

Digital Inclusive Finance and Foreign Direct Investment: Regression Analysis Based on Spatial Econometric Models

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Abstract

This study investigates the relationship between digital inclusive finance (DIF) and foreign direct investment (FDI) in China, using panel data from 31 provinces, municipalities, and autonomous regions from 2011 to 2022. The research employs a dual fixed spatial Durbin model to empirically analyze the impact of DIF on FDI and its spatial effects. The primary issue addressed in the study is how DIF influences FDI, both within a region and across neighboring areas. The main objective of the research is to evaluate the spatial clustering characteristics between DIF and FDI and to determine whether DIF significantly enhances FDI levels in a region. Furthermore, the study aims to understand the "siphon effect," where DIF may attract FDI away from surrounding areas. Methodologically, the dual fixed spatial Durbin model is utilized to capture both the direct and spillover effects of DIF on FDI across regions. The study examines regional heterogeneity, particularly how the impact of DIF varies across eastern, central, and western China. The results reveal that DIF indeed has a spatial clustering distribution with FDI, which can significantly boost FDI within a region. However, it also generates a siphon effect, attracting FDI from surrounding areas. Additionally, the study highlights regional differences, with the positive effect of DIF on FDI diminishing as one moves from the eastern to the western regions. Meanwhile, the negative spatial spillover effect of DIF development on neighboring areas is significant across all regions. Based on these findings, the study recommends tailored policy interventions to address regional disparities and mitigate adverse spillover effects, ensuring balanced development across regions.

Keywords: *Digital Inclusive Finance, Foreign Direct Investment, Spatial Effect, Spatial Durbin Model*

A. Introduction

Since the concept of inclusive finance was introduced in China in 2005, it has made great progress in concept, theory, and practice. With the continuous in-depth application of emerging technologies such as the Internet, cloud computing, AI, etc., in China, inclusive finance has become increasingly perfect in expanding service coverage, reducing the threshold for service acquisition, and innovating digital technology for services. Digital inclusive finance has also significantly narrowed the economic gap between cities within the province, supporting economic growth while balancing fairness and efficiency.

There is relatively little research on the relationship between digital inclusive finance and foreign direct investment, mainly focusing on analyzing the factors that influence foreign direct investment through digital inclusive finance. There is a lack of in-depth understanding of the economic connotations and mechanisms of the specific effects of each factor, especially on the spatial effects and heterogeneity that exist. This article explores the spatial effects and regional heterogeneity of digital inclusive finance on foreign direct investment by constructing spatial econometric models and relevant tests, starting from the spatial correlation between digital

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inclusive finance and foreign direct investment. It enriches the theoretical research on the spatial effects of digital inclusive finance on foreign direct investment and provides certain reference significance for promoting the new development of domestic digital inclusive finance, enhancing openness, and attracting foreign investment.

Kapoor (2014) proposed that inclusive finance promotes financial and economic development and supports social stability and harmony, thanks to the convenience and inclusiveness of financial services. The regional business environment can also affect the level of foreign direct investment. Vo et al. (2019) found in their study of emerging and frontier market countries such as Vietnam that inclusive finance can enhance financial stability at a certain threshold, provide affordable financial products and services for small and medium-sized enterprises and individuals, promote the growth of export trade and stabilize domestic inflation levels, and contribute to the stable development of the macroeconomy. With the innovative development of digital technology, financial technology serves inclusive finance and forms a new form of digital inclusive finance. It can not only reduce poverty and financial security but also have a positive impact on financial inclusion and welfare (Patwardhan, 2018). Brener (2019) believes that digital inclusive finance integrates inclusive finance and Internet technology. The wide application of innovative financial technologies such as cross-border payment of mobile Internet can greatly reduce the cost of payment services for enterprises, provide broad development space for financial technology companies, and encourage traditional financial institutions such as banks to accelerate the reform process of financial services. Uddin et al. (2020) found that banks that have experienced financial crises are more actively accepting the application of network technology and increasing strategic investment in digital technology to cope with increasingly fierce market competition and digital financial risks through digital transformation.

Corcoran and Gillenders (2015) used the World Bank's Ease of Doing Business (DBR) to study the factors that affect foreign direct investment (FDI) and found that the domestic business environment and regulatory system directly affect foreign investment, especially for middle-income countries, which is of great significance. Government fiscal expenditure is conducive to expanding the consumer market, increasing labor supply for industrial development, ensuring high-quality development of foreign enterprises, and rising foreign investment (Lewis and Winkler, 2017).

The general objective of this study is to analyze the impact of digital inclusive finance on foreign direct investment (FDI) across various regions in China, focusing on both the direct and spillover effects. Specifically, the research aims to (1) assess the spatial relationship and clustering patterns between digital inclusive finance and FDI, (2) evaluate the influence of digital inclusive finance on enhancing FDI within individual regions, (3) examine the "siphon effect," where digital inclusive finance in one region may attract FDI away from neighboring areas; and (4) investigate regional heterogeneity in the impact of digital inclusive finance on FDI, particularly across eastern, central, and western China. Through these specific objectives, the study seeks to provide a comprehensive understanding of how digital inclusive finance shapes FDI flows and offers insights for policymakers to foster balanced regional development.

The urgency of this study lies in the growing importance of digital inclusive finance (DIF) as a driver of economic development, particularly in the context of increasing foreign direct investment (FDI). In an era where digital technologies are transforming financial services, DIF has the potential to significantly influence investment patterns by improving access to economic resources, reducing transaction costs, and fostering financial inclusion. However, despite its importance, there is limited empirical evidence on how DIF affects FDI across different regions, especially in large, diverse economies like China. Understanding this relationship is crucial for regions seeking to attract foreign investment and promote economic growth.

Moreover, this study addresses a critical knowledge gap by examining the direct impact of DIF on FDI and its spatial spillover effects, which can either enhance or diminish investment in neighboring regions. This spatial dimension is often overlooked in traditional economic analyses but is essential for crafting effective, region-specific policies. Without understanding these spatial dynamics, unintended consequences exist, such as the "siphon effect," where investment is pulled away from less-developed areas. Given China's regional economic disparities, understanding the nuanced effects of DIF on FDI is urgent for promoting balanced and sustainable development. The findings from this study will provide valuable insights for policymakers aiming to leverage digital finance to attract FDI while ensuring equitable growth across regions. Thus, this research is timely and critical for shaping future financial and investment strategies.

B. Methods

1. Research Design

This study adopts a quantitative research design using spatial econometric models to examine the spatial effects of digital inclusive finance (DIF) on foreign direct investment (FDI). Specifically, a spatial Durbin model is employed, which allows for the analysis of both direct and spillover effects of DIF on FDI across regions. This design is suitable for understanding how changes in DIF in one region can influence FDI both locally and in neighboring areas. The study incorporates various weight matrices to ensure robustness, accounting for different spatial relationships between provinces.

2. Research Procedure

The research procedure begins with data collection spanning 31 provinces, municipalities, and autonomous regions in China from 2011 to 2022. The method includes calculating FDI using the proportion of foreign direct investment to GDP, which helps eliminate the bias introduced by varying economic scales across regions. The explanatory variable is the Peking University Digital Inclusive Finance Index, divided into three dimensions: coverage breadth, usage depth, and digitalization. Additional control variables, such as labor costs, industrial structure, urbanization rate, government intervention, education level, and informatization level, are also included to isolate the impact of DIF on FDI. These variables are measured using data from reputable sources, such as the National Tai'an Database (CSMAR) and the China Urban Statistical Yearbook.

3. Data Collection Techniques

The study collects annual data from reliable government databases and research institutions. FDI and GDP data are sourced from the CSMAR database, while control variables are extracted from the National Bureau of Statistics and the China Urban Statistical Yearbook. The Peking University Digital Inclusive Finance Index is obtained from reports published by the Peking University Digital Finance Research Center. This ensures consistency and comparability of data across the years and regions studied.

4. Data Analysis Techniques

For data analysis, the spatial Durbin model is applied to capture both the direct and indirect effects of DIF on FDI. This model considers the spatial dependence of regions, meaning it can measure how DIF in one province affects FDI in neighboring provinces, in addition to its local effects. Various weight matrices are used to enhance model accuracy, including distance-based matrices and time-varying spatial matrices. Control variables such as labor costs, urbanization, and industrial structure are integrated into the model to adjust for factors that could influence FDI beyond DIF. Monte Carlo simulations and robust LM tests are also employed to ensure

model validity and correct any potential biases or errors in the spatial econometric estimation process.

C. Findings and Discussion

Digital finance can effectively reduce enterprises' financing costs and risks, promote the improvement of their financial leverage, enhance their innovation capabilities and competitiveness, and thus attract an increase in foreign investment (Tang et al., 2020). In addition, digital inclusive finance can increase residents' consumption and significantly narrow the consumption gap between urban and rural residents (Zhang & Cai, 2021). Expanding credit channels and reducing rural precautionary savings can narrow the consumption gap between urban and rural residents. The increasing demand for enjoyment and development products among rural residents is also conducive to enterprises expanding investment and production. Many studies have proven the spatial spillover effect of digital inclusive finance. Digital inclusive finance can generate spatial spillover effects on micro enterprise innovation and development and promote industrial agglomeration and integration in the local area. The agglomeration of labor, capital, and technology attracts foreign investment inflows (Xia, 2021). Digital inclusive finance will also generate spatial heterogeneity in economic and industrial development. Regions with rapid growth of digital inclusive finance can provide many emerging job opportunities and are more attractive to talent and capital than regions with underdeveloped digital inclusive finance. Regions with higher levels of digital inclusive finance development are more favored by foreign direct investment (Song et al., 2022).

According to the regression results of the double fixed space Durbin model, the spatial autoregressive coefficient spatial rho passed the significance test at the 1% level, indicating a spatial spillover effect on foreign direct investment levels. The increase in foreign direct investment levels in surrounding areas will reduce the local area's foreign direct investment level. For every 1% increase in foreign direct investment in the surrounding regions, the level of foreign direct investment within and outside the local area will decrease by 0.3881%.

The regression coefficient of the Digital Inclusive Finance Index is 0.0513. It has passed the 1% significance level test, indicating that digital inclusive finance has a positive spatial effect on foreign direct investment, and the development of digital inclusive finance has a certain promoting effect on foreign direct investment. From the perspective of various control variables, labor cost, urbanization rate, government intervention, and education level all passed the 1% significance level test, with regression coefficients of 0.0336, 0.1641, 0.0531, and 1.5222, respectively, indicating that these four variables have a positive promoting effect on foreign direct investment. With the gradual disappearance of the demographic dividend, the advantage of domestic labor costs is no longer the primary factor driving foreign investment. On the contrary, the proportion of foreign investment in the service and high-tech industries is increasing, and a large amount of research and development investment is causing labor costs to skyrocket. At the same time, higher wage income can also bring more potential consumer markets, further attracting an increase in foreign investment. The increase in urbanization rate is also conducive to improving the level of foreign direct investment. Regions with high urbanization rates have significant relative infrastructure and business environment construction advantages. With the efficient administrative efficiency and preferential tax policies of the government, they are more attractive to foreign investment than regions with low urbanization levels. The government's fiscal expenditures and subsidies have greatly reduced the operating costs and investment risks of foreign investment, while the positive correlation of education level also confirms the trend of the domestic population dividend shifting towards talent dividend. The regression coefficients of industrial structure and informatization level did not pass the significance test, indicating that the impact of regional differences in industrial structure and

informatization on the foreign direct investment level is insignificant. This may be because the domestic industrial structure is in the process of upgrading and upgrading, and uncertain factors such as industrial transfer have, to some extent, slowed down the speed of foreign investment. At the same time, there are significant regional differences in informatization construction, and the impact on foreign-funded enterprises and foreign direct investment is still relatively weak.

Due to the inclusion of spatial factors in the model, using point estimation to measure the spatial effects between variables may result in bias. To address this issue, we will continue performing partial differential decomposition on the spatial Durbin model, decomposing the spatial effects of digital inclusive finance on foreign direct investment into direct, indirect, and total effects. The direct effect represents the average impact of the explanatory variable in a certain region on the dependent variable within that region; Indirect effects, also known as spatial spillover effects, represent the average impact of explanatory variables in a certain region on the dependent variables in surrounding areas; The total effect is the sum of direct and indirect effects, which can represent the average impact of the explanatory variable on the dependent variable in all regions.

According to the spatial effect decomposition results, the direct effect, indirect effect, and total effect of the Digital Inclusive Finance Index have all passed the significance test, with a direct effect coefficient of 0.0569, an indirect effect coefficient of -0.0868, and a total effect coefficient of -0.0299. The direct, indirect, and total effects have all passed the 1% significance level test. This indicates that digital inclusive finance impacts foreign direct investment in the local province and has spatial spillover effects on foreign direct investment in neighboring provinces. The direct effect shows that digital inclusive finance has a positive role in promoting domestic and foreign direct investment in the region. Digital finance accelerates industrial accumulation and technological innovation through digital Internet technology, improving marginal labor productivity. The inclusive nature of digital financial platforms also enables funds that were initially separated from the economic system due to their small size to enter the capital market. Capital agglomeration dramatically reduces the cost and constraints of enterprise financing, which has a huge attraction for foreign-funded enterprises and foreign direct investment.

From the perspective of indirect effects, digital inclusive finance has a negative spatial spillover effect on the level of foreign direct investment in surrounding areas, manifested as a siphon effect, that is, the higher the level of digital inclusive finance in the region, the lower the level of foreign direct investment in surrounding areas. Due to the uneven development of digital inclusive finance in certain regions, the level of digital inclusive finance in a few areas that developed first has rapidly improved, attracting more foreign investment and industrial economic development, accumulating the necessary industrial foundation and business environment for investment, and the scale effect is becoming increasingly significant. These regions generate internal agglomeration effects and attract many talents, funds, and technologies from surrounding areas. The agglomeration of population and industries brings about a larger consumer market and capital demand. Mature financial markets and diversified financial investment products broaden foreign investment platforms and further reduce investment and financing costs and risks for enterprises. The flow of these factors continuously attracts foreign investment, and the direct investment of multinational enterprises in surrounding areas will correspondingly decrease. The vast development market and relative cost advantages make foreign direct investment transfer from surrounding areas, forming a negative spatial spillover effect.

The overall effect of digital inclusive finance is still significantly negative, indicating that under the combined effect of direct and spatial spillover effects, the spatial spillover effect of digital inclusive finance on foreign direct investment dominates. The development of digital

inclusive finance promotes the increase of foreign direct investment in the local area, while to some extent suppressing the increase of foreign direct investment in surrounding areas, forming a siphon effect and polarization effect between regions.

From the perspective of spatial effects, the indirect effects in the eastern, central, and western regions are all negative and have passed significance tests, indicating that the negative spatial spillover effect of digital inclusive finance on foreign direct investment between provinces and cities is significant. The improvement of the digital inclusive finance level in neighboring provinces will lead to a decrease in foreign direct investment inside and outside the region, which has a siphon effect on foreign direct investment in the region. Foreign investment migrates from regions with higher levels of digital inclusive finance development to regions with lower levels, forming a certain range of spatial agglomeration and regional differences. Combining direct and spatial effects, the development of digital inclusive finance is conducive to positively promoting the improvement of foreign direct investment levels. At the same time, we should continue to optimize the industrial structure in the central and western regions, promote the improvement of human capital and technological innovation, and thus narrow the regional differences between digital inclusive finance and foreign direct investment.

D. Conclusion

The study uses the Peking University Digital Inclusive Finance Index and spatial econometric models to examine the impact of digital inclusive finance (DIF) on foreign direct investment (FDI) across 31 Chinese provinces from 2011 to 2022. The findings indicate that both DIF and FDI display spatial agglomeration, with significant spatial autocorrelation in a "high-high-low" clustering pattern, where regions with high levels of DIF attract more FDI, while regions with lower DIF levels lag behind. DIF development significantly enhances FDI locally, and factors such as labor costs, urbanization, government intervention, and education levels also positively influence FDI inflows. However, a siphon effect is observed, where improved DIF in one region draws FDI away from neighboring areas. The study also highlights regional heterogeneity, with DIF having the strongest positive impact on FDI in the eastern region, followed by the central region, while the western region sees minimal impact. All regions, however, exhibit negative spatial spillover effects from DIF on FDI in surrounding areas.

Based on these findings, the study recommends promoting the development of DIF in less-developed regions, particularly in central and western China, to reduce regional disparities and mitigate the siphon effect. Targeted strategies to enhance human capital and technological innovation and optimize industrial structures in these regions are crucial for attracting more FDI. Additionally, governments should continue strengthening urban infrastructure, improving administrative efficiency, and offering favorable tax policies to boost FDI, especially in regions with lower urbanization levels. Cross-regional collaboration is also encouraged to share knowledge and resources, promoting more balanced and sustainable FDI inflows across the country.

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