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Measurement of Entrepreneurial Population Niche in Regional Entrepreneurial Ecosystems: Evidence from Characteristic Towns in China

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ABSTRACT

Based on the ecological theory, in the paper we analyze the niche breadth, niche overlap and niche suitability of the entrepreneurial enterprise population as well as study their measurement problems. Data are collected from the characteristic towns in China to measure the niche of entrepreneurial enterprise populations. The results indicate the niche breadth values of the industry are all high in technical service industry and environmental protection industry, bio-industry and electronic information industry. For the entrepreneurial enterprise population in the community, the degree of similarity in the use of resources is greater. The niche suitability of the selected five regional characteristic small town entrepreneurs, the Fi comprehensive values were 0.92, 0.76, 0.24, 0.28, and 0.19, respectively. The niche suitability of HZ and JX is relatively high, JH, WZ and LS have lower niche suitability values.

1. Introduction

The main actors in the entrepreneurial ecosystem are entrepreneurial enterprises which create value and promote local economic development through active entrepreneurial activities (Suresh & Ramraj, 2012; Kapoor & Agarwal 2017). According to the theory of ecology, the entrepreneurial ecosystem consists of different ecological populations, and the entrepreneurial enterprise population is one of them (Cooke, 2001; Maleck, 2011; Pitelis, 2012). The niche of the population reflects both the relationship between the population and other populations in the community in which it is located, as well as the interaction with the community environment in which it is located. Similar to natural ecosystems, the entrepreneurial ecosystem performs physical, information, and energy exchange functions (Charron et al., 2012; Carayannis et al., 2016; Charron, Lapuente & Dijkstra, 2012; Spigel, 2017).

In the concept of niche, niche breadth, niche overlap and niche suitability are three important concepts: the niche breadth refers to the degree of diversification of various resources utilized by a population(Stam,2017).Under the circumstance, the niche-wide population has strong adaptability and correspondingly strong competitiveness(Stuart,Sorenson,2007). The niche overlap refers to the use of the same resource or the same resource among the species, which can be used to characterize the interrelationship between species. In reality, the niches are generally more or less partially overlapping; Niche suitability refers to the closeness between the realistic habitat conditions of a species habitat and the optimal habitat conditions, that is, the degree to which habitat resource conditions satisfy specific needs(Wu,Han,Yang,2006). Since the emergence of niche theory, it has been widely used in the study of population relationships, community diversity, community structure, community succession and population evolution.

The survival competition of natural creatures aims to find the ecological space which is most suitable for its own development, and the regional entrepreneurial ecological community not only needs to find an ecological space suitable for the development of entrepreneurial enterprises, but also to continuously expand and expand (Poppo et al., 2008; Neumeyer, Corbett, 2017). The entrepreneurial ecological community is a subsystem composed of multiple factors, and the resources that play a major role in the entrepreneurial enterprise are talents, capital, technology, services and policies(Nijkamp,2003;Neck et al.,2004). They constitute the core resources of the entrepreneurial ecological community and are the key to the development of the entrepreneurial ecological community (Phelps, Heidl & Wadhwa, 2012; Isenberg, 2014; Neumeyer, Santos, 2018).

Since the emergence of niche theory, it has been widely used in

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the study of population relationships, community diversity, community structure, community succession and population evolution(Corallo et al.,2016;Cumming,DeGhetto,2015). But it was not until the 1970s that the theory began to be adopted in the study of economics and management. At present, the niche theory has been extended to many other research fields and has become one of the most important basic research theories of ecology(Xia,2006; Helfa&Raubitschek,2017). According to the niche theory, in nature, each species can only survive in a certain ecological environment. Each specific ecological environment has different resource conditions and has the most suitable species for surviva(Werth&Zhang,2016;;DeGhetto,2016).Therefore, in an ecological resource, each species on the conditional axis has a specific range that can be adapted to survival(Li,2004). The two endpoints of the range are the resource condition limits for the survival of the species(Iansiti&Levien,2006). The span of the range that can survive is called the ecological range, and the ecological range of multiple ecological factors. Then the niche space is framed. Since the emergence of niche theory, it has been widely used in the study of population relationships, community diversity, community structure, community succession and population evolution. But it was not until the 1970s that the theory began to be adopted in the study of economics and managemen(Dong,2006)t. At present, the niche theory has been extended to many other research fields and has become one of the most important basic research theories of ecology(Cohen,2006; Mason&,Brown,2014). Few scholars have studied the niche of entrepreneurial ecosystems. This paper analyzes the niche breadth, niche overlap and niche suitability of the entrepreneurial enterprise population based on the ecological theory and studies their measurement problems. We get data from the characteristic towns in China to measure the niche of entrepreneurial enterprise populations.

2. Numerical measurement

According to ecological theory, niche refers to the location and function of a living organism in its environment, including the various conditions required for the organism to produce, the resources utilized, and the time there(Xia,Qiu&Chen,2011; Miller&Acs,2017). Specifically, it is a collection of the choice of resources and environmental variables for each organism(Mooi&Ghosh,2010). Because resources and environmental variables are multidimensional, the niche of a creature is a multidimensional super volume(Wang,2008;Parker et al.,2017). The niche of the population reflects both the relationship between the population and other populations in the community in which it is located, as well as the interaction with the community environment in which it is located. Similar to the ecosystem, the entrepreneurial ecosystem performs physical, information, and energy exchange functions.

The niche of the entrepreneurial enterprise refers to the specific location of the technology entrepreneurs in the entrepreneurial ecological community, the specific functions they play, and the various conditions and resources required for the survival and development of the entrepreneurial enterprise. These conditions and resources include multi-dimensional policies, funds, technology, services and talents. Therefore, the niche of the entrepreneurial enterprise population also belongs to a multi-dimensional super-volume. There are talent niche, capital niche, technology niche, service niche and policy niche in the technology entrepreneurial enterprise population. According to the ecological community of the entrepreneurial enterprise and the particularity of the population, the sampling area of the community can be regarded as a one-dimensional resource state. The niche characteristics of the entrepreneurial enterprise population can be calculated by the important values of various groups sampling in a specific community.

Important value = (relative density + relative dominance + relative frequency) / 3 (1)

In the formula, the Relative frequency is the percentage of the frequency of the population divided by the frequency of all populations; the Relative dominance is the percentage of the total group of individuals in the sample divided by the total size of all individuals in the sample; Is the percentage of individuals in a certain group divided by the number of individuals in all populations.

2.1 Measurement on niche breadth of entrepreneurial population

The niche breadth of the entrepreneurial enterprise population mainly refers to the diversification of the market resource utilization of a entrepreneurial enterprise population(Guo&Guo,2008). The niche breadth reflects the degree of species use of resources. If the market resources actually used by a entrepreneurial enterprise population only account for a small part of the overall market resource spectrum, then it has a narrow niche; if the entrepreneurial enterprise population is in a continuous market resource sequence, it can use a variety of Market resources, then it has a wider niche. The wider the resource niche of a entrepreneurial enterprise population, the smaller the specialization of the entrepreneurial enterprise population, that is, it is more generalized. On the contrary, the narrower the niche of a entrepreneurial enterprise population, the entrepreneurial enterprise population The degree of specialization is stronger, and the generalization feature makes the entrepreneurial enterprise population have a wide niche, and the enterprise has stronger resource utilization and adaptability. The niche breadth is often expressed by the Shannon-Weinner diversity index($B_{(sw)}$)and the Levins niche breadth index($B_{(L)}$).

$$B(_{sw})_i = -1/\sum_{j=1}^{r} p_{ij}\, lg\, p_{ij} \tag{2}$$

$$B_{(L)i} = 1/r\sum_{j=1}^{r} p^2{}_{ij} \tag{3}$$

In the formula: $B_{(sw)i}$, $B_{(L)i}$ is the niche breadth of the entrepreneurial enterprise population i; P_{ij} is the proportion of the population i using the jth resource to occupy all the resources.S is the number of populations; r is the number of resource bits, where:

$$P_{ij} = n_{ij} / Y_j \quad (Y_i = \sum_{j=1}^{r} n_{ij}) \tag{4}$$

n_{ij} is the important value of the population i in the jth resource position, Y_j is the sum of the important values of the population i using all the resource bits, and the niche breadth has the domain value [0, 1], that is, the population uses one resource bit, then it is 0; utilizes all resource bits and has a value of 1.

2.2 Measurement on niche similarity and overlap of entrepreneurial population

The similarity ratio of niche refers to the similarity of resources used by two entrepreneurial enterprises (Guo&Xu,1998) .

$$C_{ih} = 1\text{-}1/2\sum_{i=1}^{r}\left|P_{ij} - P_{hj}\right| = \sum_{i=1}^{r}\min(P_{ij}, p_{hj}) \quad (5)$$

C_{ih} represents the similarity between population i and h, and with domain value [0,1]; P_{ij} and P_{hj} are important values of population i and population h at resource j, respectively.

The niche overlap reflects the fact that the two populations overlap with each other using the same level, reflecting the degree of utilization of the same level of resources and the spatial allocation relationship of the population(Li,1995). When two populations use the same resource or share an environmental variable together, niche overlap occurs. In this case, there will be some resources or environmental space shared by the two populations. If two populations have identical market niches, there will be a complete overlap of niches, and then there will be a phenomenon of population competing resources. Usually, only a part of the niche overlap occurs between a startup enterprise and other populations, that is, some resources are used together, and other parts are occupied by each.

$$L_{ih} = B_{(L)i}\sum_{j=1}^{r} P_{ij} \times P_{hj} \quad (6)$$

$$L_{hr} = B_{(L)h}\sum_{j=1}^{r} P_{ij} \times P_{hj} \quad (7)$$

L_{ih} is the niche overlap index of population i overlapping population h; L_{hr} is the niche overlap index of population h overlapping population i; $B_{(L)}$ is Levins niche breadth index; $B_{(L)i}$ with domain value [1/ r,1]; L_{ih} and L_{hr} have domain values [0,1], 0 indicates complete separation of niches, and 1 indicates complete overlap of niches.

2.3 Measurement on niche suitability of entrepreneurial population

The suitability of the niche of the entrepreneurial population reflects the harmony of the entrepreneurial environment and ecology, the appropriateness of the survival and development of the technology entrepreneurial population, and the strength of the entrepreneurial environment(Zhou&Chen,2008). Resources that reflect the niche suitability of entrepreneurial populations include funds, policies, technology, talent, and services(Stam&Spigel, 2017).

There are n ecological factors that affect the survival and development niche suitability of entrepreneurial enterprises. The standardized values of the n ecological factor quantitative indicators are respectively recorded as $x_1,x_2,...,x_n$, the observations in each area can be recorded as $X_i(x^0_{i1},x^0_{i2},...,x^0_{in})$, and X_i represents the realistic niche of the regional entrepreneurial ecological population; x_{0j} represents the optimal value of the jth ecological factor, and the array of the optimal values of all ecological factors of the population is $X_{0j}=(x_{01},x_{02},...,x_{0n})$. X_0 is called the most suitable niche of the technology entrepreneurial enterprise population. Before data analysis, we use the "minimum-maximum standardization" method to normalize the data and then analyze the normalized data(Wang,2006; Meng,2018). Let min A and max A be the minimum and maximum values of attribute A, respectively, and normalize a raw data of A through min-max to new data in interval [0,1]. The formula is:

New data = (raw data-minimum value) / (maximum value-minimum value) (8)

We suppose there are m survey areas, and each survey area observes the ecological factors of n entrepreneurial enterprises, which consists of standardized values and optimal values.According to the nature of ecosystem suitability indicators, niche suitability models of entrepreneurial enterprises are constructed. The demand for ecological factors of entrepreneurial enterprise populations meets their minimum requirements, and the richer, the better(Tang et al.,2011). For this type of ecological factor, the niche suitability calculation model is

$$F_{ij} = \begin{cases} 0 & x_{ij} < x_{ij\min} \\ 1\text{-}\left|x_{ij} - x_{0j}\right| / x_{0j} & x_{ij\min} \le x_{ij} \le x_{nj} \\ 1 & x_{ij} > x_{0j} \end{cases} \quad (9)$$

There is a suitable interval for the state factor, too much or too little will be the limiting factor. For this type of ecological factor, the niche suitability calculation model is

$$F_{ij} = \begin{cases} 0, x_{ij} \le x_{ij\min}, \ \ x_{ij} \ge x_{ij\max} \\ \dfrac{x_{ij} - x_{ij\min}}{x_{0j} - x_{ij\min}}, x_{ij\min} < x_{ij} < x_{0j} \\ \dfrac{x_{ij\max} - x_{ij}}{x_{ij\max} - x_{0j}}, x_{0j} < x_{ij} < x_{ij\max} \end{cases} \quad (10)$$

The lower the ecological factor value, the better. For this type of ecological factor, the niche suitability calculation model i

$$F_{ij} = \begin{cases} 1, x_{ij} < x_{0j} \\ 1 - \dfrac{x_{ij} - x_{0j}}{x_{ij\max} - x_{0j}}, x_{oj} \le x_{ij} \le x_{ij\max} \\ 0, x_{ij} > x_{ij\max} \end{cases} \quad (11)$$

In the formula, Fij is the niche suitability of the jth factor in the i-th region. X_{ij} is the real niche of the jth factor in the i-th region, x_{0j} is the optimal niche of the j-th factor; x_{ijmin} is the minimum of the j-th ecological factor.

$$F_i = \sum_{j=1}^{n} W_j F_{ij} \quad (12)$$

In the formula, Fi is the niche suitability of the i-th region. The larger the Fi, the higher the regional suitability, and the more beneficial to the survival and development of entrepreneurs. Wj is the weight of the j-th factor, reflecting the impact of the factor on the suitability of entrepreneurship, and the sum of weight is 1 as showed in formula (13).

$$\sum_{j=1}^{n} W_j = 1 \qquad (13)$$

The value of the niche suitability of the entrepreneurial enterprise population is within the range of [0, 1], and the entrepreneurial niche suitability can be equally divided into five levels(Zhou,Chen,2008). When the niche suitability is in [0,0.2], it indicates that the entrepreneurial enterprise population ecological environment is very poor, that is, the supply of key ecological factors of entrepreneurship is seriously insufficient, and it is difficult for entrepreneurs to obtain the resources necessary for survival and growth. High; when the suitability is in the range of [0.2, 0.4], it indicates that the ecological environment of the enterprise is poor; when the suitability is in the range of [0.4, 0.6], it indicates that the ecological environment of the entrepreneurial enterprise is general; In the range of [0.6,0.8], it indicates that the ecological environment of the entrepreneurial enterprise is better; when the suitability is in the range of [0.8,1], it indicates that the ecological environment of the entrepreneurial enterprise is very good, and the population environment can be extremely great to meet the various key resources needed for entrepreneurship. From small to large, the value of the suitability of the entrepreneurial enterprise is to show very poor, poor; normal; good; very good from these aspects of supply of key ecological factors of entrepreneurship, the resource support for the survival and growth of entrepreneurial enterprises, the risk of entrepreneurship and other aspects.

3. Empirical Analysis

We choose to use seven characteristic towns in Zhejiang Province of China as a test site of regional entrepreneurial ecosystems. Each can be regarded as a resource (Rampersad, 2016; Liu et al.,2018). These entrepreneurial ecosystems have significant differences in the supply of key elements such as capital, technology, services and talents (Phelps, Heidl & Wadhwa, 2012). There are also differences in industrial categories. We surveyed 228 start-ups in these characteristic towns, which are subordinate to the nine industries of electronic information industry, bio-industry, new materials industry, equipment manufacturing industry, environmental protection industry, semiconductor industry, new energy industry, technical service industry and cultural industry which are nine entrepreneurial enterprise populations (Liu, 2013; Colombo et al., 2017). The survey mainly includes the industry category, industrial distribution and size of the enterprise. Here we focus on the niche breadth of the entrepreneurial population and the niche overlap between the populations.

3.1 Calculation of niche breadth of entrepreneurial population

The niche breadth of the entrepreneurial enterprise population mainly refers to the diversification of the market utilization of a technology entrepreneurial enterprise population. According to formula (1), the important values of the nine major entrepreneurial enterprise populations of eight resource bits are calculated. According to the important value characteristics of different industries in different populations, the formula (2), formula (3) and formula (4) are taken to calculate the niche breadth characteristics of the main populations of each hatchery base, as shown in Tab.1. The data shows that the nine populations are $B_{(L)i}$ the order is worthy of technical service industry, environmental protection industry, biological industry, electronic information industry, new energy industry, cultural industry, equipment manufacturing industry, semiconductor industry and new material industry. In technical service industry and environmental protection industry, bio-industry and electronic information industry the niche breadth values of the industry are all high, among which the technical service industry and the environmental protection industry are present in every resource position. The bio-industry and electronic information industry are dominant populations, and the enterprises are widely distributed. The ability to use environmental resources is strong, so the niche breadth is also large; while the semiconductor industry and the new material industry are narrowly distributed in the hatchery, the number is relatively small, and the environmental utilization capacity is poor, so the niche width is correspondingly small.

Tab. 1. Niche width of entrepreneurial enterprise population

	P_{i1}	P_{i2}	P_{i3}	P_{i4}	P_{i5}	P_{i6}	P_{i7}	$B_{(sw)i}$	$B_{(L)i}$
A	0.22	0.21	0.08	0.06	0.09	0.21	0.08	0.83	0.76
B	0.11	0.07	0.06	0.09	0.21	0.08	0.11	0.85	0.77
C	0.13	0.25	0.04	0.25	0.05	0.04	0.17	0.79	0.65
D	0.10	0.09	0.34	0.14	0.04	0.11	0.09	0.82	0.68
E	0.11	0.11	0.13	0.18	0.18	0.05	0.17	0.87	0.86
F	0.08	0.06	0.07	0.26	0.19	0.07	0.17	0.84	0.74
G	0.24	0.06	0.26	0.06	0.06	0.06	0.06	0.78	0.66
H	0.06	0.11	0.12	0.13	0.12	0.18	0.21	0.88	0.87
I	0.05	0.06	0.18	0.06	0.23.	0.24	0.12	0.82	0.72

Note: A.electronic information industry; B.biological industry; C.new material industry; D.equipment manufacturing industry; E. environmental protection industry; F.new energy industry; G. semiconductor industry; H. technical service; I.cultural industry

3.2 Calculation of niche similarity and overlap of entrepreneurial population

The similarity of niche reflects the similarity of the demand and utilization of resources to the population, which in turn leads to the competition of resources (Aidis et al.,2008). According to formula (5), the similarity degree of niche between populations is calculated. According to the niche similarity ratio data of main populations as showed in Tab.2, there are 65 pairs of niche similarity ratios higher than 0.5, accounting for 57%, indicating for the entrepreneurial enterprise population in the community, the degree of similarity in the use of resources is greater. Among them, the environmental protection industry and the new energy industry population niche similarity ratio is the largest, it is 0.867, and there is also a high degree of similarity in the population of entrepreneurial enterprises in the technical service industry and the environmental protection industry. The equipment industry and technical service population niche similarity ratio is the smallest, it is 0.415 and There is also a low population similarity in entrepreneurial enterprise population in the semiconductor industry and the new materials industry.

According to formula (6) and formula (7), the niche overlap between the individual entrepreneurial enterprises is calculated. The results are shown in Tab.3. The niche overlap between the major entrepreneurial enterprises is very low, fluctuating between

0.07-0.11 indicating that the populations of enterprises in various industries share the resources of entrepreneurial environment more fully. The niche overlap between the enterprise population of electronic information industry and other enterprise populations is between 0.06 and 0.12 mostly around 0.09. Although the new material industry enterprise population belongs to a niche population, the electronic information industry enterprise population corresponds to the population. The value of the overlap is large, which is 0.1. The niche overlap between bio-industry enterprise populations and other populations is also between 0.06-0.11, which has the largest overlap with the niche of semiconductor industry enterprises. In comparison, the overlap value of the niche of the enterprise service industry and other industries is relatively large, and most of them are greater than 0.1. This is because the technology service enterprise relies on emerging technologies and new technological expertise, and has high technical and intellectual intensity. Commercial organizations with more obvious customer interaction characteristics provide technological services, financial services, information and communication services and business services to other entrepreneurial enterprise populations, and their own development is linked to other groups of entrepreneurs.

Tab. 2. Niche similarity of entrepreneurial enterprise population

	A	B	C	D	E	F	G	H	I
A	-								
B	0.617	-							
C	0.631	0.532	-						
D	0.576	0.618	0.563	-					
E	0.582	0.736	0.752	0.705	-				
F	0.558	0.728	0.741	0.654	0.867	-			
G	0.655	0.665	0.476	0.721	0.574	0.506	-		
H	0.661	0.643	0.642	0.415	0.806	0.735	0.532	-	
I	0.634	0.684	0.459	0.635	0.687.	0.667	0.519	0.763	-

Note: A.electronic information industry; B.biological industry; C.new material industry; D.equipment manufacturing industry; E. environmental protection industry; F.new energy industry; G. semiconductor industry; H. technical service; I.cultural industry

Tab. 3. Niche overlap of entrepreneurial enterprise population

	A	B	C	D	E	F	G	H	I
A	-	0.09	0.10	0.07	0.08	0.07	0.09	0.09	0.09
B	0.09	-	0.07	0.09	0.09	0.09	0.10	0.09	0.09
C	0.08	0.06	-	0.07	0.09	0.09	0.06	0.08	0.06
D	0.07	0.07	0.08	-	0.08	0.08	0.11	0.08	0.09
E	0.09	0.11	0.12	0.11	-	0.13	0.10	0.11	0.11
F	0.07	0.09	0.11	0.08	0.11	-	0.07	0.10	0.09
G	0.08	0.08	0.06	0.10	0.07	0.07	-	0.07	0.07
H	0.11	0.10	0.11	0.11	0.11	0.11	0.09	-	0.12
I	0.09	0.09	0.06	0.09	0.09.	0.09	0.08	0.10	-

Note: A.electronic information industry; B.biological industry; C.new material industry; D.equipment manufacturing industry; E. environmental protection industry; F.new energy industry; G. semiconductor industry; H. technical service; I.cultural industry

The results of the niche breadth of the main entrepreneurial enterprises in the characteristic towns of Zhejiang Province are basically consistent with the Levins and Shannon-weiner indices(Yang et al.,2018). The majority of the populations are broad niche, and the utilization of resources has advantages and certain sharing of resources. The niche breadth of the bio-industry, electronic information industry, technical service industry and environmental protection industry is relatively large, which is in line with the fact that the enterprises in these industries are widely distributed and have a large number. The niche overlap between populations is not high, and resource competition among populations is small. It shows that the resources of characteristic small towns in Zhejiang Province are relatively abundant, and there is no fierce competition among the entrepreneurial enterprise populations.

3.3 Calculation of niche suitability of entrepreneurial population

Among the entrepreneurial enterprise populations, there are many factors that affect the survival and development of entrepreneurial enterprises(Chang,2012;Chen et al.,2017). The key ecological niche of talents, capital, technology, services and policies related to the growth of startups is selected, and ten secondary indexes are built around them. The niche of talents includes the difficulty level of meeting the demand for talents and the difficulty of meeting the quality requirements of talents. The niche of funds includes the difficulty of obtaining guarantees or mortgages and the difficulty of obtaining venture capital. The technical niche includes the difficulty of obtaining external technical support and the perfection of the scientific and technological achievements trading market. The service niche includes the difficulty of obtaining technology intermediary services and the difficulty of obtaining government services. Policy niche includes support for fiscal and tax incentives and intellectual property protection. The evaluation system of the niche factor (secondary indicator) evaluates the niche suitability of the entrepreneurial enterprise population(Azzam et al.,2017).

The weight of the ecological factor reflects the degree of influence of the ecological factor on the niche suitability of the community. In this paper, the Delphi method and the entropy weight coefficient method are used to calculate the weight coefficient of each ecological factor(Spilling,1996; Neumeyer&Santos,2018). The weights of the ten secondary indexes are 0.10, 0.11, 0.13, 0.07, 0.10, 0.07, 0.09, 0.08, 0.08, 0.15 respectively. The observational data of the niche factors used in this paper are mainly derived from questionnaire surveys of entrepreneurs in characteristic towns in HZ, JX, JH, WZ and LS. The ecological factor data is standardized by using the minimum-maximum normalization method. The optimum value is 1.00.

Tab. 4. Regional entrepreneurial enterprise population ecological factor indicator standardized value

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	X9
HZ	1.00	1.00	0.87	1.00	1.00	1.00	1.00	0.54	1.00	1.00	0.09
JX	0.53	0.66	1.00	1.00	0.92	0.53	0.51	1.00	0.90	0.37	0.09
JH	0.39	0.81	0.00	0.07	0.00	0.31	0.31	0.00	0.17	0.03	0.06
WZ	0.38	0.52	0.12	0.91	0.39	0.00	0.00	0.44	0.08	0.00	0.09
LS	0.00	0.00	0.12	0.64	0.33	0.11	0.12	0.15	0.00	0.41	0.11

The standardized values and weight values are substituted into formula (8), formula (9), formula (12) and formula (13) to calculate the ecological suitability of the characteristic towns of HZ, JX, JH, WZ and LS cities respectively. The results are shown in Tab. 5.

Tab. 5. Regional entrepreneurial enterprise population ecological factor suitability

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X9
HZ	1.00	1.00	0.86	1.00	1.00	1.00	1.00	0.59	0.91	1.00	0.09
JX	0.56	0.66	1.00	1.00	0.92	0.58	0.59	1.00	0.90	0.39	0.09
JH	0.37	0.82	0.03	0.07	0.00	0.31	0.36	0.00	0.18	0.03	0.06
WZ	0.39	0.53	0.13	0.91	0.48	0.08	0.11	0.47	0.08	0.00	0.09
LS	0.06	0.11	0.12	0.64	0.33	0.23	0.16	0.18	0.00	0.54	0.11

From the calculation results of the niche suitability of the selected five regional characteristic small town entrepreneurs, the F_i comprehensive values were 0.92, 0.76, 0.24, 0.28, and 0.19, respectively. The niche suitability of HZ and JX is relatively high, 0.92 and 0.76 respectively, HZ is very good, JN is good; JH, WZ

and LS have lower niche suitability values. The suitability of niche reflects the suitability of technology entrepreneurship. The greater the suitability value, the greater the proportion of regional entrepreneurial resources and supply, the more competitive the entrepreneurial environment, and the greater the attractiveness to entrepreneurial firms.

4. Results

4.1 Research conclusions

According to empirical analysis, In technical service industry and environmental protection industry, bio-industry and electronic information industry the niche breadth values of the industry are all high, among which the technical service industry and the environmental protection industry are present in every resource position.

For the entrepreneurial enterprise population in the community, the degree of similarity in the use of resources is greater. Among them, the environmental protection industry and the new energy industry population niche similarity ratio is the largest, the equipment industry and technical service population niche similarity ratio is the smallest. The niche overlap between the enterprise population of electronic information industry and other enterprise populations is large. Although the new material industry enterprise population belongs to a niche population, the electronic information industry enterprise population corresponds to the population. The value of the overlap is large. The bio-industry enterprise populations and other populations has the largest overlap with the niche of semiconductor industry enterprises. In comparison, the overlap value of the niche of the enterprise service industry and other industries is relatively large, and most of them are greater than 0.1.

The average suitability of policies and services is 0.403 and 0.446, indicating that the government's support for entrepreneurship in the region is still limited. Among them, the financial support of entrepreneurship and the correlation coefficient of tax incentives are relatively low, indicating that the support for entrepreneurship needs to be further strengthened. The work style and work attitude of government be improved. At the same time, the construction of the entrepreneurial intermediary service environment needs to be strengthened. The average of technical and talent suitability is also low, at 0.493 and 0.550 respectively. Despite the large number of universities and scientific research institutions, the technology exported and the social entrepreneurial talents cultivated can not meet the needs. The average suitability of funds is 0.576. Financial institutions have a general interest in lending to entrepreneurship, and venture capital is not actively to support social entrepreneurship.

4.2 Suggested countermeasures

Promote more entrepreneurship and create more social entrepreneurship teams. The success of entrepreneurial enterprises is inseparable from outstanding entrepreneurs. They are ambitions, executives, and innovative social entrepreneurs to promote the steady development of enterprises; entrepreneurs can have a keen insight into the problems in society and actively explore new social resources. Creatively meet market needs to achieve goals. Entrepreneurs should extensively develop and utilize resources, accumulate capital, and improve the ability to identify opportunities for entrepreneurship. Within the enterprise, we must actively explore effective staff training and training methods to create a high-quality entrepreneurial team.

Increase government support and build incentives for entrepreneurial development. To improve the suitability of the entrepreneurial ecosystem, we must continue to increase the support of government departments and build incentives for enterprise development. Formulate special industry management norms, provide a good legal environment for the development of enterprises, enjoy the corresponding tax treatment, and standardize enterprises and their operations. The government can set up an investment guidance fund specifically for entrepreneurship through financial investment to guide venture capital firms to invest in start-up ventures. In addition, the government can provide financial support to companies in the form of procurement services. Government departments should simplify the administrative procedures for entrepreneurship, improve the efficiency of work, and reduce the administrative costs of entrepreneurship.

Change the concept of entrepreneurship and build a multi-support mechanism. Universities and research institutions should further deepen the theoretical research on entrepreneurship, and actively explore a set of entrepreneurial theories that suit China's national conditions in strengthening the introduction of Western entrepreneurial theories and the absorption of localization and the study of research methods. Financial institutions should give enterprises greater financial support to promote business growth and create greater value. Enterprises should not only enhance their sense of social responsibility, but also consciously safeguard the rights and interests of stakeholders.

5. Summary

According to the niche theory, each species can only survive in a specific ecological environment (Aidis et al.,2008). Each specific ecological environment has different resource conditions and has the most suitable species for survival. Therefore, the axis of an ecological resource condition for each species has a specific range that can be suitable for survival. The two endpoints of the range are the resource condition limits for the survival of the species. The span of the range that can survive is called the ecological range, and the ecological scale of multiple ecological factors is framed. This paper analyzes the niche content and ecological factors of entrepreneurial enterprises, and emphasis the measurement of niche breadth, niche overlap and niche suitability of entrepreneurial enterprises and studies their influence on the sustainable development of entrepreneurial enterprise.

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References

Aidis, R., Estrin, S., & Mickiewicz, T.,2008. Institutions and entrepreneurship development in Russia: A comparative perspective. Journal of Business Venturing, 23(6), 656–672

Amsler, M.L., Garcia, M.H., 1997. Sand dune geometry of large rivers during flood. J. Hydraul. Eng. 123, 582-584.

Andersen, K,H.., 2000. The Dynamics of Ripples Beneath Surface Waves and Topics in Shell Models of Turbulence. Ph.D. thesis Niels Bohr Institute, University of Copenhagen.

Azzam, J. E., Ayerbe, C., & Dang, R. J.,2017. Using patents to orchestrate ecosystem stability: The case of a French aerospace company. International Journal of Technology Management, 75(1 – 4), 97 – 120.

Carayannis, E. G., Provance, M., & Grigoroudis, E. J.,2016. Entrepreneurship ecosystems: An agent-based simulation approach. The Journal of Technology Transfer, 41(3), 631 – 653.

Chang,Q. L.,2012. Evaluation of regional innovation system based on niche suitability theory. Economic Research Guide, 13, 170-171.

Charron, N., Lapuente, V., & Dijkstra, L.,2012. Regional governance matters: A study on regional variation in quality of government within the EU. DG Regional Policy Working papers WP01/2012.

Chen Y., Donada C., & Perez Y.,2017. How firms manage bottlenecks in EV business ecosystems? (Centrale-Supelec Working Paper).Retrieved from http://chairgovreg.fondation-dauphine.fr/sites/chairgovreg.fondation-dauphine.fr/files/attachments/Ecosystem_Yurong.pdf.

Cooke, P.,2001.Regional Innovation Systems, Clusters, and the Knowledge Economy. Industrial and Corporate Change 10: 945-974

Colombo, M. G., Dagnino, G. B., Lehmann, E. E., & Salmador, M.,2017. The governance of entrepreneurial ecosystems. Small Business Economics. https://doi.org/10.1007/s11187-017-9952-9.

Cohen. B.,2006. Sustainable valley entrepreneurial ecosystems. Business Strategy and the Environment 15, 1 – 14.

Corallo, A., Errico, F., Latino, M, and Menegoli, M.,2016. Assuring the sustainability of entrepreneurial ecosystem through governance: a proposed framework. SmallBusiness Economics Special Issue Development Conference: The Governance of Entrepreneurial Ecosystems. Catania, Italy. September, 21 – 30.

Cumming, D. Werth, J., & Zhang, Y. ,2016. Governance in entrepreneurial ecosystems: Venture capitalists vs. technology parks. Small Business Economics Special Issue Development Conference: The Governance of Entrepreneurial Ecosystems. Catania, Italy. September, 29 – 39.

DeGhetto, K., Sutton, A., Holcomb, T. R., & Holmes, R. M.,2015. It’s who you know and what you do: how SMEs from developing economies capitalize on founder ties to create bargaining power with foreign multinational alliance partners. In T. K. Das (Ed.), Research in strategic alliances. Charlotte: Information Age Publishing,121 – 155.

DeGhetto, K.,Sutton, A., Holcomb, T. R., & Holmes, R. M.,2016. It's who you know and what you do: how SMEs from emerging economies capitalize on founder ties to create bargaining power with foreign multinational alliance partners. Available at SSRN: https://ssrn.com/abstract=2718128 or http://dx.doi.org/10.2139/ssrn.2718128.

Dong, Q.Q.,Xie, K.F.,2007.The Evolutionary Analysis of High-tech Entrepreneurial Social Network[J].Science & Technology Progress and Policy,7,91-93.

Feld, B.,2012. Startup Communities: Building an Entrepreneurial Ecosystem in your City. Hoboken, NJ: John Wiley & Sons, Inc.

Guo, ,L, Xu, Z,X,1998.Study on the population composition and niche characteristics of broad-leaved forest trees[J].Journal of Jilin Forestry College,3,145-149.

Hannah, D.,2014. Origins and outcomes of strategy in nascent ecosystems. Academy of Management Proceedings, 1, 313-330. https://doi.org/10.5465/AMBPP.2015.98.

Helfat, C. E., Raubitschek, R. S.,2017. Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems. Research Policy (Forthcoming).

Iansiti, M., Levien, R. ,2004. The keystone advantage: What the new dynamics of business ecosystems mean for strategy, innovation,and sustainability. Boston, MA: Harvard Business School Press.

Iyer, B., Lee, C. H., Venkatraman, N. ,2006. Managing in a small world ecosystem: Some lessons from the software sector. California Management Review, 48(3), 28 – 47.

Isenberg, D,2011. The Entrepreneurship Ecosystem Strategy as a New Paradigm for Economic Policy: Principles for Cultivating Entrepreneurship. Dublin: Institute of International European Affairs.

Isenberg, D. J.,2014. What an entrepreneurship ecosystem actually is. Harvard Business Review, 5,1 – 7.

Kshetri, N..2014. Developing successful entrepreneurial ecosystems: lessons from a comparison of an Asian tiger and a Baltic tiger. Baltic Journal of Management, 9(3), 330 – 356.

Kapoor, R., Agarwal, S. ,2017. Sustaining superior performance in business ecosystems: evidence from application software developers in the iOS and Android smartphone ecosystems. Organization Science, 28(3), 531 – 551. https://doi.org/10.1287/orsc.2017.1122.

Kapoor, R., Furr, N. R.,2015. Complementarities and competition: Unpacking the drivers of entrants' technology choices in the solar photovoltaic industry. Strategic Management Journal, 36(3), 416 – 436.

Lawton-Smith, HL, Romeo, S and Bagchi-Sen, S.,2008. Oxfordshire biomedical university spinoffs: An evolving system. Cambridge Journal of Regions, Economy and Society 1(2): 303 – 319.

Li, X.C.,2004.Regional Differences of High-tech Industry Cluster-based Entrepreneurship and Its Influencing Factors[J].Journal of Nankai University(Philosophy & Social Sciences),1,18-19.

Liu, Y., Na, J., Yang, J. & Gao, G. 2018d. Modified CRM-based Model Reference Adaptive Control with Reduced Peaking Phenomenon. International Journal of Applied Mathematics in Control Engineering, 1, 70-78.

Mack, E., & Mayer, H.,2016. The evolutionary dynamics of entrepreneurial ecosystems. Urban Studies, 53(10), 2118 – 2133.

Malecki, E. J.,2011. Connecting local entrepreneurial ecosystems to global innovation networks: Open innovation, double networks and knowledge integration. International Journal of Entrepreneurship and Innovation Management, 14(1), 36 – 59.

Mason, C., Brown, R.,2014. Entrepreneurial ecosystems and growth-oriented entrepreneurship. In Final Report to OECD, Paris. Accessed 14 April 2015.

Meng, R. ,2018. Adaptive Parameter Estimation for Multivariable Nonlinear CARMA Systems. International Journal of Applied Mathematics in Control Engineering, 1, 96-102.

Miller,L.& Acs, R.,(2017. The campus as entrepreneurial ecosystem: the University of Chicago. Small Business Economics, 49(1), 75 – 95.

Mooi, E. A., & Ghosh, M. ,2010. Contract specificity and its performance implications. Journal of Marketing, 74(2), 105 – 120.

Neck, H. M., Meyer, G. D., Cohen, B., & Corbett, A. C.,2004.An entrepreneurial system view of new venture creation.Journal of Small Business Management, 42, 190 – 208.

Neumeyer, X., Corbett, A. C., 2017. Entrepreneurial ecosystems: Weak metaphor or genuine concept?. In The great debates in entrepreneurship (pp. 35 – 45). Emerald Publishing Limited.

Neumeyer, X., Santos, S. C., 2018. Sustainable business models, venture typologies, and entrepreneurial ecosystems: A social network perspective. Journal of Cleaner Production, 172(20), 4565 – 4579.

Nijkamp, P. ,2003. Entrepreneurship in a modern network economy. Regional Studies, 37(4), 395 – 405.

Phelps, C., Heidl, R., & Wadhwa, A. ,2012. Knowledge, networks and knowledge networks: a review and research agenda. Journal of Management, 38, 1115 – 1165.

Poppo, L., Zheng Zhou, K., & Zenger, T. R. ,2008. Examining the conditional limits of relational governance: specialized assets, performance ambiguity, and long-standing ties.Journal of Management Studies, 45(7), 1195 – 1216.

Parker, G., Van Alstyne, M., Jiang, X.,2017. Platform ecosystems: How developers invert the firm. Management Information Systems Quarterly, 41(1), 255 – 266.

Pitelis, C.,2012. Clusters, entrepreneurial ecosystem co-creation, and appropriability: A conceptual framework. Industrial and Corporate Change, 21(6), 1359-1388.

Qian, H., Acs, Z. J. and Stough, R. R.,2013.Regional systems of entrepreneurship: the nexus of human capital, knowledge and new firm formation. Journal of Economic Geography 13(4),559-587.

Rampersad, G. C.,2016. Entrepreneurial ecosystems: A governance perspective. Journal of Research in Business, Economics and Management, 7(3), 1122 – 1134.

Spigel, B., 2017. The relational organization of entrepreneurial ecosystems. Entrepreneurship Theory and Practice, 41(1), 49 – 72

Spilling, O.R.,1996. The entrepreneurial system: On entrepreneurship in the context of a mega-event.Journal of Business Research, 36(1), 91-103.

Stam, E., 2015. Entrepreneurial ecosystems and regional policy: A sympathetic critique. European Planning Studies, 23(9), 1759 – 1769.

Stam, E., Spigel, B., 2017. Entrepreneurial ecosystems. In R. Blackburn, D. De Clercq, J. Heinonen, & Z. Wang (Eds.), Handbook for entrepreneurship and small business. London: SAGE.

Stuart, T. E., Sorenson, O.,2007. Strategic networks and entrepreneurial ventures. Strategic Entrepreneurship Journal, 1(3–4), 211–227

Suresh, J., Ramraj, R,2012.Entrepreneurial ecosystem: case study on the influence of environmental factors on entrepreneurial success[J]. European Journal of Business and Management, 4(16),95-101.

Szerb, L., Acs, Z. J., Ortega-Argilés, R., & Komlosi, E.,2015. The entrepreneurial ecosystem: the regional entrepreneurship and development index. Available at SSRN 2642514.

Tan, L.L., Wang, D.P., Zhou, C.,2011.Application of comprehensive niche suitability in regional innovation system sustainability evaluation. Systems Engineering Theory and Practice, 31(5),927-935.

Tewdwr-Jones, M., & McNeill, D. ,2000. The politics of cityregion planning and governance. Reconciling the national,regional and urban in the competing voices of institutionalrestructuring. European Urban and Regional Studies, 7(2),119–134.

Totterman, H., & Sten, J. ,2005. Start-ups: business incubation and social capital. International Small Business Journal,23(5), 487–511.

Tracey, P., Heide, J. B., & Bell, S. J. ,2014. Bringing Bplace backin: regional clusters, project governance, and new product outcomes. Journal of Marketing, 78(6), 1–16.

Wang, J.Y.,Wang, B.,2008. Study on the Niche Analysis and Construction of Networked Growth Advantages of Cluster Enterprises[J].Journal of Beijing Institute of Technology: Social Science Edition, 5,56-58.

Wang, X.Y.,2006.Study on brand niche measurement and its evaluation method[J]. Prediction, 5, 60-64.

Wareham, J., Fox, P. B., & Cano Giner, J. L.,2014. Technology ecosystem governance. Organization Science, 25(4), 1195–1215.

Westlund, H., & Bolton, R.,2003. Local social capital and entrepreneurship. Small Business Economics, 21(1), 77–113.

Whitford, J., & Enrietti, A. ,2005. Surviving the fall of a king: the regional institutional implications of crisis at Fiat auto. International Journal of Urban and Regional Research,29(4), 771–795

World Economic Forum,2013.Entrepreneurial Ecosystems Around the Globe and Company Growth Dynamics. Davos: World Economic Forum.

Wu, X.H,Han, Z.J.,Yang, S.C.,2006.An Empirical Study on the Theory and Model of Niche of Regional Industrial Clusters[J].Science Research, 12,872-877.

Xia, T.S., Ni, J.,2006. Theoretical Discussion on the Construction of Regional Science and Technology Entrepreneurship Public Service Platform[J]. China Science and Technology Forum,7,36-39.

Xia, W,Qiu,P, Chen, H.,2011. Research on the Construction Model of Competitive Advantages of Information Service Organizations Based on Niche Perspective[J].Information Science, 8, 72-76.

Yang, Z., Fu, J., Wang, L., Chen, Z.& Bai, H. 2018b. Back-stepping Sliding Mode with Unidirectional Auxiliary Surfaces for HSV with Attitude Constrains. International Journal of Applied Mathematics in Control Engineering, 1, 77-83.

Ylinenpää, H.,2009. Entrepreneurship and Innovation Systems: Towards a Development of the ERIS/IRIS Concept, European Planning Studies 17(8): 1153-1170.

Zhang, Y., Li, H.,2010. Innovation search of new ventures in a technology cluster: the role of ties with service intermediaries. Strategic Management Journal 31(1), 88-109.

Zahra, S. A., & Nambisan, S. ,2013. Entrepreneurship in global innovation ecosystems. Academy of Management Science Review, 1, 4–17.

Zahra, S. A., & Nambisan, S. ,2012. Entrepreneurship and strategic thinking in business ecosystems. Business Horizons,55, 219–229.

Zhou, Q, Chen, C.X.,2008. Empirical Study on the Suitability of Regional Technology Innovation Ecosystem in China. Science Research, 26, 242-246.

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