Research on the Two-Way Time-Varying Relationship between Foreign Direct Investment and Financial Development Based on Functional Data Analysis

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Abstract: Studying how to achieve mutual promotion between financial development and foreign direct investment inflow contributes to the Chinese government’s work of formulating rational financial policy and FDI policy from a holistic point of view and promoting the healthy and ordered growth of the entire economy in China. Based on the provincial panel data from 2007 to 2018, this paper constructs comprehensive evaluation indexes for financial development and introduces functional data analysis (FDA) methods, extracts functional $\beta$-convergence from functional linear regression to analyze the two-way time-varying relationship and convergence and divergence between financial development and FDI in the country and the eastern, central, and western regions. The empirical results show that the mutual influence of FDI and financial development presents regional differences. In general, FDI has a promoting effect on financial development, while financial development has an inhibitory effect on FDI, and there is basically no convergence effect. Based on these conclusions, if the governments of various regions in China want to reduce the differences in financial development, promote coordinated financial development, and promote sustainable financial development, they should actively implement financial development policies, optimize the financial environment, and implement differentiated foreign investment policies to promote regional financial development.

Keywords: financial development; foreign direct investment (FDI); convergence and divergence; functional data analysis

1. Introduction

In 1993, a large amount of foreign direct investment (FDI) was introduced to China. Since then, China has become the developing country that attracted the most FDI. According to the World Investment Report 2019, the FDI in China reached 139 billion USD, a new record, accounting for more than 10% of the total FDI absorbed in countries across the world in 2018, ranking second only to America in worldwide FDI inflow [1]. Since the reform and opening up, China’s financial industry has made major achievements, and financial development has become an important hub of the national economy, an important tool for macro-control and an important force for promoting economic and social development. In fact, both FDI and financial development can significantly promote China’s economic growth. Therefore, foreign investment introduction policies and financial policies have naturally become important tasks for the government [2].

Rapid economic development, political stability, huge market scale, and a good business environment are important factors for the influx of FDI into China. In addition to these factors, China’s financial development level will also have a significant impact on FDI, but there is no definite conclusion as to whether financial distortions or financial deepening have contributed to FDI introduction. Financial distortions in China have prompted private enterprises to form a strong preference for FDI, which has accelerated the
process of FDI inflows [3–5]. The alleviation of financial distortions will reduce the demand for FDI. Financial deepening provides foreign-funded enterprises with a variety of efficient financing channels, fund settlement financial services, complete information consulting services, and effective risk hedging trading tools, which promote the inflow of FDI [6,7]. In the process of financial development, with the weakening of financial distortions and the strengthening of financial deepening, whether the impact on FDI inflows is restrained, promoted, or has a non-linear relationship remains to be studied by scholars. At the same time, with the rapid growth of China’s economy, regional financial development differences have become a major challenge facing China [8]. Are there differences in the impact of FDI inflows due to the differences in financial development levels in the eastern, central, and western regions [9]?

A large amount of FDI flows into China, which has promoted China’s technological progress to a certain extent and produced significant technology spillover effects [10]. In recent years, scholars have also begun to study the impact of FDI on financial development from the perspective of financial development. With China becoming more open to the outside world, FDI research on China’s financial development is urgently needed. FDI is different from domestic direct investment. Domestic direct investment undoubtedly has a positive impact on financial development, while the effect of FDI is more complicated. On the one hand, FDI can exert its signaling effect, reduce information asymmetry in the financial market, improve the efficiency of financial market allocation, and promote the optimal development of the financial system [11–13]; on the other hand, FDI inflows may squeeze the financing needs of private enterprises for domestic financial institutions, thereby restraining the development of financial markets. Therefore, whether the impact of FDI on financial development is restraining or promoting, or if there is a non-linear relationship, remains to be seen. At the same time, China’s FDI has obvious geographical differences [14]. The difference in the level of FDI in the three major regions of the east, middle, and west also shows differences in the impact on financial development.

Financial development and FDI present a two-way-influence relationship. Most of the previous literature is from a one-way perspective, but there are few studies from a two-way perspective. At the same time, due to the different levels of financial development and FDI in the three major regions, the differences in their impacts are also worth analyzing. In fact, financial development and the level of FDI change over time, and traditional statistical methods can only statically reflect their influence relationship but cannot reflect their true influence state. In response to the above problems, this article attempts to introduce non-parametric and non-linear functional data analysis (FDA) methods based on the interaction mechanism between financial development and FDI. A dynamic perspective portrays the changing trends of financial development and FDI. The purpose of this article is to study the two-way time-varying relationship between financial development and FDI in various regions, and to analyze convergence and divergence to investigate whether there are signs of convergence. The research results will help the governments of various regions in China formulate reasonable financial policies and foreign direct investment policies from the overall perspective, how to attract FDI inflows through financial development, how to use FDI to promote financial development, reduce differences in regional financial development, and achieve reasonable financial resources, allocating and improving financial efficiency, and promoting coordinated financial development, so as to promote the sustainable development [15] of regional finance and form a virtuous circle.

The remainder of this paper is organized as follows: the following section is a literature review; Section 3 elaborates the mutual impact between financial development and FDI; Section 4 introduces the model and data; Section 5 focuses on empirical analyses; Section 5 focuses on discussions; and Section 7 ends with conclusions and policy recommendations.

2. Literature Review

Among the research on FDI and financial development, scholars both in China and foreign countries mostly concentrate on studying the impact of financial development on FDI.
Some of the scholars thought that a good level of financial development was not conducive to FDI inflow but financial distortion was. Specifically, Eduardo and Ricardo [3] believed that there was a positive correlation between financial distortion and FDI, namely that the larger the distortion degree was, the faster the FDI inflow grew. Zhang [4] conducted research based on the relationship between FDI inflow and the difference between financial distortions in Eastern China, Central China and Western China and found that the difference in financial distortion in China significantly promoted FDI. Huang and Ying [5] noted that China’s financial market was distorted and private enterprises were facing severe financing constraints. In order to alleviate the problem of insufficient capital, attracting FDI inflow was suggested. Ju and Wei [16] discovered that FDI inflow and domestic financial capital outflow were promoted in countries with lagging financial development. In the opinion of Zhu and Qi [9], the relationship between FDI inflow and financial development varied in each region of China. Ezeoha and Cattaneo [17] studied the impact of financial development on FDI inflow and discovered that it was beneficial to attract FDI inflow in regions with inadequate financial resources. In the research of Xian and Leng [18], it was found that financial development had a significantly negative inhibiting effect on FDI in China. Ma [19] stated that in Central China and Western China, the financial development level inhibited the introduction of FDI. Some of the scholars believed that a good financial development level and financial deepening were conducive to FDI inflow. In detail, Sun [6] believed that a higher level of financial development was helpful in accelerating capital flows and reducing cost of capital, and further attracting FDI inflow. In research conducted by Jia and Kong [7], financial development was found conducive to attracting FDI inflow. In the view of some scholars, the impact of financial development on FDI was nonlinear. For instance, as revealed in the research of Xia [20], the financial development in China had a significant nonlinear impact on FDI and the two levels showed a U-shape relation. In the context of financial system reform, the adverse impact of financial development on FDI will be gradually weakened and mutual promotion will be realized eventually.

As for the impact of FDI on financial development, it was mostly concluded that FDI inflow could promote financial development and improve the financial efficiency. Guariglia and Poncet [21] found that FDI inflow could compensate for the ineffective financial system in China and promote the improvement of the financial system. Wang [22] presented that FDI could promote deepened financial development in China. Ni [23] found that FDI promoted the improvement and innovation in the financial structure and system of China. In the research of Sun [6], it was revealed that FDI inflow could promote the increase in the scale of credit in financial market and promote financial development. Li and Yu [11] mentioned that FDI inflow could effectively alleviate the ineffective credit allocation in financial market. Shi [12] believed that FDI inflow could have a signal effect, effectively reduce information asymmetry in the financial market, and promote the improvement in financial market efficiency. Cai and Yang [13] studied and made clear that FDI could alleviate corporate credit constraint and financial distortion and improve the resource allocation efficiency of financial system. However, some scholars still held the opposite points of view. For instance, Zhang et al. [24] introduced scale, efficiency, competition, and other indexes to measure the financial development level and found that further opening to the outside world did not boost, but instead inhibited, financial development in China. Zhou and Shao [14] demonstrated that FDI distribution had obvious characteristics. The financial development in a region nearby another region with high economic growth was inhibited somewhat. Yu [25] believed that there was a mutual restraint effect between FDI and financial development. Zeng and Ye [26] believed that FDI had a nonlinear impact on financial development. While, in the research of Xun [27], it was proved that FDI could promote financial development as a whole, and the impact on financial development varied in different regions. For example, FDI can significantly boost the financial development in Eastern China, while fails to drive the local financial development in Central China and Western China.
As found after a review of relevant documents, there are still some problems worthy of further discussion, although scholars have made numerous achievements in the research on financial development and FDI. First of all, from the perspective of research content, the existing documents mostly regard financial development level as a threshold variable, or merely study the one-way impact of financial development on FDI or that of FDI on financial development [28,29], lacking a comprehensive evaluation on the relationship between the two levels from a two-way point of view [30]. Secondly, from the perspective of research, most research was conducted at a provincial or national level, regardless of the regional heterogeneity of financial development and FDI. Even for the statistical analysis and measurement modeling of Eastern China, Central China, and Western China, the importance was attached to a static description of the relationship between FDI and financial development level, while the dynamic change in the relationship was ignored. With respect to the research methods, it is hard to depict the continuous variation in financial development level and FDI using a traditional measurement analysis method. However, if a fixed-parameter model is used to describe the elastic nonlinear relationship between financial development level and FDI, the dynamic changes in the indexes are not taken into consideration. Affected by national policy, financial policy and other factors, the financial development and FDI in China present an obviously nonlinear relationship [20,26] and vary in different regions [9,27]. Therefore, in this paper, a nonlinear and nonparametric functional data analysis method is adopted to facilitate studying the change rules of financial development level and FDI in different regions and the relationship between the two levels. As a big data analysis method, FDA has been widely used by scholars [31–33].

Based on the above discussion, a comprehensive evaluation index system of financial development was constructed from the nationwide and regional perspectives. Further, a functional data analysis method was taken to obtain the discrete data of China’s financial development level and FDI level during the period 2007–2018 incorporated into the category of continuous dynamic function and explore the two-way time-varying relationship between the two levels. Moreover, functional β convergence was used to study the convergence and divergence of the two levels all over China and in the three regions, and appropriate policy opinions were provided on the basis of local conditions.

3. The Mutual Impact between Financial Development and FDI

In order to better explain the two-way relationship between FDI and financial development, this article analyzes the mutual impact between FDI and financial development, and proposes a hypotheses. Figure 1 shows the interaction mechanism between financial development and FDI.

3.1. The Impact of FDI on Financial Development

On the one hand, the inflow of FDI may produce an “own-plant effect”, a “level effect”, and a “forward and backward correlation effect”. Where, “own-plant effect” refers to such an effect where, after an inflow of FDI, private enterprise expands production scale and improves product quality to boost its development and enhance its recognition, resulting in more financial mortgage loans being available, an increased bank credit quota, less financing difficulty, and the alleviation of credit distortion in the financial market [34]. “Level effect” refers to an effect where, after an inflow of foreign investment, the level of competition in the industry is greatly increased, resulting in the closure of lagging enterprises and survival of enterprises with high earning capacity and production efficiency and adequately competitive products, while more credit quota will be given to this industry by financial institutions to promote industrial development [35]. “Forward and backward correlation effect” refers to the effect where, after expanding the business scale and occupying more market share, foreign enterprise creates a correlation between the upstream and downstream industries to promote the development of industries in the entire industrial chain, while banks will increase the loan quota of relevant enterprises in this industrial chain to improve the financial resource allocation efficiency of financial
institutions. Serving as a signal in the three effects, FDI reduces the information asymmetry between the financial market and private enterprise, allows credit resources to flow to private enterprises, alleviates the financing constraints of private enterprises, improves financial distortion and financial efficiency, and promotes financial development.

![Image of a diagram](image)

**Figure 1.** The mutual impact between financial development and FDI.

On the other hand, different regions with different economic development levels have different financing demand. Western China has relatively low financing demand. After an inflow of FDI in private enterprises, their financing demands can be greatly satisfied, followed by a reduction in local credit demand, an intensification in local financial distortion and restraint in financial development. While, after an inflow of FDI in Central China and Eastern China, local credit demand is still high, but the information asymmetry is reduced, the reallocation of financial resources is promoted, and financial efficiency is improved, which is conducive to financial development in the regions.

Based on the above analysis, this article proposes the following hypotheses:

**Hypothesis 1.** The impact of FDI on financial development shows a non-linear relationship;

**Hypothesis 2.** The impact of FDI in different regions on financial development is different.

3.2. The Impact of Financial Development on FDI

China’s financial development in recent years manifested through a reduction in financial repression and the enhancement of financial deepening. Essentially, China’s financial system was completed by virtue of the financial system reform, and “financial distortion” was alleviated and eliminated by optimizing the financial market in China to eventually realize a positive cycle of financial development and economic growth.

A financial system under financial repression has a serious “financial distortion” problem. Financial distortion is exacerbated by enterprise credit discrimination, the regional quota system and low financial efficiency. Where, enterprise credit discrimination refers to a situation wherein, when information is asymmetric, financial institutions prefers to allocate the loan quota to state-owned enterprise, and so private enterprises face severe financing constraints. The regional credit quota system is a basis used by the People’s Bank of China to allocate credit funds in a trans-regional manner via an internal approach to
satisfy specific working targets and policies of the government, while credit funds almost all inflow to state-owned economic sector. Low financial efficiency refers to the state that a deposit cannot be converted into effective investment due to underdevelopment of financial instruments and derivatives. Due to financial distortion, private enterprises have formed a strong preference for FDI, which has accelerated the progress of FDI inflow.

Additionally, financial deepening reform refers to the event that government abandons interest rate and exchange rate control measures to have the two rates exactly reflect the actual supply and demand of fund and foreign currency, so as to realize self-control of the market mechanism and financial deregulation, improve financial efficiency, and better allocate financial resources. By financial deepening, foreign-owned enterprises will be provided with many efficient financial channels, fund settlement services, complete information consulting services, and effective risk hedging exchange means to promote the inflow of FDI.

Alleviating financial repression and improving financial distortion contribute to a decrease in FDI inflow, while financial deepening reform promotes an increase in inflow of FDI. Different regions have different financial development levels. Specifically, Eastern China entered the course of the reform early, while Western China is undergoing slow financial development and is most likely in the stage of alleviating financial repression. The impact of financial development on FDI is U shaped and the impact in different regions is at different stages.

As discovered from the above analysis, there is a two-way nonlinear relationship between financial development and FDI. Meanwhile, different regions have different financial development and FDI levels, which may result in differentiated impacts on the two-way relationship. In this paper, a functional data analysis (FDA) method is used to analyze the two-way time-varying relationship between the two levels nationwide and in Eastern China, Central China, and Western China to analyze the convergence and divergence of the two levels.

Based on the above analysis, this article proposes the following hypotheses:

**Hypothesis 3.** The impact of financial development on FDI shows a non-linear relationship;

**Hypothesis 4.** The impact of financial development in different regions on FDI is different.

### 4. Data and Model

#### 4.1. Data Source and the Construction of the Index System

In this research, an empirical analysis was performed on the basis of the panel data of 30 provinces in three major regions of China during the period 2007–2018. Wherein: Eastern China has 11 provinces, including Beijing, Tianjin, Shanghai, Hebei, Liaoning, Shandong, Jiangsu, Zhejiang, Guangdong, and Hainan; Central China has 10 provinces, including Heilongjiang, Jilin, Inner Mongolia, Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan, and Guangxi; Western China has 10 provinces, including Ningxia, Qinghai, Gansu, Yunnan, Shaanxi, Guizhou, Sichuan, Chongqing, and Tibet. The data of FDI (foreign investment in actual use) was sourced from the statistical yearbooks of various provinces in China. The specific data contained in FSE, FSA, and FIE (i.e., the amount of financial assets, securities market share, the balance of deposits in financial institution, and the balance of loans from financial institutions) came from the Almanac of China’s Finance and Banking. China’s marketization index was collected from the NERI Index of Marketization of China’s Provinces 2009 Report compiled by Fan Gang and others, the WIND database, and China’s marketization research report, updated every year. Urbanization level, government expenditure rate, industrialization level, GDP per capita, and consumption expenditure per capita were acquired from the China Statistical Yearbook, the Almanac of China’s Finance and Banking, and the WIND database.
The following index system was constructed based on the indexes defined by other scholars and considering the availability of the data of regional financial development level and FDI:

4.1.1. Foreign Direct Investment Variable (FDI)

This index is expressed by the regional foreign investment in actual use. As different regions have different amounts of FDI, the data expressed in USD were converted into RMB based on the annual average exchange rate of the year, taking the logarithm.

4.1.2. Financial Development

(1) Financial scale expansion (FSE), expressed by the ratio of value added in financial assets to GDP in a region and reflects the share of a financial asset in the wealth of the region [36];

(2) Financial asset structure (FSA), expressed as the ratio of total securities assets to financial assets in a region and reflects the share of direct financing in the financial assets of the region [37];

(3) Financial intermediary efficiency (FIE), equal to the ratio of the balance of loan to the balance of deposit in financial institutions in a region and reflects the deposit–loan conversion rate of financial intermediaries in the region [38].

The financial development level was measured comprehensively by FSE, FSA, and FIE from the perspectives of the scale and structure of the financial system, and the efficiency of financial intermediaries in the system.

4.1.3. Control Variable

(1) Marketization index (MD), a comprehensive index for measuring the marketization level and degree of a region. A higher degree of marketization will always promote a rise in the financial development level of the region and attract more FDI inflows;

(2) Urbanization level (UL), expressed as the ratio of urban population to total population of a region. In the process of urbanization, regional requirements for financial development will be increased, and better financial services and a more complete financial system are needed to promote regional financial development. At the same time, FDI inflow will also be attracted in the process of urbanization;

(3) Industrialization level (IND), expressed by the ratio of industrial production value to GDP of a region and measures the industrial development level of the region. As the level increases, the requirements of industrial enterprises for financial services will also increase. At the same time, this increase will further attract the inflow of foreign capital;

(4) Economic development level (ED), expressed by the GDP per capita of a region and measures the economic strength of the region. Compared with the total GDP, GDP per capita can better reflect the economic strength of the region. Governments of regions with strong economic strength often promote the development of local financial industry, and also foster competitive market and attract foreign investors to settle in;

(5) Resident consumption index (CS), expressed by the consumption level of a region (i.e., the ratio of total consumption to the permanent population in the region). In a region with high consumption per capita, the consumption potential is high, which can promote the regional economic development and is closely related to the degree of financial development in the region. At the same time, having a huge number of high-quality consumers will help enterprises increase the market share and attract foreign investors to settle in.

4.2. Functional Fitting of Discrete Data

The primary work of functional data analysis (FDA) is to reconstruct continuous eigenfunctions based on discrete observation data in the non-parametric fitting method developed by using primary functions. Taking into account the actual situation of specific problems, the observed values are often subject to different sampling intervals and obser-
penalty-based smoothing is \([39–41]\):

$$\text{SSE} = \sum_{j=1}^{T_i} [y_{ij} - y_i(t_{ij})]^2 = \sum_{j=1}^{T_i} [y_{ij} - \sum_{k=1}^{K} \zeta_{ik} \phi_k(t_{ij})]^2$$  \(1\)

In the Equation (1), \(\phi_k\) represents the primary function; \(K\) is the maximum quantity of primary functions required; \(\zeta_{ik}\) is the coefficient of the primary function. In the process of smoothing the curve, a certain roughness penalty was imposed in case of any over-fitting, to prevent it from covering up the main trend of the curve change. The roughness penalty was put forward by Ramsay et al. (2009) and defined as the integral sum of second derivatives \(y''_i(t)\). Assuming that \(\Phi(t) = \{\phi_1(t), \cdots, \phi_L(t)\}\) is the optimal primary function in Hilbert space, the fitting residual sum of squares \(\text{PENSSE}_k\) of the roughness penalty-based smoothing is \([39–41]\):

$$\text{PENSSE}(\lambda) = \sum_{j=1}^{T_i} [y_{ij} - y_i(t_{ij})]^2 + \lambda \int_T [y''_i(t)]^2 dt$$  \(2\)

The eigenfunction in Equation (2) is a linear proximity of the primary function under the standard of minimum penalty residual sum of squares, namely \(y_i(t) = \sum_{l=1}^{L} \beta_{il} \phi_l(t)\). The smoothing parameter value \(\lambda\) is used to weigh the proportional relationship between the goodness of the model fit and the smoothness of the function curve. The optimal value is determined by the standard of generalized minimum cross validation \(\text{GCV}(\lambda)\), namely:

$$\text{GCV}(\lambda) = \left(\frac{T_n}{T_n - df(\lambda)}\right) \left(\frac{\text{PENSSE}_\lambda}{T_n - df(\lambda)}\right)$$  \(3\)

In the Equation (3), \(df(\lambda)\) is the trace of projection matrix \(S_{\Phi,\lambda} = \Phi(\Phi' + \lambda R)^{-1} \Phi'\), namely \(df(\lambda) = \text{trace}S_{\Phi,\lambda}\); \(R = \int D^2\phi(s) \cdot D^2\phi'(s) ds\) is the matrix formed by the integral of the outer product of the second derivative of the primary function; \(T_n\) represents the sample size in a time point. Therefore, in order to minimize Equation (2), the optimal solution is \(\hat{\beta} = (\Phi' \Phi + \lambda R)^{-1} \Phi'y\) where \(\text{GCV}\) is the minimum under the \(\lambda\) at the time.

### 4.3. Functional Linear Model

The functional linear model is different from a traditional discrete linear model. In a functional linear model, the regression coefficient becomes the function \(\beta(t)\) of \(t\) \([42]\). In this paper, the functional linear model used is a full-functional linear regression model in which both the explaining variable, FDL (financial development level), and explained variable, FDL, are function variables. The model is as shown below:

$$Y(t) = X(t)^T \tilde{\beta}(t) + \epsilon(t)$$  \(4\)

In the Equation (4), \(X(t) = \{X_1(t), \cdots, X_p(t)\}\) is the covariate of dimension \(p\); \(\beta(t) = \{\beta_1(t), \cdots, \beta_p(t)\}\) is the unknown coefficient function \(\beta(t)\) of dimension \(p\); and \(\epsilon(t)\) is a random process with mean value of 0.

In the above-mentioned full-functional linear model, the author imposed re-penalty for smoothing and then applied the least square method from the traditional regression model to this model to calculate the estimate function \(\hat{\beta}(t)\) of the coefficient function. Besides, the
estimate function $\hat{\beta}(t)$ of the coefficient function can be calculated in the primary function expansion method by using the primary function system of $\Phi_k(t), k = 1, \cdots, K$, namely $\Phi(t) = (\Phi_1(t), \cdots, \Phi_K(t))$. Moreover, $Y(t) = A\Phi(t)$ and $\hat{\beta}(t) = B\Phi(t)$, where, matrices $A$ and $B$ are, respectively, the coefficient matrixes of primary functions of $Y(t)$ and $\beta(t)$. By matrix operation, the coefficient matrix $\beta(t)$ of the full-functional linear model is obtained.

4.4. Analysis of the Convergence and Divergence

In this paper, we explore whether the differences in financial development and FDI levels nationwide and in different regions are reduced and show convergence or not and adopt $\beta$ convergence. The development speeds of financial development levels and FDI levels in different regions are relatively convergent. In other words, in regions with a relatively low absolute level, the growth speed is high. Over a period of development, the two levels in the regions tend to converge. The following shows the conditioned $\beta$ convergence model:

$$\frac{(lny_{it} - lny_{i0})}{t} = \alpha + \beta lnx_{i0} + \lambda X_{it} + \epsilon_{it}$$

(5)

In the Equation (5), $(lny_{it} - lny_{i0})/t$ represents the annual average growth rate of the financial development level (FDI Level) of the $i$-th region in $t$ year(s); $lnx_{i0}$ is the FDI level (financial development level) of the $i$-th region in base period; $\alpha$ is intercept; $\beta$ is convergence coefficient; $X_{it}$ is a series of control variables; $\lambda$ is the coefficient of control variables; and $\epsilon_{it}$ is an error term. If $\beta < 0$ and is significant, the convergence is called conditioned $\beta$ convergence; namely, the two levels of the regions tend to converge, otherwise, conditioned $\beta$ convergence does not exist.

The aforementioned general convergence and divergence model only considers static convergence and divergence. In this research, based on the FDA method, we attempted to acquire the dynamic convergence coefficient $\hat{\beta}_t$ of the financial development level and FDI level to examine the time varying trend of the convergence coefficients of the two levels, and constructed the following functional $\beta$ convergence model [43]:

$$\frac{(lny_{dt} - lny_{d0})}{t} = \alpha_t + \beta_t lnx_{d0} + \lambda_t X_{dt} + \epsilon_{dt}$$

(6)

In the Equation (6), $(lny_{dt} - lny_{d0})/t$ is the annual average growth rate of the financial development level (FDI Level) of the $d$-th region in $t$ year(s); $\alpha_t$ is the intercept term function; $\epsilon_{dt}$ is the error term function; $\beta_t$ is the convergence coefficient function; and $X_{dt}$ represents the control variable function. If $\beta_t < 0$ and is significant, the financial development level (FDI Level) of the regions tends to be the same.

5. Empirical Results

In this section, a functional statistical description and analysis are made on the overall financial development and FDI inflow levels in China. Then, a functional linear regression method is used to study the two-way time-varying relationship between financial development and FDI. The causes of the results are then discussed.

5.1. Statistical Description and Analysis of China’s Overall Financial Development Level Based on Functional Data Analysis

Figure 2 shows the functional description data of financial development in China, including the functional average of the three indexes (FSE, FSA, and FIE) of the financial development level in China (see the left part of the figure) and the functional standard deviations (see the right part of the figure). As can be seen from the left part of the figure, the three indexes of the financial development level generally increase in addition to certain fluctuations. This indicates that the financial development level measured by the three indexes is increasing. While, as shown in the right part of the figure, standard deviations of the three indexes tend to decrease, which reveals that the difference in the overall financial development of China measured by the three indexes is decreasing.
5. Empirical Results

In this section, a functional statistical model is built to study the two-way time-varying relationship between financial development and FDI. The causes of the results are then discussed.

5.2. Statistical Description and Analysis of China’s Overall FDI level Based on Functional Data Analysis

Figure 2 illustrates the functional description data of the FDI level in China. The left part and right part of the figure, respectively, show the functions of average and standard deviation of the overall FDI level in China. The left part implies that China’s overall FDI level maintained a rapid growth trend during the period 2007–2015; after 2015, the FDI level became stable, with a decreased growth rate, which is closely correlated to the decrease in global FDI. The foreign investment in actual use in China still ranks top in the world. As presented in the right part, the standard deviation function of China’s FDI level was stable during the period 2007–2012, while undergoing a sharp rise after the period of 2012–2018. This reveals that the difference in the FDI level of 30 provinces in China is enlarging rapidly.

Figure 3. Functional average (a) and standard deviation (b) of China’s FDI.

5.3. Analysis on the Time Varying of Financial Development with FDI

In this research, FSE, FSA, and FIE were used to comprehensively measure the financial development level. A full-functional linear regression analysis was made on FDI with FSE, FSA, and FIE nationwide and in Eastern China, Western China, and Central China. The convergence and divergence of the indexes were investigated. Where: FSE, FSA, and FIE are explained variables; FDI is the explaining variable; and MD, UL, IND, ED, and CS are control variables.
The full-function linear regression model of FDI and financial development index (taking FSE as an example) were obtained after some adjustments on the basic full-function linear regression model, given that $Z_{id}^k(t)$ was an external factor that affected FDI and FDL, including continuous function variables and constant variables (control variables). Where, $y_{it}^d$ is the FSE level of province $i$ in region $d$, $x_{it}^d$ is the FDI level of province $i$ in region $d$, and $\frac{lny_{it}^d - lny_{it}^d(0)}{t}$ represents the FSE growth rate of province $i$ in region $d$. The full-function linear regression model of functional FDI and FSE is expressed as:

$$\frac{lny_{it}^d - lny_{it}^d(0)}{t} = a(t) + \beta(t)lnx_{it}^d(0) + \sum_{k=1}^{K} \theta_k Z_{it}^k(t) + \epsilon_i(t) \tag{7}$$

In the Equation (7), $a(t)$, $\epsilon_i(t)$, and $\beta(t)$ represent constant function, error function, and convergence coefficient function, respectively. If $\beta(t) < 0$ and is verified as significant, it indicates that there is convergence; namely, the initial values of FDI nationwide or in Eastern China, Central China, and Western China are negatively correlated to the FSE growth speed. As the time goes, in region with high FDI, although its initial FSE level is high, the FSE growth speed is relatively low compared with the region with low initial FDI. Eventually, the FSE of the region with low initial FDI and the region with high initial FDI will converge to the same steady-state level; otherwise, the convergence does not exist.

5.3.1. Analysis on the Time Varying of FSE with FDI

Based on the above model, the data of FDI and FSE levels nationwide and in Eastern China, Central China, and Western China were conducted using functional regression. The results are shown in Figure 4:

![Figure 4](image-url)

**Figure 4.** The coefficient function and its 95% confidence interval of the functional regression of FDI to FSE (a): whole country; (b): eastern region; (c): central region; (d): western region.

The solid black lines in Figure 4a–d represent the coefficient functions in the full-function linear regression model of FDI to FSE levels across the country and the eastern, central,
and western regions, respectively. The dashed interval is the 95% confidence interval of the coefficient function; if and only when the confidence interval is entirely below the zero point, it is considered that FDI has a convergence effect on FSE in this interval.

From a national perspective, during the period 2007–2018, $\beta(t) > 0$ and maintained growth, which shows that FDI increasingly promoted the FSE and had no convergence effect on the level of financial scale in this period. This might be because the inflow of FDI reduced information asymmetry in China’s financial market through three major effects, promoted the rational allocation of financial resources, and made private enterprises able to obtain credit funds from financial institutions. With the growth and development of enterprises and the unceasing expansion of the scale of business operations, requirements were raised in the financial industry. Finally, the FSE was boosted.

In Eastern China, during the same period, $\beta(t)$ had the same trend as that nationwide, which indicated that FDI inflow increasingly promoted FSE. Meanwhile, FDI showed no signs of convergence on the level of financial scale as this region had a good business environment for private enterprises and the government adopted a large number of preferential policies to attract the inflow of foreign investment. As such, FDI inflow contributed to improving the credit scale of private enterprises and the allocation efficiency of financial resources and promoting the financial development.

In Central China, during the same period, $\beta(t) > 0$ but maintained decreasing, which implied that FDI inflow decreasingly boosted the FSE and presented no convergence effect on the level of financial scale. This might be attributed to the fast economic development in this region. The expansion in business scale increased the demand for funds and attracted FDI inflows. Information asymmetry was weakened by FDI inflow through three major effects so that financial resources were rationally allocated, which further supported the economic development and drove the FSE.

In Western China, $\beta(t) < 0$ during the period 2007–2016 and $\beta(t) > 0$ during the period 2016–2018, forming a U-shape impact. The former showed FDI’s repression on FSE and the latter presented FDI’s promotion on FSE and the increasing trend of $\beta(t)$. The positive effect was gradually enhanced during the entire period. Meanwhile, only during the period 2007–2012, the 95% confidence interval of the coefficient function became less than 0, which suggests that FDI had no convergence effect on the level of financial scale in this period. In the same period, the financial scale levels of sub-regions with high initial FDI values and low initial FDI values were both decreasing and no convergence sign was seen during the period 2012–2018. This might be caused by the large number of state-owned enterprises, serious financial distortion, late financial development, and small financial scale in the region. Inflow of FDI was promoted by the fund demand of private enterprises and inevitably caused reduction in the credit demand. As enterprise had a relatively small fund demand, most of the demands could be met by FDI inflow so that the demand of credit from local banks decreased and FSE was suppressed. However, with the economic development in the region, new financial demand will be derived and FDI inflow will not be able to support most of the financing demands. Meanwhile, by reducing information asymmetry, FDI can boost the cooperation between enterprise and financial institutions and further drive the local FSE.

5.3.2. Analysis on the Time Varying of FSA with FDI

Based on the above model, the data of FDI and FSA levels nationwide and in Eastern China, Central China, and Western China were conducted using functional regression. The results are shown in Figure 5:
The coefficient function and its 95% confidence interval of the functional regression of FDI to FSA (Figure 5).

The solid black lines in Figure 5a–d represent the coefficient functions in the full-function linear regression model of FDI to FSA levels across the country and the eastern, central, and western regions, respectively. The dashed interval is the 95% confidence interval of the coefficient function; if and only when the confidence interval is entirely below the zero point, it is considered that FDI has a convergence effect on FSA in this interval.

From a national perspective, during the period 2007–2018, \( \beta(t) > 0 \) and maintained a weak growth trend. This revealed that the optimization of financial structure in China could be promoted and gradually enhanced by inflow of FDI. Meanwhile, FDI had no convergence effect on FSA. Specifically, with the inflow of FDI, various industries in China underwent rapid development. Many emerging enterprises gradually grew up and were more prone to financing with lower cost from the direct financing market, so that the financing structure in China’s financial sector was optimized.

From the perspective of Eastern China, \( \beta(t) \) was changed in a U-shape trend, namely less than 0 during the period 2007–2016 and continued growing above 0 during the period 2016–2018. The former change implied that FDI inflow inhibited the optimization of financial structure, while the latter change revealed that FDI inflow promoted the optimization, followed by a stronger positive effect. As can be found during the period 2007–2015, the 95% confidence interval of the coefficient function dropped below 0, presenting FDI’s convergence effect on the level of financial structure in this period. Moreover, for the sub-regions with high initial FDI values and those with low initial FDI values, the financial structure levels were reducing during the period 2007–2015 and showed no convergence signs during the period 2016–2018. The possible reasons behind this are as follows: first, this region had many FDI inflows which meet the financing demands of private enterprises so that the demand for financing from the direct financing market was reduced; second, with the inflow of FDI, the direct investment share of financing market was reduced, leading to the deterioratior of the financing structure in the financial sector. Meanwhile, with the financial deepening reform in this region, the constant improvement of the direct financing market, and the expansion of enterprise scale, more demands for direct financing were raised, and the coordinated development of financial institutions and enterprises was...
promoted. In this way, from 2016, FDI inflow began to boosting the optimization of the financial structure in Eastern China.

From the perspective of Central China, $\beta(t) < 0$ and maintained stable with slight decrease during the period 2007–2018. This demonstrated that in the entire period, FDI inflow increasingly repressed the optimization of financial structure and had no convergence effect on the FSE, for the possible reason that the economic development level in Central China was relatively lower than that in Eastern China. The inflow of FDI could greatly satisfy the financing demands of enterprises, reduce the demand for direct financing and further result in worsening of the financial structure.

From the perspective of Western China, a U-shape impact appears. Specifically, the $\beta(t) < 0$ during the period 2007–2009 shows that FDI inflows can inhibit the optimization of the financial structure, while the $\beta(t) > 0$ and continued to increase during the period 2009–2018. This implies that FDI inflow can promote optimization. However, throughout the period 2007–2018, the positive effect of FDI in promoting optimization gradually increased, and FDI had no convergence effect on the FSA. This might be because the scale of direct financing in this region was intrinsically smaller than that in other regions, while FDI inflow had a small impact on direct financing scale and a large impact on indirect financing. In this way, FDI inflow can greatly reduce enterprise’s demand for indirect financing, so that the financial structure in Western China plays an optimization role.

5.3.3. Analysis on the Time Varying of FIE with FDI

Based on the above model, the data of FDI and FIE levels nationwide and in Eastern China, Central China and Western China were conducted using functional regression. The results are shown in Figure 6:

![Figure 6](image)

**Figure 6.** The coefficient function and its 95% confidence interval of the functional regression of FDI to FIE (a): whole country; (b): eastern region; (c): central region; (d): western region.

The solid black lines in Figure 6a–d represent the coefficient functions in the full-function linear regression model of FDI to FIE levels across the country and the eastern, central, and western regions, respectively. The dashed interval is the 95% confidence interval of the
coefficient function; if and only when the confidence interval is entirely below the zero point, it is considered that FDI has a convergence effect on FIE in this interval.

In the whole country, $\beta(t) > 0$ and maintained growth during the period 2007–2018, implying that FDI inflow contributed to improving China’s financial efficiency during the entire period with an increasingly significant effect and had no signs of convergence to the level of financial efficiency. This might be because the inflow of FDI reduced the information asymmetry in the financial market via three major effects. In the meantime, as China’s financial intermediaries faced competition from enterprise financing demands, commercial banks provided convenient and preferential treatments to qualified private enterprises in the process of loan approval and issuance so that the financial efficiency was improved.

In Eastern China, there was a U-shape impact. In detail, during the period 2007–2016, $\beta(t) < 0$, which indicated that FDI inflow inhibited the increase in financial efficiency; while, during the period 2016–2018, $\beta(t) > 0$ and maintained a significant growth trend, which proved that FDI inflow promoted the improvement in financial efficiency with an increasingly large effect. Meanwhile, FDI displayed a convergence effect on FIE during the period 2007–2015 and had no such effect during the period 2015–2018, possibly because most private enterprises in the region were more liable to FDI inflow and had reduced demand for financing from financial institutions. As such, the efficiency of financial institution was reduced.

In Central China, $\beta(t) > 0$ and continued increasing during the period 2007–2018, which demonstrated that FDI inflow contributed to the increase in financial efficiency with an increasing enhancement effect and did not pose any convergence effect on the FIE. The possible reason was that the information asymmetry in the financial market was reduced by the inflow of FDI via three major effects and the financial efficiency was further increased.

In Western China, an inverted U-shape impact appeared. During the period 2007–2014, $\beta(t) > 0$, which implied that financial efficiency increase was promoted by the inflow of FDI; while, during the period 2014–2018, $\beta(t) < 0$ and continued decreasing, indicating that FDI inflow contributed to decreasing the financial efficiency and displayed a decreasing positive effect. During the entire period in the region, FDI showed no convergence effect on FIE. This might be the result of the following causes: first, the initial inflow of FDI brought competition to the financing demands of local financial institutions. As a result, financial institutions improved their operation efficiency and cooperated with enterprises. Second, intrinsically, Western China had less credit demands than other regions. As the time went by, FDI inflow gradually weakened enterprises’ demands for financing from financial institutions so that the improvement in financial efficiency was gradually reduced and even became negative.

5.4. Analysis on the Time Varying of FDI with Financial Development

On the contrary, A full-functional linear regression analysis was performed on FSE, FSA, and FIE with FDI nationwide and in Eastern China, Western China, and Central China. The convergence and divergence of the indexes were investigated. Where, FDI is the explained variable; FSE, FSA, and FIE are explaining variables; and MD, UL, IND, ED, and CS are control variables.

5.4.1. Analysis on the Time Varying of FDI with FSE

Based on the above model, the data of FSE and FDI levels nationwide and in Eastern China, Central China, and Western China were conducted using functional regression. The results are shown in Figure 7:
Figure 7. The coefficient function and its 95% confidence interval of the functional regression of FSE to FDI (a): whole country; (b): eastern region; (c): central region; (d): western region.

The solid black lines in Figure 7a–d represent the coefficient functions in the full-function linear regression model of FSE to FDI levels across the country and the eastern, central, and western regions, respectively. The dashed interval is the 95% confidence interval of the coefficient function; if and only when the confidence interval is entirely below the zero point, it is considered that FSE has a convergence effect on FDI in this interval.

In the whole country, FSE has a U-shaped impact on the FDI inflow. During 2007–2011, \( \beta(t) < 0 \), which indicated that FSE repressed the inflow of FDI; during the period 2011–2018, \( \beta(t) > 0 \), which implied that FSE promoted the inflow of FDI; meanwhile, FSE had no convergence effect on FDI level. This might be because, before FSE reached a certain level, the expansion of financial scale could relieve local enterprises’ difficulty in financing, reduce their FDI demand to some extent, and inhibit the inflow of FDI. With the expansion of financial scale in China, relevant financial systems were improved so that foreign-owned enterprises could finance more equally and conveniently in China and FDI inflow was attracted.

In Eastern China, \( \beta(t) > 0 \) during the period 2007–2018. This revealed that FSE promoted FDI inflow and had no convergence effect on FDI level in this period, possibly because financial development in Eastern China started early and had passed through the inflection point of the U shape, entering the “rising” stage. Meanwhile, the financial deepening reform and relatively complete financial systems contributed to the inflow of FDI.

In Central China, during the period 2007–2017, \( \beta(t) < 0 \) and was at the decreasing stage of the U-shape curve. At this time, FDI inflow was inhibited by FSE. With the financial development during the period 2017–2018, \( \beta(t) > 0 \) was in the increasing stage of the U-shape curve. At this stage, FSE began to promote the inflow of FDI and displayed no convergence effect on the FDI level.

In Western China, during the period 2007–2018, \( \beta(t) < 0 \), which indicated that the region was at the decreasing stage of the U-shape curve in this period. Since the economic development in this region was lagging far behind, the scale of financing demand was smaller than that in other regions. However, the expansion in financial scale met the financing demands of enterprises and greatly weakened the demand for FDI, so FDI inflow was repressed. Meanwhile, the financial scale level had no convergence effect on the FDI level.
5.4.2. Analysis on the Time Varying of FDI with FSA

Based on the above model, the data of FSA and FDI levels nationwide and in Eastern China, Central China, and Western China were conducted using functional regression. The results are shown in Figure 8:

![Figure 8](image_url)

**Figure 8.** The coefficient function and its 95% confidence interval of the functional regression of FSA to FDI (a): whole country; (b): eastern region; (c): central region; (d): western region.

The solid black lines in Figure 8a–d represent the coefficient functions in the full-function linear regression model of FSA to FDI levels across the country and the eastern, central, and western regions, respectively. The dashed interval is the 95% confidence interval of the coefficient function; if and only when the confidence interval is entirely below the zero point, it is considered that FSA has a convergence effect on FDI in this interval.

At the national level, financial structure optimization shows a U-shape impact on the inflow of FDI. During the period 2007–2013, the inflow of FDI was repressed by financial structure optimization, as $\beta(t) < 0$; while, during the period 2013–2018, the inflow of FDI was promoted by financial structure optimization, as $\beta(t) > 0$; the financial structure optimization displayed a convergence effect on FDI only during the period 2007–2008. At the beginning of the 21st century, the nationwide financing demand had not reached saturation. At this time, financial structure optimization could often meet some financing demands and reduce the inflow of FDI. With the optimization of financial structures, the development of the economy, and the expansion of industries, enterprises’ fund demand increased. Meanwhile, with the growth of domestic enterprises, a considerable number of enterprises expected to acquire technical spillover effects of FDI to improve operation efficiency and further attract FDI inflow.

As for Eastern China, $\beta(t) < 0$ and continued to decrease during the period 2007–2018, which showed that the optimization of the financial structure in this region restrained the inflow of FDI. During 2008–2018, FSA displayed a convergence effect on the FDI level. This region possessed the most developed direct financing market with direct financing scale greatly contributing to the total financial scale. With the optimization of financial structure, direct financing scale will increase, followed by a reduction in FDI demand and inhibition of FDI inflow.

For Central China, $\beta(t) < 0$ during the period 2007–2018 and maintained stable after 2010. During 2007–2009, FSA had a convergence effect on the FDI level. This revealed that, in the same way as Eastern China, the optimization of the financial structure in this region would also inhibit the inflow of FDI.
For Western China, during the period 2007–2010, $\beta(t) < 0$, which implied that the inflow of FDI could be repressed by optimizing the financial structure; while, during the period 2010–2018, $\beta(t) > 0$, which revealed that FDI inflow could also be promoted by the optimization. Only during the period 2007–2008, FSA displayed a convergence effect on the FDI level in this region. As this region had a small ratio of direct financing, the essence of this optimization was to reduce the interior credit scale, which further intensified the financing difficulty of domestic enterprises. Hence, local enterprises had to find other ways of financing. However, this region was short of a direct financing market, so the enterprises’ financing demands could not be met, which resulted in increased demand for FDI and boosted inflow of FDI.

### 5.4.3. Analysis on the Time Varying of FDI with FIE

Based on the above model, the data of FIE and FDI levels nationwide and in Eastern China, Central China, and Western China were conducted using functional regression. The results are shown in Figure 9:

![Figure 9. The coefficient function and its 95% confidence interval of the functional regression of FIE to FDI](image)

The solid black lines in Figure 9a–d represent the coefficient functions in the full-function linear regression model of FIE to FDI levels across the country and the eastern, central, and western regions, respectively. The dashed interval is the 95% confidence interval of the coefficient function; if and only when the confidence interval is entirely below the zero point, it is considered that FIE has a convergence effect on FDI in this interval.

From the national level, during the period 2007–2018, $\beta(t) < 0$, which indicated that the improvement in FIE displayed a repression effect on the FDI inflow, and the FIE level displayed no convergence effect on the FDI level. The same as the result of impact analysis, misallocation of financial resources was caused by financial distortion, so that private enterprises were difficult to finance and raised higher demand for FDI. However, with the improvement in financial efficiency and relieving of financial distortion, the financing demands of domestic enterprises were greatly satisfied by domestic financial institutions, resulting in a reduction in the demand for FDI. Therefore, FDI was reduced by improving the FIE to some extent.

In Eastern China and Central China, the improvement in FIE displayed a U-shape impact on the inflow of FDI. Where, during the period 2007–2015, $\beta(t) < 0$, which implied that this improvement could inhibit the inflow of FDI; while, during the period 2015–2018,
$\beta(t) > 0$ and continued increasing, which proved that the improvement in FIE contributed to promoting FDI inflow. FIE in Eastern China did not have a convergence effect on the FDI level, while FIE in Central China did during the period 2007–2012. Compared with Western China, these two regions had a high economic development level. With high financing demand, enterprises were dissatisfied with the capital scale of financial institutions and sought other financing channels; thus, FDI inflow was promoted. Moreover, with the expansion in business scale, enterprises began to transform and upgrade, while a technical spillover effect could be acquired from FDI inflow. At the same time, after FIE was increased to a certain extent, foreign investors would be attracted.

As for Western China, during the period 2007–2018, $\beta(t) > 0$ and continued decreasing. This implied that, in this period, FDI inflow could be promoted by improving FIE, and the FIE displayed no convergence effect on FDI level. Most enterprises in this region were state-owned enterprises and financed from the credit market. At this time, the increase in FIE and the issued amount of loan promoted the development of the state-owned enterprises to a large extent. The state-owned enterprises also expected to attract foreign investment to obtain a technical spillover effect and further boost the inflow of FDI.

6. Discussion

As mentioned in the literature review, Sun, Ni, and Li believe that FDI can expand the scale of finance, improve the efficiency of financial allocation, and optimize the financial structure [6,11,23]. Xun believes that FDI can promote financial development as a whole [28]. Our present study verifies the result that FDI inflows will simultaneously promote financial expansion, optimize financial results, improve financial efficiency, and promote overall financial development at the national level, and the promotion effect will gradually increase. Xun believes that the impact of FDI on financial development in different regions is different [28]. Our present study has verified the result that FDI will promote the expansion of financial scale, and present a U-shaped impact on the financial structure and financial efficiency in the eastern region. In the central region, FDI will promote the expansion of financial scale, improve financial efficiency, and restrain the optimization of the financial structure. In the western region, FDI has a U-shaped impact on financial scale and the financial structure, and an inverted U-shaped impact on financial efficiency. FDI presents obvious regional differences in the financial development measured by the three indicators. The empirical results also verify the hypotheses of this article: H1, the impact of FDI on financial development is nonlinear; and H2, the impact of FDI on financial development is differentiated in different regions. Zhu believes that the impact of financial development on FDI is different in different regions [9]. Xia believes that financial development presents a non-linear relationship with FDI, showing a U-shaped relationship. Under the background of financial system reform, the adverse impact of financial development on FDI will gradually weaken and eventually achieve coordinated promotion [20]. It can be confirmed from our results, at the national level, the expansion of financial scale and the optimization of financial structure will have a U-shaped impact on FDI inflows, and the increase in financial efficiency will curb FDI inflows. In the eastern region, the expansion of financial scale promotes the inflow of FDI, the optimization of the financial structure restrains the inflow of FDI, and the impact of financial efficiency on the trajectory of FDI presents a U shape. In the central region, the expansion of financial scale and the optimization of the financial structure restrained the inflow of FDI, and the impact of financial efficiency on FDI showed a U shape. In the western region, the expansion of financial scale restrains FDI inflows, and the impact of financial structure optimization on FDI presents a U shape, and the improvement of financial efficiency promotes FDI inflows. It also verifies the hypotheses: H3, the impact of financial development on FDI is nonlinear; and H4, the impact of financial development in different regions on FDI is differentiated.

China’s financial development can be manifested in the weakening of financial repression and the strengthening of financial deepening. The impact of financial development on FDI and the impact of FDI on financial development all present a U-shape. The eastern
region has a relatively high degree of financial development and started earlier. It is in the stage of deepening financial reforms. The financial system is relatively complete, with a more mature consumer market and business environment, which is more attractive to foreign capital. The eastern region has already crossed the inflection point and is in a U-shaped rising stage. This is in line with the empirical results that financial development and FDI can promote each other in recent years in the eastern region. In the western region, the financial development is relatively low, starting late, and on the left side of the U-shape. The economic development in the western region is relatively backward, the scale of business operations is relatively small, and the financing needs are relatively small. The expansion of financial scale largely meets the financing needs of enterprises, thereby squeezing out the demand for FDI. There is a relatively serious phenomenon of financial restraint in the west region. The financing constraints faced by private enterprises have promoted the inflow of FDI, and the economic scale of enterprises is relatively small. FDI inflows can meet most of the needs of enterprises and squeeze the credit demand for domestic financial institutions, suppressing the expansion of financial scale. However, with the development of the western economy, new financing needs will continue to be derived and FDI inflows can no longer support most of the financing needs. The inflow of FDI reduces information asymmetry, promotes cooperation between private enterprises and financial institutions, and stimulates the expansion of the local financial industry.

In addition, the empirical results show that the financial development of the country and the three major regions of the east, central, and west basically have no convergence effect on FDI, and that FDI basically has no convergence effect on financial development. It shows that provinces with a higher initial value of FDI have a higher level of financial development than provinces with a lower initial value of FDI. Over time, the financial development level of provinces with a higher initial value of FDI will grow faster than that of provinces with a lower initial value of FDI, which will eventually lead to greater differences in the financial development of provinces in the region. The important challenge to promote the sustainable development of regional finance is that the level of regional financial development is uneven and the differences are obvious [15]. Therefore, in order to reduce the differences in financial development in various regions, it is necessary to implement financial policies fundamentally, optimize the external financial environment, and promote coordinated financial development. At the same time, it pays attention to the combination of qualitative and quantitative financial development, so as to promote the sustainable development of finance in the region.

7. Conclusions and Recommendations

(1) Conclusions

This study aims to understand whether the two-way time-varying relationship between financial development and FDI is suppressed, facilitated, or non-linear, and if regional differences are present. This paper used a functional data analysis method to obtain the discrete data of China’s financial development level and FDI level during the period 2007–2018 incorporated into the category of continuous dynamic function and explore the two-way time-varying relationship between the two levels. Moreover, functional β convergence was used to study the convergence and divergence of the two levels across China and in the regions.

As revealed in the research results, FDI fully promoted the financial development nationwide, boosted the financial scale expansion in Eastern China and Central China, and had a U-shape impact on the Western China. It suppressed the financial structure optimization in Central China but displayed a U-shape impact on the optimization in Eastern China and Western China. Its impacts on financial efficiency improvement in the three regions were greatly different. Specifically, FDI had a U-shape impact on Eastern China, a positive impact on Central China, and a reversed U-shape impact on Western China. FDI almost had no convergence effect except the effect on FSE in Western China.
during the period 2007–2012 and the effect on FSA and FIE in Eastern China during the period 2007–2015.

FSE displayed a U-shape impact on the nationwide FDI inflow, promoted FDI inflow in Eastern China, and repressed that inflow in Central China and Western China. Financial structure optimization had a U-shape impact on the FDI inflow throughout the country and in Western China, while suppressing the FDI inflow in Eastern China and Western China. FIE improvement inhibited the FDI inflow at the national level, promoted that inflow in Western China and showed a U-shape impact on Eastern China and Central China. FSA displayed convergence effects on the FDI level all over China during the period 2007–2008, in Eastern China during the period 2008–2018, in Central China during the period 2007–2009, and in Western China during the period 2007–2008, while FIE almost had no convergence effect, except the effect on FDI level in Central China during the period 2007–2012.

(2) Theoretical contribution

This article has two theoretical contributions to the in-depth understanding of the relationship between financial development and foreign direct investment. First, this article further elaborates the law of foreign direct investment on financial development and the influence of foreign direct investment on financial development, reveals the interaction mechanism between financial development and foreign direct investment, and helps to further understand the relationship between foreign direct investment and financial development. The previous research only studied the unilateral influence mechanism, without comprehensively considering its mutual influence. Secondly, this article analyzes the differences in the interaction between financial development and foreign direct investment in different regions, and further reveals the complexity of its mechanism, which requires the consideration of regional heterogeneity.

(3) Practical Enlightenment

Based on the above conclusions, this paper also has the following practical implications:

First, governments of the regions should practically implement policy for introducing foreign capital. According to the above conclusions, financial development displayed almost no convergence effect on FDI level in recent years. This reflects that the FDI difference between the whole country and the regions will not be reduced. In order to reduce the difference, the regional governments should actively put into practice some preferential policies for inflow of foreign investment, such as relaxing the restriction for access of foreign investment and giving foreign investors national treatment of China.

Second, the regional governments should primarily and actively conduct the financial deepening reform to promote the regional financial development. As stated in the above conclusion, FDI generally had no convergence effect on financial development in recent years, which indicated that the financial development difference between the whole country and the regions would not be reduced. In order to reduce the difference, the government should primarily and actively put into practice the reform, expand financial scale, optimize financial structures, and improve financial efficiency to realize an all-round coordinated financial development in the regions, so as to promote financial sustainability.

Third, differentiated foreign investment inflow policies should be executed to promote coordinated development in the regions. In recent years, the financial development in Eastern China has been fully boosted by FDI and reached a quite high degree. Hence, when introducing FDI, more attention should be paid to “good quality and light weight” to improve the use rate of foreign investment, guide its correct flow direction, and further drive the financial innovation and development in Eastern China. While in Central China, FDI has repressed the financial structure optimization and the economic development of this region is in medium stage. Therefore, it is also necessary to initially perfect the specific financial structure while actively attracting FDI, and use foreign investment to balance the ratios of direct financing and indirect financing so as to eliminate the repression effect displayed by foreign investment on local financial structure optimization. Whereas, in Western China, FDI had U-shape impact on the financial scale and financial structure and
changed into having a promotional effect on the two levels in recent years, and had a reversed U-shape impact on financial efficiency and changed into having a suppression effect on this level in recent years. The economic development of Western China lags behind other regions. Due to this, FDI in this region should be introduced rationally in combination with the actual financing demands of local enterprises. In the meantime, it is necessary to actively complete the regional financial system and keep FDI’s role in promoting the improvement of financial efficiency.

(4) Shortcomings and future research directions

The research in this article still has some limitations. The research in this article is based on annual data, which may be an insufficient amount. Future research can be subdivided into monthly data for research. The functional fitting of discrete data into a smooth curve will reflect the characteristics of the data in more detail, so as to analyze the two-way relationship between financial development and FDI more accurately. The research in this article is based on the three major regions of East, Central, and West. The financial development and FDI level of various provinces in the region may also be quite different. Future research can be divided into more details. For example, the financial development and FDI level of Shanghai and Beijing in the eastern region are relatively different, high, and can be subdivided separately.

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