fin_{radia}}_{jk}\right) \quad (1)$$

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.

Wang & Ge (2002) further simplified the Wilson model:

$$T_{jk} = D_k \exp\left(-\beta Fin_{radia_{jk}}\right) \tag{2}$$

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, and it 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:

$$Fin_{radia_{jk}} = \frac{1}{\beta} \times \ln\frac{D_k}{\theta} \tag{3}$$

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

$$\beta = \sqrt{\frac{2T}{t_{max}D}} \tag{4}$$

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 functions in the element.

3.3 Methodology

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. Considering the non-linear relationship between financial agglomeration and economic growth, the first and square terms of the financial agglomeration index are used, as shown in Table 2 (Hao et al., 2020).

Table 2: Variable Definitions and Descriptions

	Variable name	Variable symbol	Variable definition
Explained variable	Gross Domestic Product (100 million yuan)	GDP	Based on the production function, the GDP is incorporated into model as a metric to measure the economic growth
Explanatory variables	Financial Agglomeration Score	Fin_agglo	
	The Square Term of Financial Agglomeration Score	Fin_agglo^2	Based on the results of financial agglomeration score, and a squared term is added to examine the nonlinear relationship
Control variables	Capital Stock *(100 million yuan)*	K	Based on the production function, the capital stock is incorporated into model. The calculation method from (Changqing et al., 2017)
	Labor Input (10 thousand people)	L	Based on the production function, the GDP is incorporated into model as a metric to measure the economic growth
	University Students	Uni_stu	The number of university students in each city. According to Yusuf & Nabeshima (2007), education can promote the development of the regional economy.
	R&D Expenditure (100 million yuan)	R_D	The R&D expenditure in each city. Based on Bozkurt (2015), technology is one of the most important factors driving economic growth

Source: Authors' compilation

When analyzing economic problems with spatial effects, traditional regression models may have large errors between the results and the 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. In this paper, the theory of financial integration points out the spillover impact across regions, which naturally calls for a spatial regression analysis. This paper designs a spatial measurement model based on spatial correlation and then analyzes the spillover effect of financial integration on economic growth.

Currently, there are three spatial panel regression models mainly used (LeSage & Pace, 2009), including Spatial Autoregressive Model (SAR), Spatial Error Model (SEM) and Spatial Durbin Model (SDM). The model specifications used in this study are as follows:

Spatial Autoregressive Model (SAR)

When the spatial correlation mainly reflects the dependent variable, the model is SAR with the following formula:

$$\ln GDP_{it} = \rho W_{ij} \ln GDP_{jt} + A_1 Fin\_agglo_{it} + A_2 \ln K_{it} + A_3 \ln L_{it} + A_4 \ln R\_D_{it} + A_5 \ln Uni\_stu_{it} + A_6 \,(Fin\_agglo)^2{}_{it} + \mu_i + \varphi_t + \varepsilon_{it} \quad (5)$$

Spatial Error Model (SEM)

When the error term is spatially correlated, the model is the SEM. The formula is:

$$\ln GDP_{it} = A_1 Fin\_agglo_{it} + A_2 \ln K_{it} + A_3 \ln L_{it} + A_4 \ln R\_D_{it} + A_5 \ln Uni\_stu_{it} + A_6 \,(Fin\_agglo)^2{}_{it} + \mu_i + \varphi_t + \varepsilon_{it}; \;\; \varepsilon_i = \lambda W_{ij} \varepsilon_j + \sigma_{it} \quad (6)$$

Spatial Durbin Model (SDM)

When both the dependent variable and independent variable reflect the spatial correlation, we have the SDM. In this paper, aimed at mitigating the impact of multicollinearity on the result, the SDM retains only the spatial lag terms of the core explanatory variables (Chen, 2014; Wang et al., 2023; Peng & Qiu, 2023).

$$\ln GDP_{it} = \rho W_{ij} \ln GDP_{jt} + A_1 Fin_{agglo}{}_{it} + A_2 \ln K_{it} + A_3 \ln L_{it} + A_4 \ln R\_D_{it} + A_5 \ln Uni\_stu_{it} + A_6 \,(Fin\_agglo)^2{}_{it} + \theta_1 W_{ij} Fin\_agglo_{it} + \theta_2 W_{ij} \,(Fin\_agglo)^2{}_{it} + \mu_i + \varphi_t + \varepsilon_{it} \quad (7)$$

Where i, j and t represent the city i, city j and year t. The parameter ρ is the spatial autoregressive coefficient, parameter λ represents the spatial error coefficient of the error term and parameter θ represents the coefficient of spatial lag independent variables. W is the spatial weight matrix and A is the regression coefficient of the explanatory variable. μ is the individual fixed effect, φ is time fixed effect, and ε is the error term.

All data in this part were sourced from reputable publications, including the China Statistical Yearbook (2009-2019), Chongqing Statistical Yearbook (2009-2019), Sichuan Statistical Yearbook (2009-2019), and China Financial Yearbook (2009-2019).

4. Empirical Analysis

4.1 Empirical Analysis of Financial Agglomeration

This part uses SPSS 17.0 to analyze the 8 indicators and obtain the empirical results of the Principal Component Analysis. First, a descriptive statistical analysis is performed on all selected indicator data. The results are shown in Table 3.

Table 3: Descriptive Statistics

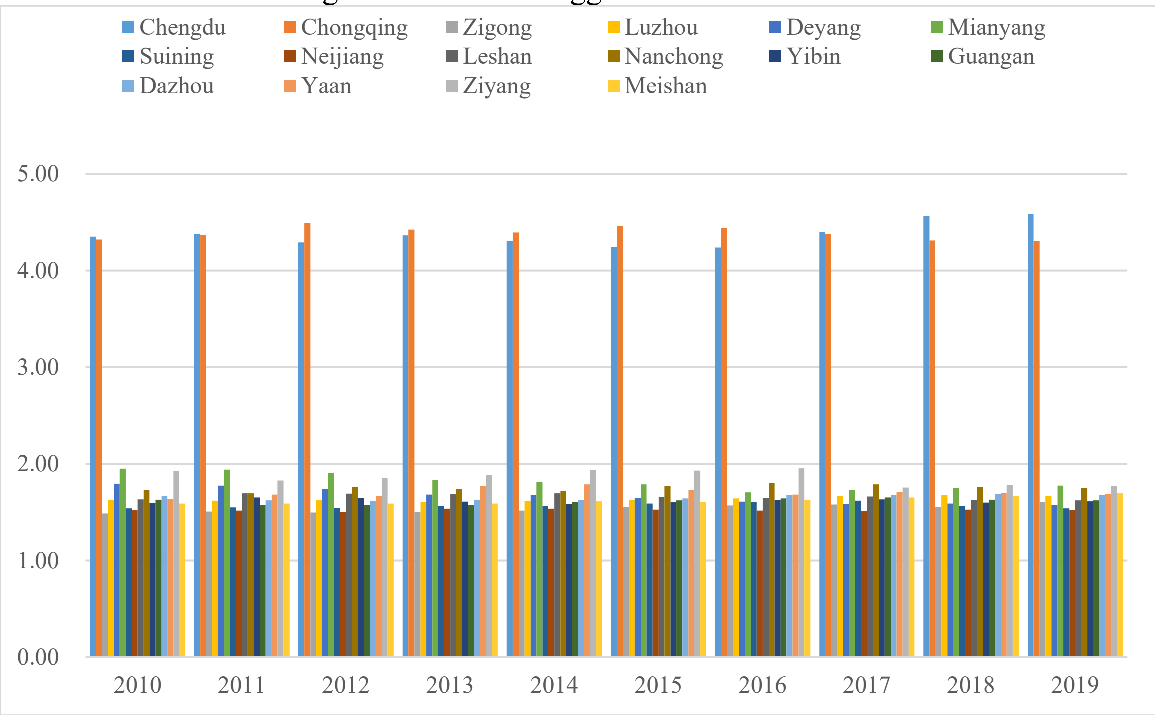
Var	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
X_1	160	4903.94	9126.88	454	40029.37
X_2	160	3613.58	7798.92	221.19	37142.16
X_3	160	100.27	185.926	9.25	951.05
X_4	160	242.34	496.82	15.65	2265.54
X_5	160	2.09	3.25	0.18	15.19
X_6	160	2.42	0.73	1.32	5.02
X_7	160	781118.20	2018309.00	1333.00	9545024.00
X_8	160	115489.10	301026.50	241.00	1227500.00

Source: Authors' compilation

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. The results show the 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. After this, Total Variance Explained results output two components. The cumulative variance contribution rate of the two principal components obtained is 99.581%, Component 1 is 95.386% , and Component 2 is 4.195%. Based on these results and the component matrix which represent the correlation between each component and the original variable, this paper chooses Component 1 to represent the degree of financial agglomeration.

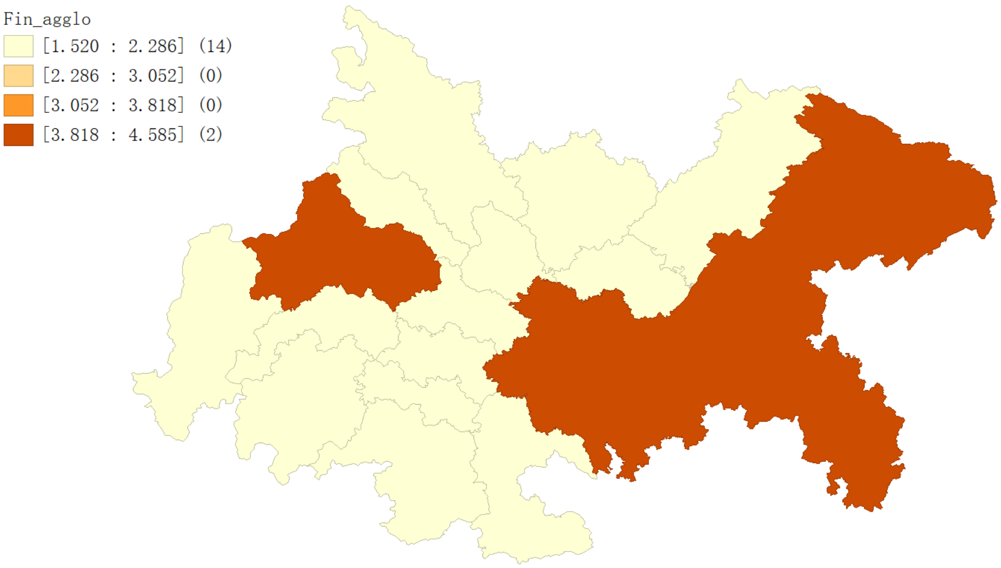
On the basis of Principal Component Analysis results, the financial agglomeration score of each city can be calculated. In this paper, to ensure the reliability of the squared term, add 2 to the financial agglomeration F score and bring it into the model for regression. Figure 2 and Figure 3 reveal that both Chengdu and Chongqing stand out with the highest financial agglomeration scores, and notably, these scores demonstrate proximity to each other. In contrast, the remaining 14 cities exhibit comparably lower and relatively uniform financial agglomeration scores, thereby indicating a discernible pattern characterized by the emergence of dual financial centers.

Figure 2: Financial Agglomeration Scores



Source: Authors' compilation

Figure 3: Spatial Distribution of Financial Agglomeration Scores in 2019



Source: Authors' compilation

4.2 Empirical Analysis of Financial Radiation

According to the Wilson models (3) and (4), when studying the financial radiation radius in the CCEC, 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 from Sichuan and Chongqing 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, and the threshold θ is determined using the minimum order of magnitude principle. According to relevant research, the minimum order of magnitude for China's financial agglomeration score is set at one percent and the threshold $\theta = 0.01$ (Long et al., 2021; Xu et al., 2022).

Regarding existing research, this paper also selects principal component scores to represent the financial resource intensity D_K of the financial center city. The β, specific values of D_K and θ are substituted into the models (3) and (4).

By calculation, we can obtain the financial radiation radius R of Chengdu and Chongqing, the financial center cities of the CCEC. The results are presented in Table 4.

Table 4: 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
2017	165.04	173.11
2018	168.45	170.60
2019	168.77	170.30

Source: Authors' compilation

4.3 The Relationship between Financial Integration and Economic Growth

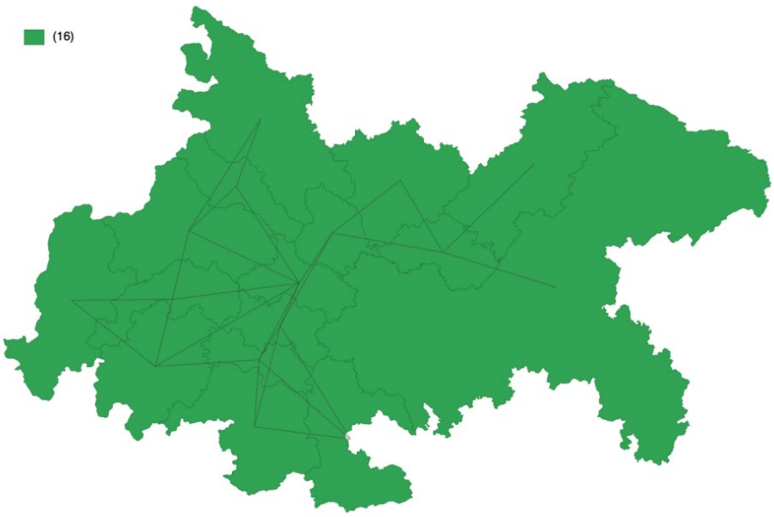
4.3.1 Setting of Spatial Weight Matrix

In spatial econometrics, the setting of the spatial weight matrix is crucial, as it quantitatively displays the spatial relationships among geographical elements. To conduct the spatial autocorrelation test, the spatial weight matrix must be determined first. There are various measurement methods for measuring the spatial weight matrix, based on relevant research (Huang & Li, 2020; Tobler et al., 1970). This part considers constructing the spatial inverse distance weight matrix with quadratic terms (shown in Formula 8, Formula 9, and Figure 4).

$$W_{ij}^{1} = \begin{pmatrix} W_{11} & \cdots & W_{1n} \\ \vdots & \ddots & \vdots \\ W_{n1} & \cdots & W_{nn} \end{pmatrix} \tag{8}$$

$$\text{Where, } W_{ij}^{1} = \begin{cases} \dfrac{1}{(d_{ij})^2}, & i \neq j \ , \ d_{ij} = \text{The distance between } i \text{ and } j \\ 0, & i = j \end{cases} \tag{9}$$

Figure 4: Spatial Distance Weight Matrix Connectivity Map



Source: Authors' compilation

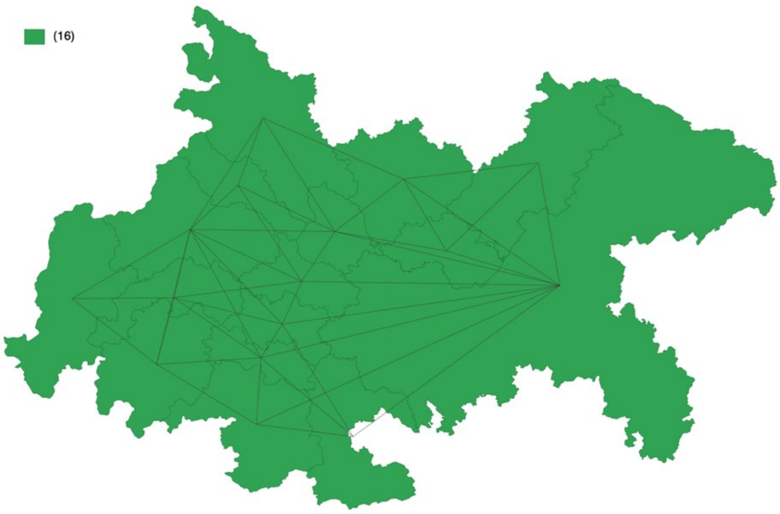
Since the spatial inverse distance weight matrix cannot reflect the impact of the financial radiation radius. Based on the financial radiation radius measured by the Wilson model and the 0-1 spatial matrix, we consider cities within the financial radiation radius as adjacent to the financial centers and construct the financial radiation weight matrix (shown in Figure 5) to show the spillover effect of financial integration.

$$W_{ij}^2 = \begin{pmatrix} W_{11} & \cdots & W_{1n} \\ \vdots & \ddots & \vdots \\ W_{n1} & \cdots & W_{nn} \end{pmatrix} \tag{10}$$

Where

$$W_{ij}^2 = \begin{cases} 1, \text{One area is Chengdu or Chongqing, and} \\ \text{the other area is within their radiation range.} \\ 0, \quad \text{Otherwise} \end{cases} \tag{11}$$

Figure 5: Financial Radiation Spatial Weight Matrix Connectivity Map



Source: Authors' compilation

4.3.2 Spatial Autocorrelation Test and Model Selection

The Lagrange Multiplier (LM) test method is a measure of spatial autocorrelation which used to test the existence of a spatial effect. When using the LM test method, the results of the LM-lag and LM-error are not statistically significant, considering that there is no spatial autocorrelation. If any of them are significant, the spatial econometric model should be used to describe the spatial effect. (Anselin et al., 1996; Anselin et al., 2004; Elhorst, 2010).

Table 5: Spatial Autocorrelation Analysis

Test	**P-value**
Spatial error:	
Lagrange multiplier	0.091
R Lagrange multiplier	0.001
Spatial lag:	
Lagrange multiplier	0.000
R Lagrange multiplier	0.000

Source: Authors' compilation

From Table 5, the LM-lag and LM-error test results are statistically significant at the 10% level. The spatial econometric model should be used in this study.

To further determine the selection of the spatial regression models, the Likelihood Ratio (LR) test and Wald test are introduced to select a suitable model (Yamake et al., 2023).

Table 6: Model Selection

Test	P-value
LR_spatial_lag	0.0000
LR_spatial_error	0.0000
Wald_spatial_lag	0.0000
Wald_spatial_error	0.0880

Source: Authors' compilation

As Table 6 shows, Wald and LR test results are significant at the 10% level, suggesting that SDM is more appropriate than SAR and SEM. This study thus uses an SDM model for the empirical analysis, which is sound.

4.3.3 Regression

Table 7: Descriptive Statistics

Var	Obs	Mean	Std. Dev.	Min	Max
GDP	160	2678.873	4424.275	296.71	23605.77
K	160	6342.736	12322.32	196.47	81300.89
L	160	1716.055	2480.11	200.39	14439.43
R_d	160	46.15208	93.5748	1.3023	469.5714
U_stu	160	127625.1	239525.3	0	981692
$(Fin\_agglo)^2$	160	2.423563	0.7270604	1.32	5.02
BP test					Pass
Hausman test					Pass

Source: Authors' compilation

The aim of the Hausman test is to determine whether a model with fixed or random effects is superior, and the BP test is to compare the mixed OLS model and the random effect model to see which is better. The results in Table 7 show that the spatial model with fixed effects is more appropriate, which also has the advantage of robustness in that the individual effects are allowed to correlate with the included regressors in the model.

Recalling Equation (8) and the spatial weight matrices Formulas (8) and (9), the SDM model used in this paper is as follows:

$$\begin{aligned}\ln GDP_{it} = {} & \rho W_{ij}^{1} \ln GDP_{jt} + A_1 Fin\_agglo_{it} + A_2 \ln K_{it} + A_3 \ln L_{it} + A_4 \ln R\_D_{it} \\ & + A_5 \ln Uni\_stu_{it} + A_6 \,(Fin\_agglo)^2{}_{it} + \theta_1 W_{ij}^{2} Fin\_agglo_{it} \\ & + \theta_2 W_{ij}^{2}\,(Fin\_agglo)^2{}_{it} + \mu_i + \varphi_t + \varepsilon_{it} \qquad (12)\end{aligned}$$

Table 8: SDM Regression Result

Var.	Coef.
Fin_agglo	-0.7460***
$\ln K$	0.3278***
$\ln L$	0.0980*
$\ln R\_d$	0.0406***
$\ln U\_stu$	-0.0333
$(Fin\_agglo)^2$	0.0773**
Spatial effect	
$\ln GDP$	145.0483***
Fin_agglo	-0.4037***
$(Fin\_agglo)^2$	0.0508***

*Note: The table is the coefficient value and *, **, *** respectively indicate that the level of 10%, 5%, 1% has passed the significance test.*

Source: Authors' compilation

In the regression results of Table 8, except for the $\ln U\_stu$, regression coefficients of explained and explanatory variables are significant at the 10 % level. Among them, the coefficient of the square term of financial agglomeration is positive and the coefficient of financial agglomeration is negative, which shows the impact of financial agglomeration on economic growth is a positive U-shaped relationship. 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 industry 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 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 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 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 financial agglomeration has achieved a coordinated match with the development of the city's economy, which can further promote regional economic growth.

Second, the spatial effect coefficient of GDP in this region passed the significance test at the 1% level, indicating that GDP has obvious spillover effects between regions. The increasing GDP of neighboring cities can have a positive impact on the GDP of the city. 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.

Finally, the spatial effect of financial integration indicates 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 and has financial radiation power, the financial radiation in the surrounding cities will drive down the GDP and the development of financial resources in the city. The regression results also show a "positive U-shaped" spatial association between GDP and financial agglomeration.

Table 9: Spatial Decomposition Effect of SDM

Var.	Coef.
Direct effect	
Fin_agglo	-0.9401***
$(Fin\_agglo)^2$	0.1013**
Indirect effect	
Fin_agglo	-3.2945***
$(Fin\_agglo)^2$	0.4160**
Total effect	
Fin_agglo	-4.2345***
$(Fin\_agglo)^2$	0.5172***

*Note: The table is the coefficient value and *, **, *** respectively indicate that the level of 10%, 5%, 1% has passed the significance test.*

Source: Authors' compilation

Due to the spatial lag term included in the model, the estimation results cannot directly reflect the marginal effect of the variables. Therefore, the partial differential method is used to measure direct effect, indirect effect, and total effect (LeSage & Pace, 2009), with the results shown in Table 9. Results show the direct and indirect spatial effect coefficient of Fin_agglo on GDP are -0.9401 and -3.2945, respectively. The significance test reflects the significant negative effects when the degree of financial agglomeration is low. The negative indirect effect is greater than the direct effect, indicating that the negative impact of financial agglomerations has a stronger influence on the GDP of surrounding cities. The reason for this situation is that the financial agglomeration of a city often involves the absorption of financial resources from surrounding cities, which can significantly hinder the economy of neighbouring cities. Simultaneously, the direct and indirect spatial effect coefficient of $(Fin\_agglo)^2$ on GDP are 0.1013 and 0.4160, respectively. The significance test reflects the significant positive effects when the degree of financial agglomeration is high. The indirect effect is greater than the direct effect, indicating that the positive impact of financial agglomerations has a stronger influence on the GDP of surrounding cities. The reason for this situation is that the positive effects of financial integration are primarily achieved through financial radiation power. Once the degree of financial agglomeration in a city reaches a certain level, the driving force behind economic development becomes limited, while its impact on the economic development of surrounding cities with lower levels of development becomes more significant. Overall, the direct effect results are similar to the SDM results, indicating a positive U-shaped relationship between financial integration and economic development. At the same time, due to the relatively low overall level of financial integration in the region, its positive driving effect on economic development is limited (the total effect of $(Fin\_agglo)^2$ is 0.5172), indicating the requirement for further enhancement of the level of regional financial integration development.

5. Conclusion

This paper employs empirical analysis to evaluate and explore the degree of financial integration in the Chengdu-Chongqing Economic Circle. This endeavor addresses the gap in the study of financial integration in Southwest China, with the following results:

First, through the research on the total score of financial agglomeration and the financial radiation radius, this paper finds that the degree of financial resources within the CCEC is very uneven. Financial resources are mainly concentrated in the two major cities of Chengdu and Chongqing, and only these two cities possess financial radiation capabilities. Other cities have relatively fewer and more evenly distributed financial resources. In this study, the promotion of economic development in regional cities through financial integration mainly manifests in the financial radiation impact of two major cities. Therefore, whether these cities are within the financial radiation range of the major cities is crucial for them.

Second, the empirical results indicate that when the level of financial integration is high, it can promote economic growth. However, when the level of financial integration is low, it may hinder economic development. This implies that the positive effect of financial integration on economic growth requires sufficient support from financial resources.

Third, when the financial integration level of surrounding cities is low, it hinders the economic development of the city, whereas when the financial integration level of surrounding cities is high, it promotes the economic development of the city. This spatial association between financial integration and economic development in the CCEC requires the government to coordinate the development of the entire region and consider the impact of spatial correlation on regional development.

Fourth, the spatial decomposition effect indicates that the driving force of financial integration on economic development in this region is limited, possibly due to the relatively low level of financial integration and the absence of economies of scale in this region. There is an urgent need to strengthen the development of financial integration in this region to enhance the positive effect of financial integration.

In conclusion, the empirical findings indicate a U-shaped curve relationship and a spatial association between financial integration and economic growth. It is imperative to acknowledge the adverse consequences associated with a low level of financial integration; 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. The government should also take note of the overall low level of financial integration in this region, which limits its capacity to drive economic development. It is imperative for the government to enhance the integration of financial resources to promote the development of financial integration, thereby realizing economies of scale and maximizing the efficiency of financial integration in driving economic development. This paper emphasizes a comprehensive understanding of the implications stemming from varying degrees of financial integration. By delving into the intricate dynamics of financial integration across different levels, policymakers can craft more nuanced and efficacious strategies to enhance economic growth while simultaneously mitigating potential challenges.

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