Research on Regional Differences and Spatial Effects of Inclusive Finance Driven by Financial Technology

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Abstract

This study constructs a fintech and inclusive finance evaluation system using principal component analysis and the entropy method, and conducts empirical research based on provincial panel data in China through spatial econometric models. The findings reveal that fintech significantly promotes inclusive finance development but exhibits regional heterogeneity, with stronger effects in eastern and western regions compared to central areas. Education level, communication infrastructure, and the proportion of tertiary industry are identified as key driving factors. Spatial analysis indicates the formation of "high-high" agglomeration zones in eastern coastal regions, while central and western areas demonstrate "low-low" development challenges. The study innovatively uncovers the spatial spillover mechanism through which fintech drives inclusive finance, providing a basis for formulating differentiated policies.

Keywords

FinTech, Inclusive finance, PCA, Entropy Weight Method, GMM, Moran's Index.

1. Introduction

In the era of digital economy, fintech is reshaping the global financial landscape and creating new opportunities for inclusive finance development[1]. While inclusive finance aims to provide equitable financial services to all social strata, traditional models relying on branch network expansion and credit policy preferences face bottlenecks such as limited service coverage and high operational costs[2]. The rise of fintech offers new pathways to overcome these constraints, demonstrating significant potential.

Existing research generally agrees that fintech enhances financial service accessibility in remote areas by reducing transaction costs, improving efficiency, and expanding coverage, thereby transforming traditional inclusive finance model[3-5]. Furthermore, fintech's influence extends to the macroeconomic level[6]. By improving financial inclusion and optimizing resource allocation efficiency, fintech indirectly promotes economic growth, though its effectiveness is constrained by institutional environments and digital infrastructure development[7]. Therefore, understanding the driving role of fintech in inclusive finance is crucial for sustainable development.

This study systematically examines fintech's impact on inclusive finance using provincial panel data from China. By employing spatial econometric methods, we analyze regional disparities in fintech and inclusive finance development. Based on the findings, we propose differentiated policy recommendations to support sustainable inclusive finance through fintech innovation.

2. Research Methods

2.1. Measurement of Financial Technology Level (FinTech)

2.1.1. Indicator Selection

The study constructs a financial technology index system based on four dimensions: factor foundation, technological environment, digital inclusive finance, and financial technology cognition.[8,9] Factor foundation includes three indicators: economic scale, population scale, and financial resources; technological environment covers five indicators such as the number of registered fintech enterprises and high-tech industry employees; digital inclusive finance uses three dimensions of the Peking University Digital Inclusive Finance Index; financial technology cognition is measured by crawling the Baidu search index of 22 keywords using Python. Data sources include China Statistical Yearbook, China Fintech Enterprise Database, China Torch Statistics Yearbook, Peking University Digital Inclusive Finance Index, and Baidu Index Official Website.

2.1.2. Measurement Method

This study uses the Principal Component Analysis (PCA) to construct a comprehensive financial technology index. The specific measurement steps are as follows: First, standardize the original data and normalize it to the [0,10] interval; second, verify the correlation of indicators through the KMO test (0.797) and Bartlett's sphericity test ($p<0.01$). The results show a strong correlation between secondary indicators, making PCA suitable for synthesizing the financial technology index; then, extract the first three principal components with eigenvalues greater than 1 and a cumulative variance contribution rate exceeding 80%, as shown in Table 1; finally, calculate the financial technology index scores of each province by weighting the variance contribution rates of each principal component.

Table 1. Results of PCA on FinTech Index

Component	Eigenvalue	Variance Percentage (%)	Component	Component	Eigenvalue	Variance Percentage (%)	Component
1	6.34	52.833	52.833	7	0.228	1.897	97.232
2	2.367	19.276	72.558	8	0.14	1.171	98.403
3	1.454	12.12	84.679	9	0.061	0.507	98.91
4	0.512	4.269	88.948	10	0.054	0.454	99.364
5	0.44	3.671	92.619	11	0.04	0.337	99.701
6	0.326	2.717	95.335	12	0.036	0.299	100

2.2. Measurement of Inclusive Finance Level

2.2.1. Indicator Selection

This study constructs an inclusive finance index system covering four dimensions[10,11]: availability (per capita deposit/loan balances, insurance density), accessibility (outlets/employees per 10,000 people or per 10,000 km^2), effectiveness (deposit/loan-to-GDP ratios, insurance penetration), and sustainability (non-performing loan ratio, insurance payout ratio). It comprehensively evaluates development levels by integrating positive and negative indicators, with data from China Financial Yearbook, the People's Bank of China, and national financial regulatory authorities.

2.2.2. Measurement Method

This paper uses the entropy method to construct an inclusive finance development level index. The entropy method is an objective weighting method that determines weights based on the variation degree of indicators by calculating their information entropy. The specific calculation process is as follows: first, standardize the original data and distinguish between positive and

negative indicators; second, calculate the characteristic proportion, entropy value, and difference coefficient of each indicator to determine weights; finally, synthesize the comprehensive index by weighting. This method objectively assigns weights through the variation degree of indicators, avoiding subjective bias and being suitable for multi-dimensional comprehensive evaluation.

2.3. Panel Regression Analysis

2.3.1. Variable Setting and Explanation

This study employs the Inclusive Finance Development Index (*IFI*) as the core dependent variable, a positive indicator reflecting regional inclusive finance levels through coverage breadth, usage depth, and digitization. The key explanatory variable is the logarithmic Financial Technology Development Index (*LnFT*), with higher values indicating faster fintech growth. Control variables include urbanization rate (*LnC*), education level (*LnEdu*), tertiary industry share (*LnTh*), and communication infrastructure (*LnFI*), capturing urbanization, human capital, economic structure, and IT infrastructure.

2.3.2. Model Setting

To ensure the accuracy of the results, it is necessary to incorporate the endogeneity problem into the analysis. This paper will apply the system generalized method of moments (system GMM) for regression. The regression method based on system GMM and robust standard errors can more effectively combine moment conditions, which can effectively mitigate the existing multicollinearity and endogeneity problems in the model, while well eliminating the negative interference of heteroscedasticity on the model. The regression model is as follows:

$$IFI_{it} = \beta_0 + \beta_1 IFI_{i,t-1} + \beta_2 LnFT_{it} + \beta_j \text{Lncontrol}_{i,t} + u_i + \varepsilon_{it}$$

Among them, IFI_{it} represents the dependent variable; $IFI_{i,t-1}$, the lagged first-period term of the dependent variable, is introduced as an instrumental variable to help alleviate the endogeneity problem of the model; $LnFT_{it}$ represents the explanatory variable; and $Lncontrol_{i,t}$ represents each control variable.

To further investigate the heterogeneity in the impact of financial technology on the development level of inclusive finance, this paper divides provinces (municipalities directly under the Central Government, autonomous regions) into three regions-eastern, central, and western-according to geographical location, and will conduct regression analysis on the samples by region. The division is shown in Table 2.

Table 2. Regional Division and Corresponding Provinces

Region	Provinces
Eastern	Guangdong, Beijing, Jiangsu, Zhejiang, Shandong, Hebei, Fujian, Liaoning, Tianjin, Hainan
Central	Henan, Hubei, Anhui, Hunan, Jiangxi, Shanxi, Heilongjiang, Jilin
Western	Sichuan, Shaanxi, Chongqing, Guangxi, Yunnan, Guizhou, Inner Mongolia, Gansu, Ningxia, Qinghai, Xinjiang

2.4. LISA Local Spatial Agglomeration Analysis

This study uses the LISA (Local Indicators of Spatial Association) method for local spatial agglomeration analysis, mainly based on its methodological advantages of effectively identifying regional spatial heterogeneity and agglomeration characteristics. By separately drawing LISA cluster maps of financial technology development level and digital inclusive finance development, we can visually compare the spatial distribution patterns of the two core

variables and reveal the synergy and differences in their spatial agglomeration patterns, providing visual evidence for understanding the spatial spillover mechanism of financial technology driving inclusive finance development. This comparative analysis method can not only identify "high-high" agglomeration hotspots and "low-low" agglomeration coldspots but also provide a scientific basis for formulating differentiated regional coordination policies. The calculation formula for the local Moran's I is:

$$I_i = \frac{(x_i - \bar{x})}{s^2} \sum_{j=1}^{n} w_{ij}(x_j - \bar{x})$$

Where x_i is the observation value of the region, s^2 is the sample variance, and w_{ij} is the weight matrix. This paper selects a spatial adjacency weight matrix for analysis, where 1 indicates adjacency between two regions and 0 indicates non-adjacency.

3. Research Results

Table 3. FinTech Index of Provinces by Year

Province	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Guangdong	8.18	9.27	11.15	14.09	16.18	18.72	19.18	19.98	20.17	20.61
Beijing	7.78	8.92	10.25	11.24	12.21	14.18	14.09	14.53	15.13	15.2
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Jiangsu	7.4	6.65	8.46	9.44	11.28	13.01	13.8	14.52	14.82	16.2
Xinjiang	1.88	2.12	3.59	3.29	4.22	4.84	5.05	5.18	5.83	5.98

Table 4. Inclusive Finance Index of Provinces by Year

Province	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Guangdong	0.25	0.25	0.27	0.29	0.29	0.3	0.31	0.32	0.33	0.35
Beijing	0.5	0.36	0.38	0.61	0.62	0.63	0.66	0.67	0.68	0.69
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Jiangsu	0.23	0.25	0.36	0.28	0.29	0.3	0.32	0.33	0.35	0.36
Xinjiang	0.19	0.22	0.21	0.25	0.26	0.27	0.26	0.27	0.25	0.26

Table 5. GMM Regression Results of Inclusive Finance in Eastern, Central and Western Regions

Explanatory Variable	IFI (Eastern)	IFI (Central)	IFI (Western)
LnFT	0.0773***(0.0101)	0.035***(0.0097)	0.0736***(0.012)
LnC	-0.1226(0.118)	0.0537(0.135)	-0.00358288
LnEdu	0.2463***(0.1043)	0.2364***(0.0654)	0.1098***(0.0191)
LnTh	0.1338*(0.0746)	0.044(0.0343)	0.3241***(0.0305)
LnFI	0.2202***(0.0356)	-0.0006(0.0264)	-0.005(0.0066)
_Cons	1.790148***(0.3563)	1.4114(0.2011)	1.0474***(0.0696)
Individual Effects	Controlled	Controlled	Controlled
Time Effects	Controlled	Controlled	Controlled
R^2	0.9781	0.9166	0.7725

The results are shown in Table 3, Table 4 and Table 5.In eastern China, fintech development (coefficient 0.0773, 1% significant) significantly boosts inclusive finance, alongside education (0.2467, 5% significant) and communication capacity (0.2202, 1% significant). Central China shows weaker fintech impact (0.035, 1% significant) but strong education effects (0.2364, 1% significant). Western China benefits from fintech (0.0736, 1% significant), education (0.1098, 1% significant), and tertiary industries (0.3241, 10% significant).

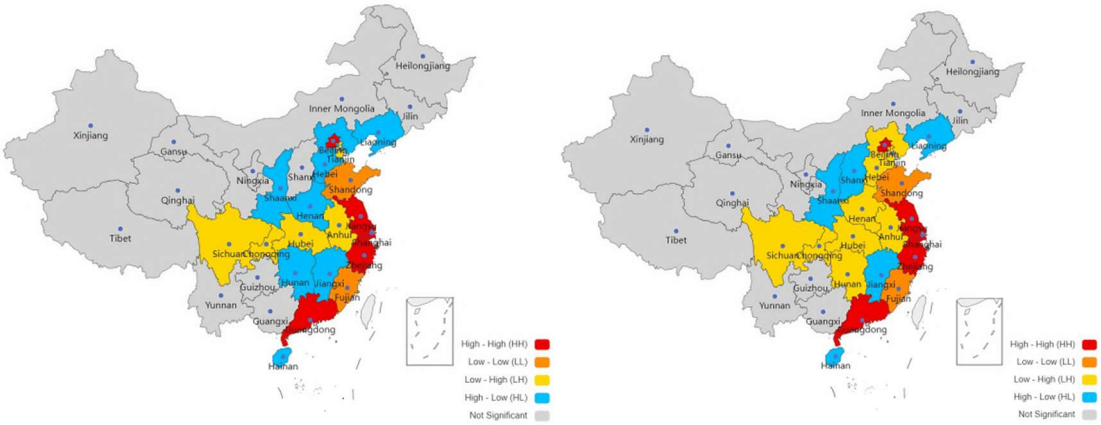

Figure 1. Comparative Spatial Distribution Patterns of FinTech Index and Inclusive Finance Index

As shown in Figure 2, China's fintech and digital inclusive finance show distinct spatial clustering. High-High (HH) clusters (e.g., Beijing, Shanghai, Jiangsu, Zhejiang, Guangdong) lead in innovation and economic strength. Low-High (LH) areas (e.g., Tianjin, Anhui, Hubei) benefit from neighboring spillovers, while High-Low (HL) regions (e.g., Hebei, Liaoning) face constraints from weaker surroundings. Shandong (LL in fintech, LH in inclusive finance) and Hebei (HL in fintech, LH in inclusive finance) reveal development imbalances.

4. Conclusion

Based on provincial panel data in China, this study reveals that fintech significantly promotes inclusive finance development but exhibits regional disparities, with stronger effects in eastern and western regions than in central areas. Key drivers include education levels, communication infrastructure, and the proportion of tertiary industries. Spatially, eastern coastal regions demonstrate "high-high" agglomeration, while parts of central and western China face "low-low" development traps, showing distinct clustering patterns.

Region-specific strategies are essential: Eastern regions should deepen fintech integration to establish regional hubs and drive spillover effects; central areas must address fintech gaps by upgrading infrastructure, nurturing talent, and attracting fintech firms; western provinces can leverage local industries and policies to expand inclusive finance while collaborating with eastern counterparts for industrial transfers. Nationally, coordinated policies and resource-sharing mechanisms are critical to reducing regional disparities and fostering balanced, sustainable development of inclusive finance.

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