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The Research on Cultural and Creative industries Cluster Development Based on Nash Equilibrium

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Abstract

Cultural and creative industry is the second largest pillar industry of the tertiary industry, with the characteristics of innovative, high value and strong correlation relationship. The development of industrial cluster is helpful to cultural communication and information transfer, so it can enhance the competitiveness of the creative industry. The key problems need to be solved are the development condition and development strategy of creative industry cluster. This paper builds a mathematical model of two areas and two enterprises to study how can the effect of location factor and aggregation influence the development of cultural and creative industries, and the result shows a series of optimal development forms of the cultural and creative industry under different conditions. Finally four piece of recommendations to promote the development of creative industry clusters have been put forward.

Keywords: Cultural and creative industry, mathematical model, optimal development forms

1. Introduction and Background

Cultural and creative industry clusters can be understood as a form of cultural resources and creative consciousness of a business or organization in a market economy environment's fusion development. Since the 21st century, it has become one of various important pillar industries in the national and regional economic development, showing a cluster development trend. Besides it has profoundly impacted on the countries' level of economic development and the upgrading of industrial structure. In recent years, the development of cultural and creative industries cluster has become a research focus among domestic and foreign scholars. Scott. A. J., (1997) believed that a particular location could help promote cultural industry cluster, and pointed out the reason that Hollywood could become the most influential cultural industry in terms of gathering place largest in the world , because the key factor of location and population density. Currid. E., (2006) thought that the creative industries cluster development, on the one hand, could contribute to the exchange of information and technology, on the other hand ,it might contribute to the trust and cooperation between the manufacturers. The Chinese scholar Zhang. Z. P et al (2011), summarized the creative industries form possess the following four basic conditions: the factors of production conditions (cultural resources, human resources, capital resources, and infrastructure), consumer demand conditions, other industries related to the pillar industries, environmental conditions (institutional factors, marketing factors, the innovation factor), and his idea similar to Su's (2011). Other scholars' studies most on the formation mechanism of the cultural creative industries and sustainable development and the better development of strategies (Song.W.Y., 2008; Cha. H. C., and Qiao.G.2010; Jin.Z., 2012; Zhou.J. and Cao. M., 2015; Ding, J. 2015).

Up to now, most of the research on this issue lay particular stress on two sides: the causes of the cluster development and cluster development advantages, there are few scholars can seem the industry as a system, building a model from the of view of economics, exploring the creative industries cluster development with conditions.

This study constructs a distribution model of two enterprises in a different region, starting from the market demand and cost functions, to determine the optimal condition required by the production. Then, we turn to Beijing Cultural and Creative Industry Distribution and Dahongmen clothing costumes enclave formation as an example to prove the

rationality of the model we have established, finally, I put forward some suggestions to promote the development of cultural and creative industries cluster.

2. Economic Model Construction and Nash Equilibrium Analysis

This paper adopts the Weber's point view on the development of industry gathering that the factor on creative enterprise location choice can be summarized as: location effect and aggregation effect. Location factors are the factors affecting the distribution of creative industries. There are five factors that often referred to in the literature: market factors, institutional factors, environmental factors, talent and cultural factors .Cultural factor is the basic factor, however the market factor is the core factor, institutional factor is the obstacle, human factor is the key, and environmental factor is the supporting factor. (1) Environmental factor mainly refers to the atmosphere of the area of cultural and creative industries, the size and number of its associated industries, consumer demand for the convenience of transportation and market culture. (2) Cultural factor mainly refers to the hardware facilities of the development of creative industries and culture. (3) Human factor refers to the creative class, technical personnel and management personnel. (4) Institutional factor mainly refers to the relevant laws and regulations enacted by the government to promote the development of cultural and creative industries cluster and various preferential policies. (5) Market factor refers to environmental factors affecting the demand and supply of cultural and creative products. Agglomeration effects can generate enormous external, such as the promotion of economies of scale, reduction risk, improving innovation and competitiveness, and promoting collaboration between related enterprises and enhancing the brand. These factors can reduce the creative product cost of sales.

At this point, we will establish a two enterprises econometric model, and the Nash equilibrium position of cultural and creative industries is obtained based on the principle of profit maximization, and then we identify the conditions for the development of cultural and creative industries cluster should have.

2.1 Model Assumptions

First, there are two market conditions and completely divided regions: the S area and T area, the two random location of creative enterprises – firm 1 and firm 2, they produce the cultural and creative product homogeneous. Second, the two market inverse demand function is:

$$p_x = \alpha - \beta(q_{1x} + q_{2x}), x = (S,T) \tag{1}$$

Among that α, β refers to the positive constant; p_x refers to the different market price on the land x; $q_{ix}(i = 1,2)$ refers to the i firm's sales volume on the x land .

Third, we assume the production cost of both cultural and creative enterprises A; Transportation cost between S and T is f .S area has favorable location factors of the creative industries, so the S area can produce the effect of location factor, cost savings is ν , among them, $\nu = \varpi_1\nu_1 + \varpi_2\nu_2 + \varpi_3\nu_3 + \varpi_4\nu_4 + \varpi_5\nu_5$, ν_i （$i = 1,2,3,4,5$）respectively denotes the cost savings brought about by the effect of environmental factors, the effect of cultural factor, personnel factor effect, institutional factor effect and market factor effect, ϖ_j （$j = 1,2,3,4,5$）refers to the weight of the contribution of each effect on cost savings in the location effect .

If the two enterprises produces production in the same area, cost savings due to the cluster effect in the same area denoted as μ , among them, $\mu = \omega_1\mu_1 + \omega_2\mu_2 + \omega_3\mu_3 + \omega_4\mu_4 + \omega_5\mu_5$, （$i = 1,2,3,4,5$）, μ_i respectively, refers to economies of scale, the degree of reduced risk, the ability to innovate and enhance the competitiveness of the division of labor and cooperation effect and brand advantage effects brought cost savings. ω_j （$j = 1,2,3,4,5$） represents the weight of the contribution of each factor on the total cost savings in cluster factors effect.

2.2 Location Plan profits

(1) Both the cultural and creative enterprises are gathered in the S production area, which between the two

enterprises ,in place S, the final cost of sales per unit is $A-\mu-\nu$, and in T area per unit of final cost of sale is $A-\mu-\nu+f$ .Therefore, the profit function of the two enterprises are as follows:

$$Y_1=[\alpha-\beta(q_{1S}+q_{2S})-(A-\mu-\nu)]q_{1S}+[\alpha-\beta(q_{1T}+q_{2T})-(A-\mu-\nu+f)]q_{1T} \tag{2}$$

$$Y_2=[\alpha-\beta(q_{1S}+q_{2S})-(A-\mu-\nu)]q_{2S}+[\alpha-\beta(q_{1T}+q_{2T})-(A-\mu-\nu+f)]q_{2T} \tag{3}$$

Y_1 and Y_2 ,respectively, on behalf of the profits of firms 1 and 2.

Nash equilibrium from game theory, it refers to each person will choose the optimal strategy to maximize their own effectiveness under a given the conditions. Obviously, in order to find the optimal solution of the Nash equilibrium, firstly, we can derivative (2), (3) the partial derivative sare:

$$\begin{cases}\alpha-2\beta q_{1S}-\beta q_{2S}=A-\mu-\nu\\ \alpha-2\beta q_{2S}-\beta q_{1S}=A-\mu-\nu\\ \alpha-2\beta q_{1T}-\beta q_{2T}=A-\mu-\nu+f\\ \alpha-2\beta q_{2T}-\beta q_{1T}=A-\mu-\nu+f\end{cases} \tag{4}$$

After Solving the equations, the regional sales volume s of two companies were as follows:

$$\begin{cases}q_{1S}=q_{2S}=\dfrac{\alpha-A+\mu+\nu}{3\beta}\\ q_{1T}=q_{2T}=\dfrac{\alpha-A+\mu+\nu-f}{3\beta}\end{cases} \tag{5}$$

Then combine (5) and (1) ,we get the sales price of the two enterprises of S and T :

$$\begin{cases}p_S=\dfrac{\alpha+2(A-\mu-\nu)}{3}\\ p_T=\dfrac{\alpha+2(A-\mu-\nu+f)}{3}\end{cases} \tag{6}$$

We can get equilibrium profit about the two companies located at S when bringing the formula (5) and (6) into equation (2) and formula (3) respectively.

$$Y_1=Y_2=\frac{[\alpha-(A-\mu-\nu)]^2+[\alpha-(A-\mu-\nu+f)]^2}{9\beta} \tag{7}$$

At this point, $Y_1=Y_2=Y_S$

(2) Both the cultural and creative enterprises gathers in T land (Note: there is no location effect here), this two companies in the S area's per unit cost of sales is $A-\mu+f$, while in T area the per unit cost sales of T area is $A-\mu$, then corporate profits function are:

$$Y_1=[\alpha-\beta(q_{1S}+q_{2S})-(A-\mu+f)]q_{1S}+[\alpha-\beta(q_{1T}+q_{2T})-(A-\mu)]q_{1T} \tag{8}$$

$$Y_2 = [\alpha - \beta(q_{1S} + q_{2S}) - (A - \mu + f)]q_{2S} + [\alpha - \beta(q_{1T} + q_{2T}) - (A - \mu)]q_{2T} \quad (9)$$

Y_1 and Y_2 refer to the profit of firm 1 and 2.

Ultimately we obtain the equilibrium profit of the two companies at the same time in T land:

$$Y_1 = Y_2 = \frac{[\alpha - (A - \mu + f)]^2 + [\alpha - (A - \mu)]^2}{9\beta} \quad (10)$$

At this point, $Y_1 = Y_2 = Y_T$

(3) Both the cultural and creative enterprises scatters in the different places, it is assumed that the enterprises 1 lies in the S area, corporate 2 lies in T area. The origin cost of marketing is A and the cost of off-site cost of marketing is $A + f$, then two corporate profit functions are:

$$Y_1 = [\alpha - \beta(q_{1S} + q_{2S}) - A]q_{1S} + [\alpha - \beta(q_{1T} + q_{2T}) - (A + f)]q_{1T} \quad (11)$$

$$Y_2 = [\alpha - \beta(q_{1S} + q_{2S}) - (A + f)]q_{2S} + [\alpha - \beta(q_{1T} + q_{2T}) - A]q_{2T} \quad (12)$$

Equilibrium profits of the two enterprises scattered in two places is:

$$Y_1 = Y_2 = \frac{(\alpha - A + f)^2 + (\alpha - A - 2f)^2}{9\beta} \quad (13)$$

At this point, $Y_1 = Y_2 = Y_{ST}$, When firm 2 products in S area, while the enterprise 1 in T area ,the formula (13) with the result of the profits of the two companies is the same.

2.3 Two corporate decision-making

By comparing (7) and (10) , we find that $Y_S > Y_T$,by comparing (7)and (13) ,we need a classification discussion:

(1)If we hypothesis $Y_{ST} > Y_S > Y_T$, then the solution is :

$$f > \frac{\sqrt{(\nu + \mu)(16\alpha - 16A + 9\nu + 9\mu)}}{4} - \frac{\nu + \mu}{4} ;$$

(2)If we hypothesis $Y_S > Y_{ST} > Y_T$, then the solution is :

$$\frac{\sqrt{\mu(16\alpha - 16A + 9\mu)}}{4} - \frac{\mu}{4} < f < \frac{\sqrt{(\nu + \mu)(16\alpha - 16A + 9\nu + 9\mu)}}{4} - \frac{\nu + \mu}{4} ;$$

(3) If we hypothesis $Y_S > Y_T > Y_{ST}$, then the solution is :

$$f < \frac{\sqrt{\mu(16\alpha - 16A + 9\mu)}}{4} - \frac{\mu}{4} .$$

In a perfectly competitive market, that is, we can ignore the factors' interference on asymmetric information, the location decisions of the two companies is a static game Nash equilibrium .so the solution are as follows:

Firm 2

Firm 1	S	T
S	(Y_S, Y_S)	(Y_{ST}, Y_{ST})
T	(Y_{ST}, Y_{ST})	(Y_T, Y_T)

$$\lambda_1 = \frac{\sqrt{(\nu+\mu)(16\alpha-16A+9\nu+9\mu)}}{4} - \frac{\nu+\mu}{4}, \quad \lambda_2 = \frac{\sqrt{\mu(16\alpha-16A+9\mu)}}{4} - \frac{\mu}{4},$$

There will be a different Nash equilibrium under different conditions:

2.3.1 $f > \lambda_1, Y_{ST} > Y_S > Y_T$, and that the two companies are dispersed S andT are Nash equilibrium;

When the transport cost of cultural and creative product is more than the value λ_1 determined by the cost of sales and location effect ,then it can't form aggregation .Therefore we can draw that not all the development of aggregation are most excellent, and the optimal is a" degree" problem, decentralized form development is also a form of Nash equilibrium under some condition .

2.3.2 $\lambda_2 < f < \lambda_1, Y_S > Y_{ST} > Y_T$, that the two companies gathered in S area is Nash equilibrium;

When the market demand is stable, that is the sales cost and the combined effect is not change, it can save more cost due to location factors effect, that is ν increases, then the value of λ_1 is larger, so the interval between λ_1 and λ_2 will get wider, which confirms the existing theoretical studies: enhanced location effect factor will contribute to enterprise's aggregation.

2.3.3 $f < \lambda_2, Y_S > Y_T > Y_{ST}$, that the two companies are in S or T is Nash equilibrium.

Gathered in the two places are likely to occur, when the transportation cost is further reduction ,oil price drops and regional development, theoretically the ration of aggregation occurs in S higher than the probability of T area (S has favorable location factors for the industry),which can be calculated through the above model results, we can draw that the cultural and creative products cluster formation is neither random nor wholly determined by location factors, it is determined by the cost savings , market demand function and the location effect and the combined effect together, the above three cases revealed gathering conditions.

In addition, a small amount of the pillar industries of the combined effect increases, other things remain unchanged (economies of scale, reduce risk effect, effect of innovative capacity and competitiveness, promote the division of labor and cooperation effects and brand superiority effect one or several effects increases), as μ increases, then λ_1 and λ_2 are increased, but the increase of λ_1 is greater than λ_2, i.e. the possibility of $\lambda_2 < f < \lambda_1$ and $f < \lambda_2$ increases, the probability of aggregation occurred in the S, or both S and T, will be increased.

Theoretically, in the early time of cultural and creative industries development , location factor effect plays a major

role, because the volume of the gathering corporate is not a lot, agglomeration effects are generally small. When location effect and agglomeration effect can't occur in the same area, and a small number of pillars of creative enterprise gathering will generate huge agglomeration effect, that gathered effect of the savings production cost is greater than the location factors. The cultural and creative enterprises will likely give up the location factor effect , then to select the cluster effect, so the gathering cultural and creative industries is also likely to occur in the location factor where is not a superior region. Therefore, our two-region and two companies model, is not only to explain how the formation of cultural and creative industries, but also reveal the distribution of cultural and creative industries under different conditions.

3. An Example Analysis

30 large-scale cultural and creative industries concentrated areas has been formatted since December 14, 2006 , in Beijing .and they locates in Beijing's 16 districts and counties, belonging to eight key industries, the relevant information collation is as follows:

Table 1. Overview of Beijing's Cultural and Creative Cluster Development

Name & Industry Sector	Respective Regional
Zhong guan cun creative industries Pilot Base Culture and Arts	Haidian
Beijing Digital Entertainment Industry Demonstration Base Software, network and computer services	Shijingshan
National New Media Industry Base Press and Publication	Daxing
Zhongguancun Science and Technology , Yonghe Park software, network and computer services	Dongcheng
China (Huairou) film base Radio and TV movies	Huairou
798 Art Zone in Beijing Design, publishing and leisure complex	Chaoyang
Beijing DRC Industrial design and creative industries base Design Services	Xicheng
Beijing Panjiayuan Antique art trade park Antique art	Chaoyang
The Songzhuang original art and cartoon industry gathering area Antique art	Tongzhou
Zhongguancun Software Park Software, network and computer services	Haidian
Beijing CBD International media industry gathering area Radio and TV movies	Chaoyang
The Shunyi State Fair Industrial Park Advertising exhibition	Shunyi
The Liulichang history of cultural and creative industrial park Art trade	Xicheng
Tsinghua Science Park Software, network and computer services	Haidian
Armco Times Square Clothing&design	Chaoyang
The Beijing fashion design Square	

Service design	Chaoyang
Gathering area of traditional culture industry of qianmen Tourism and leisure and art trade	Dongcheng
Publishing Logistics Center in Beijing Press and Publication	Tongzhou
Beijing Happy Valley eco-cultural park Travel and Leisure	Chaoyang
Dahongmen Apparel gathering area Clothing, design	Fengtai
Gathering area of historical and cultural tourism Travel and Leisure	Fangshan
China Animation Game City Software, network and computer services	Shijingshan
Beijing Olympic Park Travel and Leisure	Chaoyang
Badaling Great Wall - cultural tourism industry gathering area Travel and Leisure	Yanqing
Beijing Gubeikou International Tourism & Leisure Valley industrial agglomeration area Travel and Leisure	Miyun
Zhaitang ancient villages andTrail cultural tourism industry gathering area Travel and Leisure	Mentougou
Valley - the capital of music, Culture and Arts	Pinggu
The Lugouqiao cultural creative industries concentrated area Culture and Arts	Fengtai
Beijing Music Arts & Creative Park Culture and Arts	Chaoyang
The Ming Tombs cultural creative industries concentrated area Travel and Leisure	Changping

Source from: related websites in China. http://www.bjci.gov.cn/

Table 1 shows obviously, due to the geographical location, historical development, economic level, and other factors, Chaoyang District has obvious regional effect to form a cultural and creative industries cluster , it has formed eight industries gathering area in four successively years; covering 6 major categories :the arts and culture, tourism leisure and entertainment, and design services of software and computer network services, radio and television movies, antique art. Haidian District, because of its unique scientific and technological and culture resources, has formed a creative industry pilot base: the Zhongguancun Software Park, and the Tsinghua Science Park. Besides, Chaoyang District, Dongcheng District, Shijingshan District, only respectively has one cultural industry park. It can be inferred that Haidian District has the obvious geographical advantages to develop science and technology industrial clusters. In addition, Fangshan, Changping , Pinggu , Mentougou, Miyun County and Yanqing County are remote (with the consumption potential crowd is mostly concentrated in urban areas, there is always relatively large distance between the demand area and supply area) The development of general creative industries calls for transportation costs, so several counties has none gathering area for a long time. In recent years, Beijing municipal government has made some preferential policies, basing on the particularly historical characteristics of the various districts and counties, and successfully guided a number of tourist and leisure class enclave development. On the one hand, it avoids the transport costs restricting the industrial enclave development, on the other hand ,it allows visitors to enjoy the Beijing's scenery on the way to this industries.

The distribution characteristics of Beijing's cultural and creative industries (many industries in city center, few in the outside city) on the one hand , explains transport costs and location advantages is easy to develop creative industries; but gathering area can also develop in the areas with the high transportation costs. In order to better understand how the location advantages areas can develop into a gathering area, taking Beijing Dahongmen clothing, apparel and creative industries cluster area as an example to further illustrate.

Beijing Dahongmen clothing apparel and creative industries cluster area startes with the "village of Zhejiang" and locates between South Third Ring and the Fourth Ring in Fengtai District. It is five kilometers away from Tiananmen Square in straight line distance, but due to the slow economic development of Fengtai District, the transportation system is imperfect, as a result it will take more than an hour to reach the urban. We can see that location factors become a main reason for slow development of the Dahongmen clothing apparel and creative industries gathering area. In recent years, on the one hand, Beijing municipal government has made great efforts to support the development of Dahongmen clothing, apparel and creative industries cluster area; On the other hand, Metro Line 8 of three engineering, passes through the Dahongmen from south to north, which will greatly eliminate the anxiety of businesses men.

Currently, Dahongmen cluster area owns more than 30 Monopoly fields, including clothing trade city, Tianya, Jing Wen, the new century, etc. According to statistics, the total business area is more than a million square meters, and the average annual number of businesses is over 20,000, the annual turnover is about 200 billion yuan (about more than 50 percent of Beijing clothing transaction amount). These constitute a large-scale clothing business circles, and a cluster effect of market is gradually obvious. In recent years, along with the market upgrading, the environment optimizing and the brand promoting duo to international garments festival, the popularity and reputation of the Dahongmen clothing brand has been further improved in Beijing region and even the world garment industry. Now, it has driven a development of related industries, such as fashion design, event planning, consulting services, advertising exhibition, logistics, culture and leisure industries and so on. As a result, the problem of lacking industry chain has been effectively resolved. At present, the production cost savings of the cluster effect in Dahongmen cluster area is significantly greater than the cost wasting of the location factors effect brought by traffic inconvenience. So the gathering of the cultural and creative industries also may occur in the areas where location factor is not favorable, we cannot ignore the a creative cluster area without location factors.

4. Conclusions and Suggestions

Creative industries cluster development is not only conducive to the sharing of resources among enterprises, but it also can produce economies of scale, technology spillovers, and ultimately can enhance the competitiveness of the industry. In addition, the cultural and creative industry has a strong correlation relationship, thus its development can spur the level of development of the whole national economy. But the 2014 Economic Census data shows that corporate accounting is only about 10%, the personnel income level in the industrial enclave is slightly higher than that of in the non aggregation area. This shows that the advantage of the creative industries enclave in Beijing is still not obvious, and the potential to further enhance the industry cluster is still huge. Finally, based on the conclusions herein above, we put forward four piece of recommendations to further promote the development of creative industries cluster.

First, it is necessary to enhance logistics and distribution capabilities of the cultural and creative industries to reduce the cost of transportation. Although Beijing has a most advanced transportation system built by aviation's, railways and roads, it also can't be ignored that the capital of China has also been known as the "blocking", especially in commuting time, the packed main road is a regular phenomenon, then the time cost of distribution becomes a bottleneck restricting in the development of Beijing cultural and creative industries. So we should establish creative products logistics center in every possible becoming industry gathering area place .

Second, we should consciously enhance the effect of location factors in blank industrial enclave. It can be strengthened in terms of environmental factor, cultural factor, personnel factor, institutional factor and market factor to increase the probability of occurrence of the creative industry clusters. As for the market factor, the enterprises should actively guide the public's concept of cultural consumption, which can increase the demand for cultural industries. Now the per capita consumption is more than $ 4,000 in China .According to the international practice, Chinese cultural consumption should reach $ 4 trillion in total. It is a pity that Chinese cultural consumption is only $ 1 trillion. We can see that the potential of Chinese cultural consumption is still very great.

Third, we need to take developing the pillar industries into account to enhance the clustering effect. The agglomeration effects cost savings between the enterprises is huge, so the government should encourage the development of cultural industries cluster, enable more preferential policies for the pillar enterprises, prompt them to spur the prosperity of the surrounding industries, and at the same time attract the same industry. Additionally, the government should also be good at learning from the experience of the foreign creative industries cluster development.

Fourth, it shouldn't ignore the region's cultural and creative industries cluster development in the areas where the location effect is not obvious. We can see that Chaoyang District includes nearly one-third of creative industries areas because of its favorable location factors, but economically backward areas like Fengtai, Daxing, with the development of the industry in terms of historical legacy can still produce a larger cluster effect to form cultural and creative industries concentrated areas. In addition, we also find out the conditions of the development of regional industrial clusters, which have no advantages of the location effect. At last, we can increase the probability of occurrence of industrial clusters in a region in the way of increasing the capacity of fixed cultural consumption, and reducing the production cost of creative products.

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