The Spatial Spillover Effect of College Students' Entrepreneurial Activeness Degree

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Abstract—Analyzing the influence of the spatial spillover effect of college students' Entrepreneurial Activeness Degree (EAD) in each region on the cultivation intensity of their Innovation and Entrepreneurial Ability (IEA) is of certain theoretical and practical significance. However, in the research of domestic scholars, when studying the relationship between the EAD of college students and the cultivation intensity of their IEA, they generally give comprehensive evaluations based on the Evaluation Index Systems (EISs) they built, few of them have concerned about the spatial spillover effect of the EAD of college students, and relevant analysis based on spatial measurement method is rarely seen. To fill in this research blank, this paper aims to study the spatial spillover effect of the EAD of college students based on the improvement of IEA. At first, the paper gave the analysis framework of EAD, and adopted a layer-by-layer vertical and horizontal scatter degree method to perform dynamic measurement on the EAD of college students based on evaluation data collected from different regions. Then, this paper built a college student innovation and entrepreneurial Knowledge Production Function (KPF) model and used it to analyze the relationship between IEA cultivation intensity and the EAD of college students, thereby attaining the development status and spatial spillovers of the entrepreneurial activities of college students. At last, experimental results proved the effectiveness of the measurement method and the constructed model, and the analysis results of the spatial spillover effect in the study regions were given.

Keywords—Entrepreneurial Activeness Degree (EAD), Innovation and Entrepreneurial Ability (IEA), spatial spillover effect, cultivation intensity, Knowledge Production Function (KPF), scatter degree

1 Introduction

College students are important members in the nation-wide venture tide, and the cultivation of their IEA is closely related to the realization of the development goals of an innovative country [1-6]. To provide impetus for the high-quality development of regional economy, it's necessary for the academic circle to research college students' IEA and find ways to improve their EAD [7-11]. Compared with developed countries with more advanced educational ideas, in most Chinese colleges and universities, the cultivation time of IEA is not long enough, and there're a few problems with it such as the lack of awareness for IEA cultivation, the insufficient efforts put into IEA cultivation, the low development level, and the unbalanced development status, etc. [12-19]. Therefore, analyzing the influence of the spatial spillover effect of college students' EAD in each region on the cultivation intensity of their IEA is of certain theoretical and practical significance.

In terms of IEA improvement of college students, scholar Zou [20] built a quality tracking model for the training of college students' IEA based on big data analysis which can run rapidly and efficiently via the matching and coordination between elements such as participants, capital, technology, network design, and the institutional system. Another scholar Sang [21] started from the evaluation of the IEA of students in higher vocational colleges, based on previous research about EIS and scientific practice, the paper introduced a comprehensive evaluation method and constructed an evaluation model with three layers and 40 indexes, and the specific indexes were briefly introduced as well. In terms of the analysis of spatial spillover effect, Cabrer-Borrás et al. [22] analyzed the spatial pattern of innovation, the inter-regional interdependence and evolution, and the role of regional innovation in Spain; their research results suggested that, with the spatial spillover effect of innovation taken into consideration, the trade-based regional proximity is appropriate; with economic growth and supporting facility improvement, innovation and R&D exhibit significant output and spillover effects. Li and Liang [23] took the number of patents granted on environment-friendly innovation and R&D as the dependent variable, and factors such as researcher and innovation capital as independent variables to conduct empirical comparison and verification based on regional spatial measurement model. With prefecture-level city as measurement unit and the number of granted patents as the agent of regional innovation, Liu and Wang [24] used a spatial panel data model to analyze the regional innovation effect of Zhejiang Province of China from 2001 to 2008, and their research results proved that R&D investment and industrial clustering have a significant impact on regional innovation in Zhejiang.

After reviewing relevant literatures, it's found that, compared with the research of foreign scholars, the research of domestic scholars on the EAD of college students is falling behind. When studying the relationship between the EAD of college students and the cultivation intensity of their IEA, domestic scholars generally give comprehensive evaluations based on the EISs they built, few of them have concerned about the spatial spillover effect of the EAD of college students, and relevant analysis based on spatial measurement method is rarely seen. To fill in this research blank, this paper aims to study the spatial spillover effect of the EAD of college students based on the improvement of IEA, and the main content of this paper includes these aspects: the second chapter gave the analysis framework of EAD, and adopted a layer-by-layer vertical and horizontal scatter degree method to perform dynamic measurement on the EAD of college students based on evaluation data collected from different regions. The third chapter built a the KPF model and used it to analyze the relationship between IEA cultivation intensity and EAD of college students, thereby attaining the development status and the spatial spillovers of the entrepreneurial activities of college students. At last, experimental results proved the effectiveness of the measurement method and the constructed model, and the analysis results of the spatial spillover effect in the study regions were given.

2 Measurement of EAD of college students

Figure 1 gives the analysis framework of the EAD of college students. As shown in the figure, this paper selected five first-level indexes for assessing college students' EAD, including the average path length of entrepreneurial nodes, the distribution of entrepreneurial nodes, the centrality of entrepreneurial nodes, the clustering coefficient of entrepreneurial nodes, and the density of entrepreneurial nodes. These indexes can effectively describe the regional distribution characteristics of college students' entrepreneurship. To measure the EAD of college students, at first, weight values need to be assigned to the evaluation indexes of EAD, to ensure that the evaluation results are comparable, this paper adopted a layer-by-layer vertical and horizontal scatter degree method to perform dynamic measurement on the EAD of college students based on the evaluation data collected from different regions.

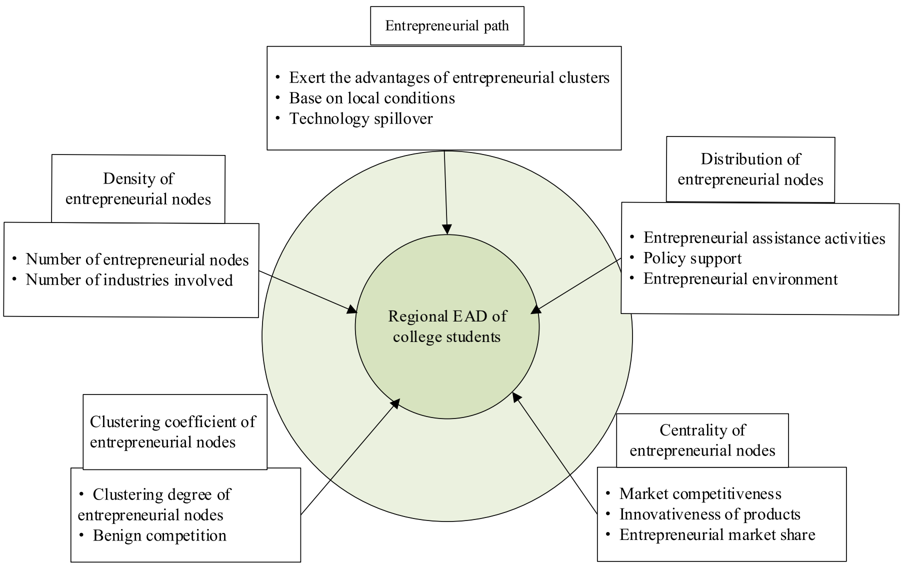

Fig. 1. Analysis framework of EAD

Taking the proposed first-level indexes as examples, assuming: there're N study regions E_1, E_2, E_3, ..., E_N, and each region has N first-level indexes; then, the original evaluation index dataset of each year was constructed and denoted as $\{a_{ij}(p_l)\}$, wherein $\{a_{ij}(p_l)\}$ represents the observed value of the first-level index of the EAD of the j-th college student in the i-th study region in the l-th year, then the comprehensive evaluation value of all first-level indexes can be calculated by the following formula:

$$b_i^{(t-2.l)k}\left(p_l\right)=\sum_{w=1}^{m_t}\phi_w b_j^{(t-1.w)}\left(p_l\right) \tag{1}$$

The comprehensive evaluation value of the objective layer of the evaluation of college students' EAD could be calculated by the following formula:

$$b_i^{(1,1)}\left(p_l\right)=\sum_{w=1}^{m_t}\phi_w b_j^{(2.w)}\left(p_l\right) \tag{2}$$

If we want to attain the comprehensive evaluation value of the EAD of college students in each study region within the study period, the observed values of EAD of college students in each year within the study period need to be superimposed, thus the observed value of each year needs to be assigned with a reasonable time weight. To avoid errors in the observed results caused by blindly pursuing the time series difference of observed values, based on the information entropy, this paper defined an entropy index *DU* as Formula 3, and the difference between observed values of each year can be described by the time scale μ shown in Formula 4. Assuming: φ_l represents the time weight vector, *M* represents the number of study years, then there are:

$$DU=-\sum_{l=1}^{M}\phi_l ln\phi_l \tag{3}$$

$$\mu=\sum_{l=1}^{M}\frac{t-l}{t-1}\phi_l \tag{4}$$

According to above formula, *DU* value increases with the decrease of φ_l difference and decreases with the increase of φ_l difference.

Then, the time weight vector of the evaluation indexes of EAD was attained by the nonlinear programming method, to minimize the difference between vectors, Formulas 5 and 6 give the solution:

$$max\left(-\sum_{l=1}^{M}\phi_l ln\phi_l\right) \tag{5}$$

$$s.t.\begin{cases}\mu=\sum_{l=1}^{M}\frac{M-l}{M-1}\phi_l\\ \sum_{l=1}^{M}\phi_l=1,\phi_l\in[0,1]\end{cases} \tag{6}$$

This paper introduced the *TOWA-GA* operator of the time series weighted measurement model into the superimposing and merging processes of the observed values of EAD to ensure that the importance of time weights of different years could be fully reflected. Assuming: φ_j represents the time weight of the *j*-th year, y_j represents the intensity of IEA cultivation of the study region in the *j*-th year, then the following formula gives the definition of the operator:

$$B\left(\langle v_1, x_1\rangle, \ldots, \langle v_M, x_M\rangle\right) = x_1 \sum_{j=1}^{m} \theta_j y_j + x_2 \prod_{j=1}^{m} y_j^{\theta_j} \tag{7}$$

Formula 8 gives the expression of the *TOMA* operator in the *TOWA-GA* operator:

$$G = \left(\langle v_1, x_1\rangle, \ldots, \langle v_M, x_M\rangle\right) = \sum_{j=1}^{m} \phi_j y_j \tag{8}$$

Formula 9 gives the expression of the *TOMAGA* operator:

$$H = \left(\langle v_1, x_1\rangle, \ldots, \langle v_M, x_M\rangle\right) = \prod_{j=1}^{m} y_j^{\phi_j} \tag{9}$$

Assuming: G_i and H_i respectively represent the time-series weighted average operator and the geometric average operator of study region *i* with the study period; ε_1 and ε_2 represent the deviation and the squared sum of G_i and H_i, then the comprehensive evaluation value of EAD of college students in study region *i* within the study period can be calculated by the following formula:

$$B_i = x_1 G_i + x_2 H_i \tag{10}$$

$$x_1 = \frac{\varepsilon_1}{\varepsilon_1 + \varepsilon_2} x_2 = \frac{\varepsilon_2}{\varepsilon_1 + \varepsilon_2} \tag{11}$$

3 Empirical analysis of EAD and the spatial spillover effect

This paper constructed a KPF model to analyze the relationship between the IEA cultivation intensity of the region and the EAD of college students, thereby attaining the development status and the spillovers of college students' entrepreneurial activities. Assuming: EEO_{ip} and ITN_{ip} respectively represent the entrepreneurial economic output and the number of innovative technologies of college students in study region i in the p-th year; HRI_{ip} represents the human resource input of the entrepreneurship; EAE_{ip} represents the entrepreneurial activity expenditure, then the expression of the constructed model is given by the following formulas:

$$ITN_{ip} = \beta_0 + \beta_1 HRI_{ip} + \beta_2 EAE_{ip} + \sigma_{ip} \tag{12}$$

$$EEO_{ip} = \gamma_0 + \gamma_1 HRI_{ip} + \gamma_2 EAE_{ip} + v_{ip} \tag{13}$$

By taking the logarithmic form of above formulas, the expanded KPF model shown as follows could be attained to get smaller data volatility. Assuming: $\ln EEO_{ip}$ and $\ln ITN_{ip}$ represent the natural logarithms of EEO and ITN of study region *i* in the p-th year; $\ln HRI_{ip}$ and $\ln EAE_{ip}$ represent the natural logarithms of HRI and EAE; σ_{ip} and v_{ip} represent random error terms, then there are:

$$lnITN_{ip} = \beta_0 + \beta_1 \ln HRI_{ip} + \beta_2 \ln EAE_{ip} + \sigma_{ip} \tag{14}$$

$$\ln EEO_{ip} = \gamma_0 + \gamma_1 \ln HRI_{ip} + \gamma_2 \ln EAE_{ip} + v_{ip} \tag{15}$$

Assuming: $(q_{ij})_{m\times m}$=Q represents the spatial weight matrix; the spatial effects of the entrepreneurial economic output and the number of innovative technologies (variables of EAD) of college students in the adjacent region on the EAD of college students in the current region are represented by the two spatial lag variables Q ln EEO_{ip} and $_t$Q ln ITN_{ip}; υ represents spatial autocorrelation coefficient, by introducing the spatial lag variables into the above model, we can get:

$$\ln ITN_{ip} = \beta_0 + \upsilon_1 \left(\sum_{j=1}^{m} q_{ij} \ln ITN_{jp} \right) + \beta_1 \ln RDE_{ip} + \beta_2 \ln RDP_{ip} + \sigma_{ip} \tag{16}$$

$$\ln NPV_{ip} = \gamma_0 + \upsilon_2 \left(\sum_{j=1}^{m} q_{ij} \ln NPV_{jp} \right) + \gamma_1 \ln RDE_{ip} + \gamma_2 \ln RDP_{ip} + v_{ip} \tag{17}$$

Since different regions would have different strategies and features of IEA cultivation, the spatial measurement model that incorporates regional time-invariant heterogeneity is given by the following formula:

$$b_{ip} = A_{ip}\gamma + \chi_i + \sigma_{ip}, \sigma_{ip} \sim M\left(0, \varepsilon_v^2\right) \tag{18}$$

The spatial lag model and the spatial error model are given by Formulas 19 and 20, respectively:

$$b_{ip} = \upsilon \sum_{j=1}^{m} q_{ij} b_{jp} + A_{ip}\gamma + \chi_i + \sigma_{ip}, \sigma_{ip} \sim M\left(0, \varepsilon_v^2\right) \tag{19}$$

$$b_{ip} = A_{ip}\gamma + \chi_i + \sigma_{ip}, \sigma_{ip} \sim N\left(0, \varepsilon_v^2\right) = \mu \sum_{j=1}^{m} q_{ij} \sigma_{jp} + \lambda_{ip}, \lambda_{ip} \sim M\left(0, \varepsilon_v^2\right) \tag{20}$$

The spatial Durbin model that incorporates the interaction effect of both dependent and independent variables is given by the following formula:

$$b_{ip} = \upsilon \sum_{j=1}^{m} q_{ij} b_{jp} + A_{ip}\gamma + \sum_{j=1}^{m} q_{ij} A_{jp} + \chi_i + \lambda_{ip}, \lambda_{ip} \sim M\left(0, \varepsilon_v^2\right) \tag{21}$$

The spatial weight matrix can be used to describe the spatial relationship of EAD of college students in each region, this paper chose to use an EAD distance matrix for empirical analysis. Assuming: Ai represents the evaluation indexes of EAD that form the spatial weight matrix of EAD; Ji represents the set of spatial units with common boundaries in study region i, then, the EAD weight matrix can be estimated based on the absolute deviation of the evaluation indexes of EAD:

$$q_{ij} = \begin{cases} 1/\left|A_i - A_j\right|, i \neq j \\ 0, i = j \end{cases} \tag{22}$$

$$q_{ij} = \begin{cases} A_i / \sum_{l \in J_i} A_l, \textit{spatial unitsiandjhave common boundaries} \\ 0, \textit{others} \end{cases} \tag{23}$$

Assuming: EEO represents the per capita entrepreneurial economic output of college students in study region i in the p-th year; the entrepreneurial investment of college students is measured by ECS (entrepreneurial capital stock) and HRI (human resource input); the entrepreneurial environment is measured by JVI (joint venture investment); PSI represents policy support input; the region's input into IEA cultivation is measured by EDU (the average education years of college students), then, based on these five variables, the following regression model can be constructed:

$$\begin{aligned} \ln EEO_{ip} &= \gamma_0 + \gamma_1 \ln ECS_{ip} + \gamma_2 \ln HRI_{ip} \\ &+ \gamma_3 \ln JVI_{ip} + \gamma_4 \ln PSI_{ip} + \gamma_5 \ln EDU_{ip} + \sigma_{ip} \end{aligned} \tag{24}$$

Considering that the influence of joint venture investment on the overall EAD of college students is not very important, and the degree of such influence is not high, then the above formula can be simplified to:

$$\begin{aligned} \ln EEO_{ip} &= \gamma_0 + \gamma_1 \ln ECS_{ip} + \gamma_2 \ln HRI_{ip} \\ &+ \gamma_3 \ln PSI_{ip} + \gamma_4 \ln EDU_{ip} + \sigma_{ip} \end{aligned} \tag{25}$$

Assuming: t represents the spatial autoregression coefficient; q_{ij}=Q represents the spatial weight matrix of EAD distance; γ represents the regression coefficient of variable; σ_{ip} represents random error term; then, for the corresponding spatial lag model and spatial error model, there are:

$$\begin{aligned} \ln EEO_{ip} &= \upsilon \left(\sum_{j=1}^{m} q_{ij} \ln EEO_{jp} \right) + \gamma_0 + \gamma_1 \ln ECS_{ip} + \gamma_2 \ln HRI_{ip} \\ &+ \gamma_3 \ln PSI_{ip} + \gamma_4 \ln EDU_{ip} + \sigma_{ip} \end{aligned} \tag{26}$$

$$\begin{aligned} \ln EEO_{ip} &= \gamma_0 + \gamma_1 \ln ECS_{ip} + \gamma_2 \ln HRI_{ip} \\ &+ \gamma_3 \ln PSI_{ip} + \gamma_4 \ln EDU_{ip} + \sigma_{ip} \end{aligned} \tag{27}$$

Wherein, $\sigma_{ip}=\lambda\Sigma^{m}_{j=1}q_{ij}\sigma_{jp}+\lambda_{ip}$, $\lambda_{ip}\sim M(0,\varepsilon^2_v)$. The corresponding spatial Durbin model can be expressed as:

$$\begin{aligned} \ln RGDP_{ip} &= \upsilon\left(\sum_{j=1}^{m} q_{ij} \ln RGDP_{jp}\right) + \gamma_0 + \gamma_1 \ln RDI_{ip} + \gamma_2 \ln RDP_{ip} \\ &+\gamma_3 \ln FAI_{ip} + \gamma_4 \ln EDU_{ip} + \mu_1\left(\sum_{j=1}^{m} q_{ij} \ln RDI_{jp}\right) \\ &+\mu_2\left(\sum_{j=1}^{m} q_{ij} \ln RDP_{jp}\right) + \mu_3\left(\sum_{j=1}^{m} q_{ij} \ln FAI_{jp}\right) \\ &+\mu_4\left(\sum_{j=1}^{m} q_{ij} \ln EDU_{jp}\right) + \sigma_{ip} \end{aligned} \tag{28}$$

The fixed effect spatial Durbin model is expressed as:

$$\begin{aligned} \ln RGDP_{ip} &= \upsilon\left(\sum_{j=1}^{m} q_{ij} \ln RGDP_{jp}\right) + \gamma_0 + \gamma_1 \ln RDI_{ip} + \gamma_2 \ln RDP_{ip} \\ &+\gamma_3 \ln FAI_{ip} + \gamma_4 \ln EDU_{ip} + \mu_1\left(\sum_{j=1}^{m} w_{ij} \ln RDI_{jp}\right) \\ &+\mu_2\left(\sum_{j=1}^{m} q_{ij} \ln RDP_{jp}\right) + \mu_3\left(\sum_{j=1}^{m} q_{ij} \ln FAI_{jp}\right) \\ &+\mu_4\left(\sum_{j=1}^{m} q_{ij} \ln EDU_{jp}\right) + \chi_i + \sigma_{ip} \end{aligned} \tag{29}$$

4 Experimental results and analysis

This paper took the entrepreneurship of college students in 14 study regions from 2010 to 2020 as the research object, and employed a layer-by-layer vertical and horizontal scatter degree method to assign weight values for indexes in the proposed EIS for assessing college students' EAD. Among the five first-level indexes (average path length of entrepreneurial nodes, distribution of entrepreneurial nodes, centrality of entrepreneurial nodes, clustering coefficient of entrepreneurial nodes, and density of entrepreneurial nodes), the weights of the first three are higher, respectively 0246, 0.217, and 0.208. After time weights were assigned, based on the constructed time series weighted measurement model, the comprehensive scores of the EAD of college students in the 14 study regions from 2010 to 2020 were measured, and the results are given in Table 1.

According to the table, the value range of the EAD of college students in the 14 study regions is [0.31, 0.57], and the highest EAD value is twice the lowest value of EAD, indicating that there are significant differences in the entrepreneurial development level of college students in the 14 study regions. Within the study period, the EAD of college students in many regions exhibited an upward trend year by year, which also indicates that the EAD of college students was maintained at a certain level, and it's necessary to cultivate their IEA based on local conditions, and their entrepreneurial development path should match with the local industrial development conditions.

Table 1. Measurement values of the EAD of college students in 14 study regions

Region No.	2010	2012	2013	2014	2015	2016	2017	2018	2019	2020	Final measurement value
1	0.51	0.43	0.57	0.54	0.57	0.55	0.51	0.58	0.53	0.59	0.57
2	0.45	0.45	0.52	0.48	0.54	0.52	0.49	0.53	0.47	0.38	0.47
3	0.41	0.41	0.41	0.42	0.39	0.41	0.45	0.43	0.39	0.41	0.48
4	0.46	0.49	0.48	0.44	0.33	0.41	0.40	0.36	0.39	0.48	0.52
5	0.39	0.46	0.42	0.41	0.41	0.38	0.45	0.41	0.49	0.45	0.48
6	0.40	0.44	0.48	0.43	0.46	0.41	0.41	0.47	0.45	0.42	0.47
7	0.48	0.48	0.40	0.47	0.38	0.39	0.49	0.49	0.38	0.47	0.38
8	0.42	0.31	0.36	0.39	0.39	0.45	0.42	0.43	0.37	0.46	0.36
9	0.36	0.43	0.45	0.41	0.51	0.38	0.38	0.45	0.41	0.43	0.41
10	0.31	0.34	0.47	0.42	0.47	0.41	0.32	0.38	0.36	0.39	0.38
11	0.37	0.39	0.49	0.36	0.42	0.47	0.41	0.32	0.25	0.35	0.35
12	0.35	0.35	0.32	0.34	0.31	0.39	0.36	0.39	0.47	0.41	0.31
13	0.33	0.38	0.37	0.38	0.34	0.35	0.37	0.36	0.39	0.37	0.39
14	0.39	0.31	0.30	0.33	0.37	0.32	0.31	0.37	0.35	0.32	0.35

To verify the effectiveness of the constructed model, this paper performed *OLS* regression estimation, and Table 2 gives the *OLS* regression estimation results. According to the table, the p values of the regression coefficient of *ECS* (entrepreneurial capital stock), *HRI* (human resource input), *PSI* (policy support input), and *EDU* (average education years) are all relatively small, so it can be considered that the regression results of the constructed model are significant, which means that these 4 variables have significant impact on the EAD of college students. The p value of the regression coefficient of *JVI* (joint venture investment) is larger, indicating that its impact on the EAD of college students is not significant.

Table 3 shows the estimation results of the constructed spatial Durbin model. According to the table, the p values of the regression results of *ln ECS*, *ln HRI* and *ln PSI* are all less than 0.05, it can be considered that these three variables had passed the significance test; however, the p value of *EDU* is 0.326, which is greater than 0.05, so this variable hadn't passed the significance test.

In addition, the regression coefficients of *ln ECS* (entrepreneurial capital stock) and *ln HRI* (human resource input) of college students in the adjacent region are both greater than 0, indicating that the regression results of the two are significant, which means that the *ln ECS* (entrepreneurial capital stock) of college students in the adjacent region has a significant positive impact on the EAD of college students in the study region; in the meantime, the *ln HRI* (human resource input) of college students in the adjacent region has a significant impact on the EAD of college students in the study region. While the regression coefficients of *ln PSI* (policy support input) and *ln EDU* (average education years) are less than 0, indicating that the two have a promotive impact on EAD of college students in the study region, but such impact is not that significant.

Table 4 shows the estimation results of the Durbin model incorporated with time and space fixed effects. According to the table, at the 5% significance level, the spatial lag term of the constructed time and space fixed effect model didn't pass the significance test, and the spatial lag term of the space fixed effect model didn't pass the significance test as well. On the contrary, in the constructed time fixed effect model, the estimation coefficients of *ln ECS* (entrepreneurial capital stock), *ln HRI* (human resource input), *ln PSI* (policy support input) and *ln EDU* (average education years) are all greater than 0, all of them had passed the significance test, which has further verified that, with the passing of time, these variables positively promote the EAD of college students in the study region.

Table 2. *OLS* regression estimation results of the constructed model

	Estimate	***Std.Error***	***t-value***	***Pr(>id)***
ln ECS	0.25147	0.01625	12.030	<3*e*-15
ln HRI	-0.21524	0.06948	-13.524	<3*e*-15
ln JVI	0.01322	0.03415	0.894	0.351
ln PSI	0.26259	0.06259	16.325	<3*e*-15
ln EDU	3.12415	0.18457	22.958	<3*e*-15

Table 3. Estimation results of the constructed spatial Durbin model

	Coef.	**Std.Ert**	**z**	**P>z**	**[85%Conf.ln tervall]**	
ln EEO						
ln ECS	0.032655	-0.152482	2.58	0.029	0.152955	0.514822
ln HRI	3.125621	0.623522	21.36	0.025	2.154712	3.265955
ln PSI	-0.169295	0.958622	-1.69	0.014	-0.326592	0.041528
ln EDU	1.205221	1.124155	6.48	0.326	7.154225	1.524855
Q						
ln ECS	0.625392	0.326592	4.35	0.011	0.416253	1.623595
ln HRI	-0.748596	0.312547	-2.16	0.069	-1.625922	-0.124152
ln PSI	0.625154	0.162954	4.59	0.062	0.326589	1.623669
ln EDU	-1.302623	2.154786	-4.36	0.047	-1.625955	-5.294854
ln EEO	3.265592	0.526359	6.59	0.058	2.314585	4.5211851

Table 4. Estimation results of the constructed fixed effect Durbin model

Model	**Time and space fixed**		**Time fixed**		**Space fixed**	
	Coefficient	***P-value***	***Coefficient***	***P-value***	***Coefficient***	***P-value***
ln EEO	0.2152	0.0154	0.2615	0.0148	0.2639	0.0014
ln ECS	-0.0745	0.0362	-0.0125	0.1367	-0.0615	0.0418
ln HRI	0.6152	0.4152	0.6958	0.0048	0.6195	0.0014
ln PSI	0.0326	0.6341	0.0384	0.3958	0.0241	0.5183
ln EDU	0.0592	0.0413	0.0748	0.6295	0.1302	0.0741

Q	0.3748	0.0269	0.3706	0.0325	0.3958	0.0294
ln ECS	-0.0251	0.1326	-0.1952	0.2748	-0.2635	0.0812
ln HRI	-0.2541	0.1925	-0.1475	0.2958	-0.2153	0.0481
ln PSI	0.0623	0.0152	0.0418	0.0625	0.0958	0.0152
ln EDU	0.1326	0.1849	0.0523	0.6158	0.1429	0.1627
ln EEO	0.1305	0.1147	0.2051	0.0162	0.1957	0.2105

With the data of the per capita entrepreneurial economic output of college students in each study region within the study period as the example, this paper plotted the scatter diagrams of local Moran's I index at the initial and final stages of the study period based on the R software, as shown in Figures 2 and 3.

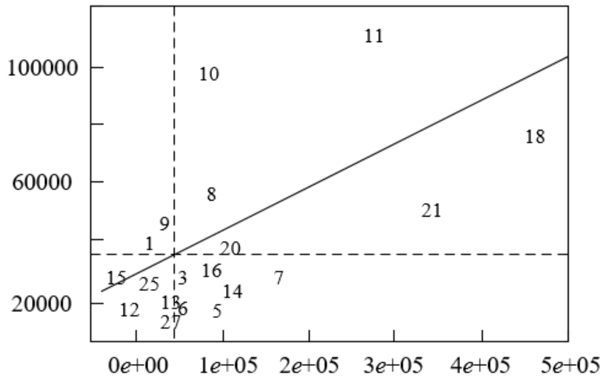

Fig. 2. Local Moran's I index at the initial stage of the study period

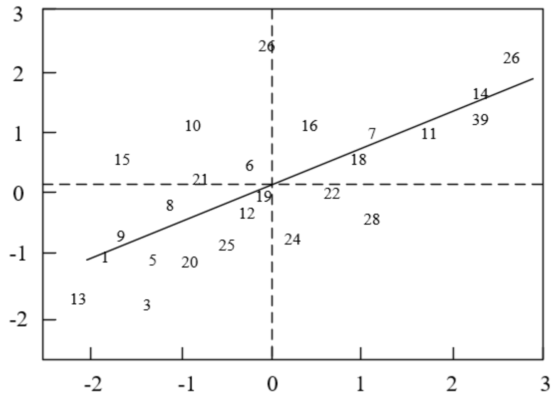

Fig. 3. Local Moran's I index at the final stage of the study period

The values of the local Moran's I index of each sub region in the 14 study regions were measured, and the spatial clustering positions of the EAD of college students were determined to study the spatial differences among different sub-regions.

According to Figures 2 and 3, within the study period, more Moran scatter points of the EAD and its spatial lag term of college students in most sub-regions of the study regions are distributed in the first and third quadrants, indicating that there's a certain positive spatial correlation in the EAD of college students in each sub-region of the study regions. Under the condition that the cultivation intensity of IEA in the study region has been increased, the EAD of college students will distribute more evenly.

At last, this paper randomly arranged the data of the per capita entrepreneurial economic output of college students in each study region within the study period for 1000 times, calculated the corresponding values of the Moran's I index and simulated its distribution, thereby attaining the occurrence probability of the corresponding index. In the multi-time random arrangement results, the values of less than 10 terms are greater than the actual measured values. To further verify whether there's a spatial autocorrelation in the EAD of college students in each study region, Figure 4 gives the simulated distribution results of the Moran's I index.

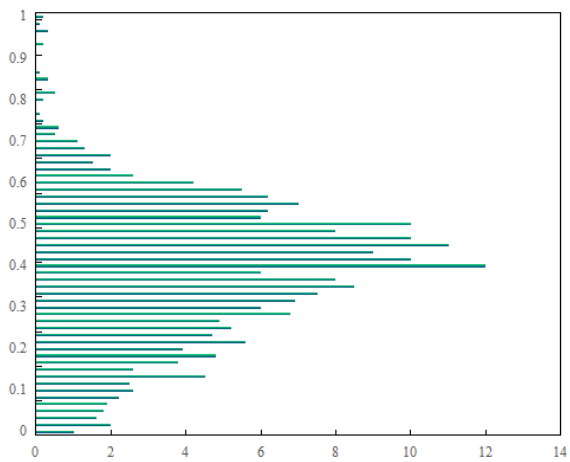

Fig. 4. Simulated distribution of Moran's I index

5 Conclusion

This paper studied the spatial spillover effect of college students' EAD based on the improvement of entrepreneurial ability. At first, this paper gave the analysis framework of EAD, and adopted a layer-by-layer vertical and horizontal scatter degree method to perform dynamic measurement on the EAD of college students based on evaluation data collected from different study regions. Then, this paper built a the KPF model and used it to analyze the relationship between IEA cultivation intensity and EAD of college students, thereby attaining the development status and the spatial spillovers of the entrepreneurial activities of college students. Via experiment, this paper counted the measurement values of the EAD of college students in 14 study regions, gave the OLS regression estimation results of the constructed model, and verified the effectiveness of the constructed model; then, it gave the estimation results of the spatial Durbin model and the Durbin model incorporated with time and space fixed effects, and demonstrated that, with the passing of time, *ECS* (entrepreneurial capital stock), *HRI* (human resource input), *PSI* (policy support input), and *EDU* (average education years) positively promoted the EAD of college students in the study region; at last, this paper plotted the scatter diagrams of the Moran's I index at the initial and final stages of the study period, and proved that there's a certain positive spatial correlation in the EAD of college students in each sub-region of the study regions. Under the condition that the cultivation intensity of IEA in the study region has been increased, the EAD of college students will distribute more evenly.

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