

The Spillover Effect of Financial Agglomeration on Urbanization: An Empirical Study in Southwestern China

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Abstract: To investigate the spillover effect of financial agglomeration, this study selected 46 prefecture-level cities in Southwest China from 2011 to 2020 as research subjects. The research applies Moran's Index correlation test, using spatial econometric models for association analysis. Results show financial agglomeration has a pronounced spatial correlation with urbanization and the spillover effect of financial agglomeration enhances the development of urbanization. This study provides empirical support for policymakers in Southwest China to implement sustainable development goals for finance and urbanization.

Keywords: Spillover Effect; Financial Agglomeration; Urbanization; Southwestern China

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1. Introduction

Financial agglomeration generally refers to the concentration of financial institutions and financial services within a specific area. This concentration can generate economies of scale, external economic effects, and knowledge spillovers, thereby improving the efficiency and competitiveness of regional financial services.^[1] The concept and phenomenon of financial agglomeration have been examined and developed by numerous scholars over time.^[2] Existing studies have identified a statistically significant spatial correlation between financial agglomeration and a range of economic activities.^[3-5] In particular, previous research has primarily focused on the effects of financial agglomeration on economic growth, employment, innovation, real estate, and green development. As a low-carbon industry, the financial sector plays an important role in urban sustainable development and clean production. Financial agglomeration is therefore regarded as an important driver of regional development, as it improves the allocation efficiency of financial resources, reduces transaction costs, and promotes urbanization and sustainable development. In developing countries and regions, financial agglomeration can also facilitate sustainable urbanization by encouraging industrial upgrading and environmental protection. Moreover, its influence extends beyond local urban development and may produce spillover effects in surrounding areas.^[8]

Urbanization is commonly understood as the process through which population shifts from rural areas to urban areas. However, it is a multidimensional and highly complex phenomenon. In most countries, the urbanization process can be broadly divided into five stages: economic growth and development, demographic transition, social transformation, the restructuring and expansion of urban space, and urban shrinkage planning. Current research on the determinants of urbanization mainly concentrates on economic, policy, social, geographical, cultural, and technological factors. Urbanization

affects economic growth through several important channels. First, cities play a central role in the economic and social structures of both developed and developing countries by providing access to education, employment, and healthcare. Second, urbanization promotes the concentration of population and enterprises, which generates economies of scale, lowers transaction costs, and creates a favorable environment for business development. This process also makes it easier for firms to obtain financing and access larger local markets. Urban enterprises are often more profitable than rural enterprises and are generally better positioned to attract and cultivate skilled workers. This, in turn, promotes the migration of high-skilled talent to large cities and enhances the exchange of knowledge and skills. In addition, urbanization creates positive externalities for rural areas by facilitating the flow of information, technology, capital, and human resources through migration and remittances. Economic growth and geographic agglomeration are therefore mutually reinforcing, and spatial agglomeration is widely considered conducive to development. In this context, the relationship between financial agglomeration and urbanization has become an important topic for understanding the sustainable development of low-carbon urbanization.^{[9][10]}

Financial agglomeration contributes to the sustainable development of urbanization through multiple mechanisms, including labor attraction, income growth, capital allocation, information transmission, industrial upgrading, and infrastructure development. These channels not only accelerate the urbanization process but also support coordinated and sustainable urban development in economic, social, and environmental dimensions. Existing research on the impact of financial agglomeration on urbanization has mainly concentrated on several key regional contexts. For example, studies of the Yangtze River Economic Belt have shown that financial agglomeration exerts a smaller positive effect on population urbanization and economic urbanization in the western region than in the eastern and central regions, where the positive effects are more pronounced. Although such studies distinguish among eastern, central, and western China, the geographical scope remains too broad, and the linear distribution of cities along the Yangtze River Economic Belt limits the ability of the findings to fully capture the spatial relationship between regional financial agglomeration and urbanization. To address this limitation, some scholars have focused specifically on eastern China and found that financial agglomeration significantly promotes industrial urbanization and spatial urbanization, whereas its impact on population urbanization is relatively limited. In the Pearl River Delta urban agglomeration, industrial agglomeration has been shown to significantly promote local new urbanization, with notable spatial spillover effects generated by producer services and financial industries. In addition, land urbanization under excessive financial support has been linked to financial efficiency, and excessively high financial efficiency may lead to misallocation and waste of financial resources. At present, research on the relationship between financial agglomeration and urbanization remains concentrated in central and eastern China, where the level of financial agglomeration is relatively high. By contrast, comparatively little attention has been paid to southwestern China.^{[11][12]}

Against this background, examining the impact of financial agglomeration on urbanization in Southwest China has important theoretical and practical value. First, it supplements the existing literature by shifting attention from developed regions to a less developed area that has received limited scholarly attention, thereby enriching research in financial economics and regional economics. Second, the use of satellite data to measure urbanization levels, combined with denoising techniques, helps improve objectivity and accuracy while reducing potential measurement bias. Third, Southwest China provides a distinctive case for analysis because of its uneven economic development, allowing for a clearer understanding of regional variation under different levels of development. Fourth, although the urbanization rate in Southwest China has risen steadily in recent years, it remains well below the national average. Investigating the spatial relationship between financial agglomeration and urbanization in this region can therefore provide useful evidence for government decision-making, particularly in relation to industrial restructuring and regional development policy.^[13-15]

The remainder of this paper is organized as follows. Section 2 describes the study area and data. Section 3 presents the methodology and related tests. Section 4 reports the regression results. Section 5 provides the robustness analysis. Section 6 concludes the paper and discusses the policy implications. Section 7 outlines the limitations of the study and directions for future research.

2. Research Area and Materials

2.1 Research Area

China's administrative system is characterized by a nested hierarchical structure. Below the central government, the administrative hierarchy descends through provinces, prefecture-level cities, counties, towns, and villages. At the provincial level, China has 34 administrative regions, including 23 provinces, 5 autonomous regions, 4 municipalities, and 2 special administrative regions. Existing studies on financial agglomeration and urbanization have mainly concentrated on the central and eastern regions, as well as several economically advanced belts. In contrast, relatively limited attention has been given to the southwestern region, where financial agglomeration developed comparatively later.

The three southwestern provinces of Sichuan, Guizhou, and Yunnan have a combined population of more than 200 million, accounting for nearly 15 percent of the national population. This large population base provides considerable potential for urbanization. At the same time, the region occupies a strategically important position in major national development initiatives, particularly the Western Development Strategy and the Belt and Road Initiative. Examining the impact of financial agglomeration on urbanization in this region can therefore contribute to improving the quality of regional economic development and strengthening its international competitiveness. As industrial restructuring and upgrading continue, the financial sector has become increasingly important in these provinces and now plays a vital role in promoting regional economic growth. Against this background, this study focuses on 46 prefecture-level cities located in the southwestern provinces of Sichuan, Guizhou, and Yunnan.

2.2 Materials

Satellite data were used to construct indicators of economic urbanization and population urbanization for 46 cities in Southwest China over the period 2011 to 2020. Specifically, nighttime light data were used as a proxy for the level of economic urbanization, whereas urban scale data, following preprocessing and noise reduction procedures, were employed to measure the level of population urbanization.

This study conceptualizes urbanization as comprising two dimensions, namely population urbanization and economic urbanization, which are used as the dependent variables. The core explanatory variable is the level of financial agglomeration, measured by the location entropy index. Originally developed to capture the uneven spatial distribution of economic activity across regions in the United States, the location entropy index has been widely applied in regional economic analysis and urban planning to assess the relative concentration of a particular industry within a specific area.

The financial agglomeration index is calculated as follows:

$$Finsaj = \frac{L_{it}/G_{it}}{L_t/G_t}$$

where L_{it} denotes the total deposits and loans of financial institutions in city i in year t , and L_t denotes the total deposits and loans of all cities in year t . G_{it} represents the GDP of city i in year t , while G_t represents the GDP of all cities in year t . Accordingly, $Finsagg_{it}$ indicates the financial agglomeration index of city i in year t , also referred to as the location entropy of financial agglomeration.

As shown in Table 1, and following previous studies, this paper includes transportation infrastructure, fixed asset investment, foreign direct investment, government expenditure, industrial development, science and technology, education, and healthcare as control variables. Including these control variables helps provide a more comprehensive and accurate examination of the relationship between financial agglomeration and urbanization. By accounting for these important factors, the analysis is better able to identify the independent effect of financial agglomeration on urbanization while also reducing the risk of omitted variable bias.

Table 1 List of variables

	Variable name	Variable symbol	Variable definition	Unit
Explained variables	Population urbanization	Purba	The proportion of urban population to total people	
	Economic urbanization	Eurba	Disposable income of urban residents	

	Variable name	Variable symbol	Variable definition	Unit
Explanatory variables	Financial agglomeration	Finsa	The level of financial agglomeration	/
	Transportation infrastructure	INT	Highway mileage	km
	Fixed assets investment	INF	Fixed assets investment	100 million yuan
	Foreign actual investment	FDI	Actual use of foreign capital	10 thousand dollar
	Government expenditure	GOV	Local general public budget expenditure	10 thousand yuan
Control variables	Industrial development	IND	The second industrial added value	100 million yuan
	Science and technology level	SIC	Internal expenditure on research and development	10 thousand yuan
	Educational level	EDU	Number of beds in Health Institutions	beds
	Medical health level	MED	Number of students enrolled in middle and higher education institutions	people

The study covers 46 prefecture-level cities in Yunnan, Guizhou, and Sichuan provinces from 2011 to 2020. Urbanization levels are derived from satellite data, while economic indicators come from regional and city-level statistical yearbooks, including financial loans, GDP, highway mileage, fixed asset investment, foreign capital usage, R&D expenditure, fiscal spending, secondary industry value added, university enrollment, and hospital beds. For cities with missing data on foreign capital, R&D expenditure, and hospital beds, the moving average smoothing method was used to impute values and ensure data consistency.

3. Methodology

3.1 Moran's I Index

Spatial auto-correlation analysis is a spatial statistical method used to study spatial correlation, reflecting the degree of correlation between certain geographical phenomena or attribute values across regions. Global spatial auto-correlation can indicate the overall characteristics of spatial correlation^{[6][7]}. The global Moran's I index can be expressed as follows:

$$\text{Moran's I} = \frac{\sum_{i=1}^n \sum_{j=1}^n W_{ij} (Y_i - \bar{Y})(Y_j - \bar{Y})}{S^2 \sum_{i=1}^n \sum_{j=1}^n W_{ij}}$$

In the formula, $S^2 = \frac{1}{n} \sum_{i=1}^n (Y_i - \bar{Y})^2$, $\bar{Y} = \frac{1}{n} \sum_{i=1}^n Y_i$, Y_i denotes the financial agglomeration level of city i , n is the total number of cities, \bar{Y} denotes the mean of financial agglomeration levels across all cities. The Moran's I index ranges from -1 to 1: if Moran's I < 0, there is negative spatial interaction between regions; if Moran's I > 0, there is positive spatial interaction between regions; if Moran's I = 0, there is no spatial interaction between regions.

The spatial weight matrix for geographic distance in this study is established based on the inverse square of the geographic distance between two cities, aiming to assess whether geographic proximity influences the impact of financial agglomeration on urbanization. Given data availability, linear distance (d) is used as the standard, as shown below.

$$W_{ij} = \begin{cases} \frac{1}{d_{ij}^2} & (i \neq j) \\ 0 & (i = j) \end{cases}$$

W_{ij} represents the weight of the geographic distance between cities i and j . The smaller the distance between the two cities, the greater the weight. d_{ij} represents the geographic distance between cities i and j .

3.2 Spatial econometric models

Spatial econometric models include the Spatial Lag Model (SLM), Spatial Error Model (SEM), and Spatial Durbin Model (SDM). To determine whether SLM or SEM is more appropriate, the LM (lag) test is proposed. If LM (lag) shows statistical significance in the spatial dependence test, SLM is suitable; if not, SEM is more appropriate. The SLM primarily examines

whether there are spillover effects among variables within regions. The expression is as follows:

$$Y_{it} = \rho \sum_{j=1}^N W_{ij} Y_{it} + \beta X_{it} + \alpha_i + \tau_t + \mu_{it}$$

In this formula, Y_{it} represents the depended variable, referring to the urbanization level of region i in year t ; $\rho \sum_{j=1}^N W_{ij} Y_{it}$ denotes the spatial lag of the dependent variable. X_{it} signifies the core explanatory variable; ρ is the spatial auto-correlation coefficient; W_{ij} is an $n \times n$ matrix representing the spatial weight matrix based on geographic distances, β represents the parameter estimates of the independent variables, α_i stands for spatial fixed effects, τ_t denotes time fixed effects, and μ_{it} represents the random error term.

The spatial error model is suitable for analyzing spatial heterogeneity, where the spatial correlation of the target variable depends on the random error term. In equation, ε_{it} represents the spatial dependence of sample observations, indicating the extent to which variables in one region spillover to neighboring regions. ε_{it} follows a normal distribution as the random error vector. The model can be expressed as:

$$Y_{it} = \beta X_{it} + \alpha_i + \tau_t + \varepsilon_{it}$$

$$\varepsilon_{it} = \lambda \sum_{j=1}^N W_{ij} \varepsilon_{it} + \mu_{it}$$

The Spatial Durbin Model (SDM) is a general form of spatial econometric models. Under certain conditions, it can be simplified to include both spatial lag and spatial error terms of the dependent variable. The model considers not only the spatial correlation of the explanatory variables but also their spatial lag effects. When $\theta = 0$, SDM reduces to the Spatial Lag Model (SLM). when $\theta = \rho = 0$, SDM degrades to the Spatial Error Model (SEM).

The model can be expressed as equation (5):

$$Y_{it} = \rho \sum_{j=1}^N W_{ij} Y_{it} + \beta X_{it} + \theta \sum_{j=1}^N W_{ij} X_{it} + \alpha_i + \tau_t + \mu_{it}$$

In the equation, Y_{it} represents the dependent variable, X_{it} denotes the explanatory variables, ρ is the spatial auto-correlation coefficient, W_{ij} is the spatial weight matrix, $\theta \sum_{j=1}^N W_{ij} X_{it}$ and $\rho \sum_{j=1}^N W_{ij} Y_{it}$ respectively represent the spatial lag of the explanatory and dependent variables. β , θ represent the regression coefficients of the explanatory variables and their spatial relationships, and μ_{it} is the error term. The determination of whether the Spatial Durbin Model (SDM) can be simplified to the Spatial Lag Model (SLM) or Spatial Error Model (SEM) is assessed using Wald tests and LR statistics. If the Wald-spatial-lag and LR-spatial-lag values do not pass significance tests, it indicates that SDM should be reduced to SLM or SEM.

To investigate the spatial relationship between financial agglomeration level and urbanization (both population and economic) in the southwestern region of China, this study introduces a spatial panel Durbin model. All variables are expressed in logarithmic form to mitigate potential heteroskedasticity.

$$\ln Eurba_{it} = \alpha_0 + \rho \sum_{j=1}^n W_{ij} \times (\ln Eurbz_{jt}) + \phi \ln Finsa_{it} + \theta \sum_{j=1}^n W_{ij} \times \ln Finsa_{jt} + \emptyset \ln X_{it} +$$

$$\gamma \sum_{j=1}^n W_{ij} \times \ln X_{jt} + \alpha_i + \tau_t + \mu_{it}$$

$$\ln Purba_{it} = \alpha_0 + \rho \sum_{j=1}^n W_{ij} \times (\ln Purbz_{jt}) + \phi \ln Finsa_{it} + \theta \sum_{j=1}^n W_{ij} \times \ln Finsa_{jt} + \emptyset \ln X_{it} +$$

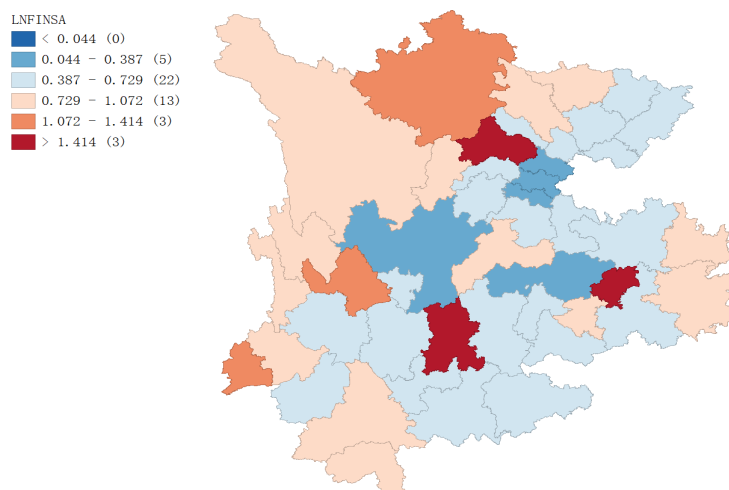
$$\gamma \sum_{j=1}^n W_{ij} \times \ln X_{jt} + \alpha_i + \tau_t + \mu_{it}$$

In the above formula, W represents the spatial matrix where i and j denote different cities; t denotes the year; $Eurba_{it}$, $Purba_{it}$ respectively represent the economic urbanization and population urbanization levels of city i in year t . α_0 is the intercept term; ρ denotes the coefficient of spatial lag term; ϕ , θ and \emptyset , γ are parameters to be estimated. α_i , τ_t respectively represent region fixed effects and time fixed effects; μ_{it} is the error term; $Finsa_{it}$ represents the financial agglomeration level of city i in year t ; X_{it} denotes the set of all control variables.

4. Rebounding and Defensive Comprehensiveness

4.1 Map of Financial Agglomeration Index

Figure 1 The distribution map of the Financial Agglomeration Index for the year 2020.



Based on the data presented in the figure, the distribution of the Financial Agglomeration Index across three provinces in 2020 reveals several key points. First, high financial agglomeration areas in Yunnan and Sichuan are concentrated in provincial capitals and surrounding regions, such as Kunming and Chengdu, with financial agglomeration indices greater than 1.41. In contrast, Guizhou's high financial agglomeration areas are primarily located in and around Guiyang. Secondly, Guizhou's financial agglomeration index distribution is relatively uniform, with most regions exhibiting low levels of financial agglomeration. In comparison, Yunnan and Sichuan display significant variations in their financial agglomeration indices, with distinct high agglomeration zones. Lastly, the peripheral areas of all three provinces generally have lower financial agglomeration indices, indicating that financial resources are predominantly concentrated in central cities and more economically developed regions.

4.2 Spatial Auto-correlation Analysis

Using the inverse distance squared geographic spatial weight matrix and GeoDa software, the bi-variate Moran's I indices for financial agglomeration with population urbanization and economic urbanization in the southwestern region of China from 2011 to 2020 were calculated. Spatial correlation tests were conducted, and the results are shown in Table 2.

Table 2 Moran's I index

Financial agglomeration and population urbanization			Financial agglomeration and economic urbanization		
Year	Moran's I	P-value	Year	Moran's I	P-value
2011	-0.092	0.033	2011	-0.092	0.038
2012	-0.084	0.046	2012	-0.088	0.039
2013	-0.088	0.044	2013	-0.045	0.212
2014	-0.078	0.059	2014	-0.040	0.258
2015	-0.079	0.041	2015	-0.063	0.090
2016	-0.066	0.076	2016	-0.085	0.046
2017	-0.061	0.094	2017	-0.090	0.037
2018	-0.053	0.149	2018	-0.077	0.050
2019	-0.024	0.380	2019	-0.062	0.094
2020	0.048	0.048	2020	0,004	0.376

The results indicate that from 2011 to 2020, the Moran's I statistics for financial agglomeration and urbanization were predominantly negative and statistically significant in most years. This suggests a significant spatial relationship between financial agglomeration and both population urbanization and economic urbanization. Therefore, when analyzing the characteristics and influencing factors of financial agglomeration in the southwestern region of China, it is essential to consider geographic factors and spatial effects. This necessitates the construction of a spatial panel model for further research,

providing a basis for subsequent studies.

4.3 Tests for Spatial Econometric Models

To further examine the presence of spatial correlation and to select the appropriate model, we conducted LM tests, LR tests, and Wald tests in table 3. LM tests are preliminary tests used to determine the existence of spatial auto-correlation. These tests include examinations of the Moran's I statistic as well as tests related to spatial lag and spatial error models. LR tests, on the other hand, are used to assess the suitability of different spatial models, determining which model is the most appropriate. Wald tests are employed to check whether the chosen optimal spatial model could degenerate into other spatial models, ensuring the optimality of the model.

Table 3 Spatial panel model test

Spatial panel model test		Finsa / Eurba		Finsa / Purba	
		Statistic	P-value	Statistic	P-value
LM test	Moran's I	15.298***	0.000	10.138***	0.000
	LM-lag	221.495***	0.000	95.958***	0.000
	Robust-LM-lag	144.499***	0.000	113.981***	0.000
	LM-error	80.278***	0.000	7.575***	0.006
	Roust-LM-error	3.282*	0.070	25.594***	0.000
LR test	LR-SDM/SAR	54.01***	0.000	54.50***	0.000
	LR-SDM/SEM	71.14***	0.000	108.72***	0.000
Wald test	Wald-SDM/SAR	54.87***	0.000	51.99***	0.000
	Wald-SDM/SEM	71.35***	0.000	85.84***	0.000
Spatial-time fixed effect test	LR-both/ind	27.95***	0.0018	3.78	0.9568
	LR-both/time	759.29***	0.0000	2428.58***	0.000

Note: ***, **, * are significant at 1%, 5%, and 10% levels respectively.

The results of the LM test, as shown in the table, further confirm the spatial relationship between financial agglomeration and urbanization. To explore whether the Spatial Durbin Model (SDM) may degenerate into the Spatial Auto-regressive Model (SAR) or the Spatial Error Model (SEM), the results of the LR test indicate that the SDM is more accurate than the SAR and SEM, rejecting the possibility of degeneration into SAR and SEM at the 1% significance level. Additionally, the Wald test results also confirm that the SDM does not degenerate into the SAR or SEM, further validating the robustness of the results.

4.4 Empirical Analysis and Results

Table 4 presents the empirical results and related indicators of the impact of financial agglomeration on population urbanization and economic urbanization under the inverse distance squared geographic spatial weight matrix.

Table 4 The empirical results of SDM

	LnEurba	LnPurba
LnFinsa	0.7063*** (4.52)	0.1448*** (3.30)
LnINT	0.3723*** (4.10)	-0.0294 (-1.16)
LnINF	0.0228 (1.16)	0.0257*** (4.67)
LnFDI	0.0024 (0.71)	-0.0009 (-1.01)
LnGOV	0.1298*** (2.30)	-0.0112 (-0.74)

	LnEurba	LnPurba
LnIND	0.2837*** (5.31)	0.009 (0.60)
LnSIC	0.0091 (0.72)	-0.0059 (-1.64)
LnEDU	0.0292 (1.06)	-0.0208** (-2.69)
LnMED	0.0590 (1.53)	0.0270** (2.50)
WLnFinsa	0.8651*** (2.79)	0.3421*** (4.32)
WLnINT	-0.1067 (-0.49)	0.1450*** (3.71)
WLnINF	0.0200 (0.44)	0.0225* (1.90)
WLnFDI	0.0071 (0.82)	-0.0010 (-0.51)
WLnGOV	0.1163 (1.41)	-0.0283 (-1.36)
WLnIND	-0.4201*** (-3.93)	0.0561** (1.98)
WLnSIC	-0.1058*** (-3.31)	-0.0100 (-1.21)
WLnEDU	0.1338*** (2.67)	-0.0710*** (-4.69)
WLnMED	0.679 (0.77)	0.0360 (1.62)
ρ	0.6082*** (13.59)	0.2369*** (3.61)
R2	0.7617	0.7283
Log-likelihood	377.91	969.84

Note: ***, **, * are significant at 1%, 5%, and 10% levels respectively.

In this study, the Spatial Durbin Model (SDM) was applied to empirically analyze the relationship between financial agglomeration and urbanization. To enhance the robustness of the estimation results, eight control variables were included: infrastructure level, fixed asset investment, actual foreign investment, government expenditure, industrial level, technological development level, education level, and healthcare level. The results indicate that at the 1% significance level, financial agglomeration positively affects both the internal and spillover effects on population urbanization and economic urbanization. This demonstrates that an increase in the level of financial agglomeration not only promotes population and economic urbanization within the region but also has a positive impact on the urbanization of surrounding areas. In terms of the extent of the impact, the increase in financial agglomeration level has a greater effect on economic urbanization than on population urbanization.

The level of transportation infrastructure shows a positive correlation with the internal effects on economic urbanization. This is primarily because improvements in transportation facilities can effectively promote local economic activities and attract investment. However, its internal effects on population urbanization are insignificantly negative, possibly due to the convenience of transportation leading people to choose to live in surrounding areas. Fixed asset investment shows a positive correlation with both population urbanization and economic urbanization, but its positive correlation with economic

urbanization is not significant. This is mainly due to weak economic foundations, industrial structure issues, and low capital efficiency. Actual foreign investment shows an insignificantly negative correlation with both economic and population urbanization. This reflects the limited effect of foreign investment in driving economic restructuring and development. Government expenditure shows a significantly positive correlation with the internal effects on economic urbanization, mainly attributed to its positive role in infrastructure development and job creation. However, it shows an insignificantly negative correlation with the internal effects on population urbanization, indicating that government spending has not effectively promoted population migration and integration into urban areas. The development of the secondary industry has a significantly positive correlation with the internal effects on economic urbanization, while it shows an insignificantly positive correlation with population urbanization. This may be due to the diversity of the labor source and the mobility of local residents. Research and development (R&D) expenditure shows an insignificantly positive correlation with the internal effects on economic urbanization and an insignificantly negative correlation with population urbanization. This is primarily because the effects of technological innovation take time to materialize and are influenced by the mobility of talent. Education level shows an insignificantly positive correlation with the internal effects on economic urbanization, possibly due to the mismatch in the job market and economic structural limitations. However, it shows a significantly negative correlation with the internal effects on population urbanization, mainly due to the outflow of highly educated individuals. Healthcare level shows an insignificantly positive correlation with the internal effects on economic urbanization, but a significantly positive correlation with the internal effects on population urbanization. This reflects the attractiveness of high-level medical services to residents' quality of life and settlement choices.

The level of transportation infrastructure shows an insignificantly negative correlation with the spillover effects on economic urbanization in surrounding areas, possibly due to resource competition and regional development imbalances. However, it has a significantly positive correlation with the spillover effects on population urbanization, reflecting the positive influence of improved transportation facilities on population inflow and diverse residential choices in neighboring regions. Fixed asset investment shows a positive correlation with both economic and population urbanization spillover effects. However, the positive correlation with economic urbanization is not significant, mainly due to weak economic foundations and industrial structure issues. The positive correlation with population urbanization is significant, benefiting from improvements in infrastructure and public services, as well as the promotion of regional coordinated development. Actual foreign investment shows insignificant spillover effects on both economic and population urbanization. This indicates the limited impact of foreign investment in balancing regional development and increasing the inflow of external populations. Government expenditure shows a positive but insignificant spillover effect on economic urbanization, possibly influenced by resource constraints and policy implementation issues. The spillover effect on population urbanization is insignificantly negative, suggesting that government expenditure might increase the pressure on urban social management. The development of the secondary industry has a significantly negative spillover effect on economic urbanization, mainly due to environmental burdens and resource competition. However, it has a significantly positive spillover effect on population urbanization, primarily due to the increase in social service facilities and the driving force of regional economic growth. R&D expenditure shows a significantly negative spillover effect on economic urbanization, reflecting the impact of technological diffusion on local economies. The spillover effect on population urbanization is insignificantly negative, mainly due to the mobility of talent. Education level shows a significantly positive spillover effect on economic urbanization, highlighting its positive role in attracting talent and promoting technology transfer. However, it has a significantly negative spillover effect on population urbanization, possibly due to the outflow and settlement trends of highly educated individuals. Healthcare level shows an insignificantly positive spillover effect on economic urbanization and an insignificantly positive spillover effect on population urbanization. This may be because the limitations of healthcare services have not significantly extended to surrounding areas.

5. Conclusions and Recommendations

This study focuses on 46 prefecture-level cities in southwestern China from 2011 to 2020, using the Location Quotient (LQ) method to measure the level of financial agglomeration and employing satellite data to estimate the levels of population and economic urbanization. Moran's I index was used for spatial auto-correlation analysis, followed by the Spatial Durbin Model

(SDM) to investigate the spatial relationship between financial agglomeration and urbanization. Transportation infrastructure, healthcare levels, fixed asset investment, industrial development, technological advancement, and education levels were included as control variables in the empirical analysis. The results indicate that financial agglomeration has significant positive internal and spillover effects on population and economic urbanization at the 1% significance level. The main conclusions and policy recommendations are as follows.

5.1 Main Conclusions

Spatial Characteristics of Financial Agglomeration: Southwestern China exhibits spatial characteristics of financial agglomeration. Financial agglomeration has significant positive internal and spillover effects on both population and economic urbanization at the 1% significance level, primarily influencing urbanization levels through indirect effects.

Control Variables' Influence: Industrial development, government expenditure, fixed asset investment, and healthcare levels significantly promote both economic and population urbanization in southwestern China. Education levels negatively affect the internal effects on population urbanization but positively influence the spillover effects on economic urbanization. Transportation infrastructure and healthcare levels mainly impact urbanization through direct effects, while industrial development, government expenditure, fixed asset investment, education levels, and technological advancement mainly affect urbanization through indirect effects.

5.2 Policy Recommendations

Promote Regional Financial Centers: Develop regional financial centers in southwestern China by selecting cities with geographical and economic advantages to establish financial special zones, attracting domestic and international financial institutions. Enhance financial infrastructure, such as financial technology, payment systems, and credit systems, in less developed areas to improve financial service convenience and efficiency. Provide tax incentives, financing facilitation, and land use benefits to attract financial institutions and related enterprises.

Strengthen Financial Support for Urbanization: Innovate financial products and services to meet urbanization needs, such as housing loans and urban infrastructure financing, providing financial support for both population and economic urbanization. Promote inclusive finance by extending financial services to small and medium-sized cities and towns through policy guidance and technological innovation to ensure balanced regional development.

(1) **Leverage Financial Agglomeration Spillover Effects:** Enhance regional financial cooperation to facilitate cross-regional financial resource flows, thereby boosting the spillover effects of financial agglomeration. Establish regional financial cooperation mechanisms for resource sharing and complementary advantages. Increase investment in financial technology R&D, encourage the use of big data and AI by financial institutions to improve service efficiency, and focus on financial talent development to attract high-end financial professionals and elevate the regional financial sector.

(2) **Invest in Infrastructure and Public Services:** Increase investments in transportation, healthcare, government spending, industrial development, fixed assets, and education to provide a solid foundation for urbanization through their internal and spillover effects. Pay special attention to underdeveloped areas in southwestern China, utilizing these elements to maximize their spillover effects on surrounding regions.

(3) **Enhance Policy Coordination and Innovation:** Establish multi-level coordination mechanisms involving local governments, financial institutions, and enterprises to form a cohesive policy force for promoting financial agglomeration and urbanization. Deepen financial system reforms, open up financial markets, and improve the competitiveness and service level of the financial sector to support the urbanization process. Continuously monitor and evaluate the development of urbanization and financial agglomeration, adjusting policies as needed to ensure effective implementation and achievement of objectives.

(4) **Implementing these policy recommendations can effectively promote the coordinated development of financial agglomeration, population urbanization, and economic urbanization in southwestern China, thereby enhancing the region's overall competitiveness and sustainability.**

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