

Research on the Financing Niche of Strategic Emerging Industries

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Abstract. To introduce the ideas of ecological niche into the research context of the strategic emerging industries financing activities; to achieve the construction of financing ecological niche model through the maximum entropy principle of non-equilibrium statistical mechanics; to conduct the numerical simulation by using the self-organizing neural network; and to conduct the financing niche simulation measurement and the analysis of regional difference by adopting the financial data of the 21 new energy listed companies in Jiangsu province for 2017, and the economic, financial and other data around Jiangsu province; so as to verify the ecological linkage effect of the enterprise financing.

Keywords: financing ecological niche; Strategic emerging industries; Self-organizing neural network.

1. Introduction

On October 18, 2010, the state council issued the decision of the state council on accelerating the cultivation and development of strategic emerging industries. On December 19, 2016, the state council issued the 13th five-year national strategic emerging industries development plan, which made comprehensive arrangements for the development goals, key tasks, policies and measures of China's strategic emerging industries during the 13th five-year plan. According to the 2017 China strategic emerging industries development report released by the Chinese academy of engineering for the first time, strategic emerging industries have now become an important force for China to realize adverse growth under the downward pressure of the economy. The ecological niche idea is introduced in this article, in light of the specific economic and ecological environment in our country, to construct the maximum entropy principle of non-equilibrium statistical mechanics (MPEG) and self-organizing neural network (SOM) model, taking the new energy industry as an example, which is one of the seven strategic emerging industry being critically cultivated and developed in China, to interpret and verify the ecological linkage effect for the industry financing, and to analyze the position of the industry groups in the struggle for fund which is in short supply, aiming to provide new science realm and beneficial research reference for the achievement of higher financing efficiency in the strategic emerging industry in China under the limited financial resources

2. Three-Dimensional Construction of Financing Ecological Niche

The concept of niche was first put forward by Grinnell (1917), and then the concept and theories of niche emerged one after another. Ecological niche can be understood as the specific position of a species in the ecosystem and community that distinguishes it from other species. The survival of a species requires the use of various resources in its ecosystem. Different species in the same ecosystem form different inter-species relationships due to the same or different use of resources. Species interact with the ecosystem and other species, forming the unique ecological niche of each species.

Niche theory is not only applicable to biology, but also to social and economic systems. Since the 1980s, ecological niche theory has also been widely developed in the field of social science. McPherson (1983) proposed organizational niche, etc. Chinese scholars lu xiaocheng (2008) and cao rong (2003) also studied the ecological niche of industrial clusters and urban population respectively.

In a certain area, and the fund being able to be provided to many industries is limited, as for the strategic emerging industries of strategic that need to nurture large amounts of investment for the development, the limited fund is not enough to meet their needs, therefore the strategic emerging

industry enterprises are facing fierce competition of the financial resource, meanwhile the enterprise finance activities also depends on its environment. Different species, community composition and environment constitute the ecosystem, and the financing activities of different enterprises and many factors affecting the financing activities of enterprises in a certain area also constitute the financing ecosystem. In view of the competition among financing activities of enterprises and the complex relationship between the financing activities of enterprises and the financing environment constituted by various factors that affect the financing activities of enterprises, we define the "financing niche" as the relative position of a single enterprise's financing activities in its financing ecosystem. We can construct the financing ecological niche of strategic emerging industries from three dimensions:

(1) Financial and economic basis. It reflects the comprehensive economic strength of enterprise financing environment of strategic emerging industries and the development degree of financial markets and financial institutions, including total economic output, economic structure, growth rate, degree of economic openness, Banks, Insurance Institutions, stock market and debt market.

(2) The human resources and level of science and technology. It reflects the human resources in the financing environment of enterprises in strategic emerging industries and the infrastructure supporting financing activities, including financial institutions, management consulting, intra-industry human resources reserves, scientific research and innovation, etc.

(3) The strength of strategic emerging industry enterprises. It reflects their ability to compete for resources, including profitability, debt paying ability, operation ability and growth ability.

3. Research and Design of Financing Niche

3.1 Research Methods

In order to fully reveal the ecological relationship between financing activities of enterprises in strategic emerging industries, this article constructs a financing ecological niche analysis model of strategic emerging industries based on three dimensions of financing ecological niches, namely, financial and economic foundation, human resources and scientific and technological level, and enterprises' own strength.

For the multidimensional niche measurement, which has always been the difficulty of niche research, Feng Jiayi, Chai Lihe (2008), (2010), on the basis of complex physics theory, dialyzed the inherent dynamic characteristics of complex multivariate data, the maximum entropy principle of non-equilibrium statistical mechanics. In this article the maximum entropy principle of non-equilibrium statistical mechanics (MPEG) is used for reference to construct the financing ecological niche, and the numerical simulation is conducted through the self-organizing neural network (SOM).

3.1.1 Evolution of Financing Niche based on MGEP

Complex systems often have nonlinear interactions, and the maximum entropy principle can reveal its evolution rules. Financing system is a complex system. Various flows are formed through the exchange of various elements of human, fund, information and technology, which are defined as generalized flows.

Based on the maximum entropy principle, this article considers the financing ecological niche of a single enterprise as a statistical mechanical system formed by n information bodies, each of which obtains a generalized flow from the environment and is expressed as $x_1, x_2, x_3, \dots, x_n$. In order to reflect the interaction between information bodies, the information distribution function of obtaining generalized flow at t time of financing system is defined. $\rho(x, t) dx$. Then the average generalized flow obtained by all information bodies in t -time financing system is expressed as:

$$\bar{J} = \int \rho(x, t) J(\rho) dx \quad (1)$$

in which the generalized flow J can be generalized:

$$J = \eta + \sum_i \gamma_i x_i + \sum_{ij} \gamma_{ij} x_i x_j + \sum_{ijk} \gamma_{ijk} x_i x_j x_k + \sum_{ijkl} \gamma_{ijkl} x_i x_j x_k x_l + \dots \quad (2)$$

However, the financing niche of a single enterprise cannot develop arbitrarily, and it is bound to be subject to various constraints from the internal and external environment of the financing system, which can be expressed as

$$\langle x_i \rangle = f_1, \langle x_i x_j \rangle = f_2, \langle x_i x_j x_k \rangle = f_3, \langle x_i x_j x_k x_l \rangle = f_4 \quad (3)$$

According to the maximum entropy principle of non-equilibrium statistical mechanics, when the open system is far from equilibrium, the system is always optimized by the optimization process which can make it obtain the maximum generalized flow under a given constraint. Therefore, the generalized flow represented by formula (1) is maximal under the constraint condition (3), and can be obtained by using Lagrangian multiplier optimization method.

$$\rho = \frac{c}{J - \alpha - \sum_i \beta_i x_i - \sum_{ij} \beta_{ij} x_i x_j - \sum_{ijk} \beta_{ijk} x_i x_j x_k - \sum_{ijkl} \beta_{ijkl} x_i x_j x_k x_l - \dots} \quad (4)$$

Replace formula (2) with formula (4):

$$\rho = \frac{c}{\eta - \alpha + \sum_i (\gamma_i - \beta_i) x_i + \sum_{ij} (\gamma_{ij} - \beta_{ij}) x_i x_j + \sum_{ijk} (\gamma_{ijk} - \beta_{ijk}) x_i x_j x_k + \sum_{ijkl} (\gamma_{ijkl} - \beta_{ijkl}) x_i x_j x_k x_l + \dots} \quad (5)$$

By expansion $e^x = 1 + x + \frac{1}{2!} x^2 + \frac{1}{3!} x^3 + \dots$ Formula (5) can be converted to:

$$\rho = e^{\mu + \sum_i \sigma_i x_i + \sum_{ij} \sigma_{ij} x_i x_j + \sum_{ijk} \sigma_{ijk} x_i x_j x_k + \sum_{ijkl} \sigma_{ijkl} x_i x_j x_k x_l + \dots} \quad (6)$$

The exponential term of formula (6) is defined as a potential function

$$\Phi(\sigma, \mathbf{x}) = \mu + \sum_i \sigma_i x_i + \sum_{ij} \sigma_{ij} x_i x_j + \sum_{ijk} \sigma_{ijk} x_i x_j x_k + \sum_{ijkl} \sigma_{ijkl} x_i x_j x_k x_l \quad (7)$$

Formula (7) represents the potential function of the financing niche of a single enterprise, reflecting the evolution characteristics of the financing niche of a single enterprise, its nature is determined by the parameter σ , while the parameter σ is determined by the coefficient β and coefficient γ , and the function of β and γ is to regulate the dynamics rules of the interaction between financing niche information bodies. As Φ controls the flow direction of the generalized flow representing the interaction between the information bodies, and moves through the self-organizing optimization, therefore, the potential function Φ is the theoretical basis for analyzing the phenomenon of niche movement.

Perform translation transformations for the potential function Φ in the formula (7):

$$\xi_j = \sum_{j=1}^n \omega_{ij} x_j \quad (8)$$

After diagonalization of the constant term matrix in formula (8), the potential function becomes:

$$\bar{\Phi}(\lambda, \xi) = \zeta + \sum_k \lambda_k \xi_k^2 + \dots \quad (9)$$

In formula (9), ξ_k is the x_i combination model of the information body x_i , which reflects the structural model formed by the interaction of the information bodies in the financing niche of a single enterprise, which is similar to the order parameter, and represents the financing niche of a single enterprise.

According to the relationship between the potential function and the dynamic evolution equation, formula (9) can be further deduced, so that the financing niche structure of a single enterprise is formed and the evolution characteristics are more obvious, and the results are as follows:

$$\xi_k = \lambda_k \xi_k + S_k(\xi_1, \xi_2, \dots, \xi_n) + F_k(t), \quad k = 1, 2, \dots, n \quad (10)$$

Formula (10) is a general form of the dynamic equation of the evolution of financing niche of a single enterprise, F (t) represents the random influence, the state of switching the financing niche, and the structural parameter, I. E., ξ_k , which is the variable describing the characteristics of the financing niche of a single enterprise, can be used to represent a single enterprise financing niche.

3.1.2 Numerical Simulation Design based on SOM

Through the above analysis, the ξ_k structure variable can be used to express the financing niche, but because some of the indexes in the above derivation, such as constraint conditions f_1, f_2, \dots, f_4 are difficult to obtain, moreover, the interaction between the information bodies is very complex, so it is difficult for us to solve the above-mentioned formula by specific numerical value.

Self-organizing neural network (SOM) is of a study conducted with mentor, which has the function of self-organizing and classifies the input mode by self-training many times. The basic idea is consistent with the dynamic process of niche evolution. We use SOM to simulate numerically the financing niche. The simulation steps are as follows:

(1) Initialization. Set the initial random state of the system to A, assign $a_{ij}(i = 1, 2, \dots, N; j = 1, 2, \dots, M)$ a value from 0 to 1. Assign the initial value of the positive feedback rate $\eta(0)(0 < \eta(0) < 1)$. Identify the initial value of $N_g(0)$ of the domain $N_g(t)$. The domain $N_g(t)$ is centered on the competitive winning mode determined in step (4) and contains the range of a number of neurons. The value of $N_g(t)$ reflects the number of neurons contained in the domain during the t-th feedback process. Determine the total number of feedback times(T).

(2) Select any of the q input modes P_k , after the normalization process is completed, it shall be input into the neural network.

$$\overline{P_k} = \frac{P_k}{\|P_k\|} = \frac{(p_1^k, p_2^k, \dots, p_n^k)}{[(p_1^k)^2 + (p_2^k)^2 + \dots + (p_n^k)^2]^{1/2}} \quad (11)$$

(3) Normalize the distributed state of neural network $A_j = (a_{j1}, a_{j2}, \dots, a_{jN})$, count the Euclidean distance between $\overline{A_j}$ and $\overline{P_k}$,

$$\overline{A_j} = \frac{A_j}{\|A_j\|} = \frac{(a_{j1}, a_{j2}, \dots, a_{jn})}{[(a_{j1})^2 + (a_{j2})^2 + \dots + (a_{jn})^2]^{1/2}} \quad (12)$$

$$d_j = [\sum_{i=1}^N (\overline{p_i^k} - \overline{a_{ji}})^2]^{1/2}, \quad j = 1, 2, \dots, M \quad (13)$$

(4) Find out the minimum distance d_g , corresponding to the Distribution of competitive Victory Neural Network A_k ,

$$d_g = \min[d_j], \quad j = 1, 2, \dots, M \quad (14)$$

(5) Adjust the state of the system. Modify the system $N_g(t)$ pattern between all neurons and input neurons in the competition domain

$$\overline{a_{ju}(t+1)} = \overline{a_{ju}(t)} + \eta(t) [\overline{p_i^k} - \overline{a_{ju}(t)}], \quad j \in N_g(t), \quad j = 1, 2, \dots, M \quad (15)$$

(6) Continue to select the data normalization and input it into the neural network and re-perform step (3) until all data input is completed

(7) Positively feedback rate $\eta(\mathbf{t})$ and its domain $N_g(\mathbf{t})$, which, t Indicates the number of feedbacks, T Represents the total number of feedbacks

$$\eta(\mathbf{t}) = \eta(\mathbf{0})\left(1 - \frac{t}{T}\right) \quad (16)$$

Set the coordinate value of neuron g in a two-dimensional or multi-dimensional array be (x_g, y_g) , Then the domain scope is the square with the dot $(x_g + N_g(\mathbf{t}), y_g + N_g(\mathbf{t}))$ and the dot $(x_g - N_g(\mathbf{t}), y_g - N_g(\mathbf{t}))$ as the upper right corner and the lower left corner. The revised formula is as follows:

$$N_g(\mathbf{t}) = INT \left[N_g(\mathbf{0}) \left(1 - \frac{t}{T}\right) \right] \quad (17)$$

Among which, $INT[X]$ is for rounding symbol, $N_g(\mathbf{0})$ is the initial value of $N_g(\mathbf{t})$.

(8) let $\mathbf{t} = \mathbf{t} + \mathbf{1}$, return to step2 and repeat, until $\mathbf{t} = \mathbf{T}$

(9) Final state distribution of neural network): \mathbf{A} represents the a_{ij} Distribution Value, at the same time, count $\xi_k = \sum_{i=1}^n a_{ji} p_i^j$, then the neural network pattern is obtained.

3.2 The Construction of the Index System of Financing Niche

Based on the above analysis, this article selects the following indexes (Table 1) to construct the index system of measuring strategic emerging industry financing niche from three Dimensions: financial economic base, human resources, scientific and technological level, and enterprise's own strength.

4. Empirical Analysis

4.1 Data Sources

Because the new energy industry is an important part of the strategic emerging industry, this article selects the data of 21 new energy listed companies in Jiangsu Province in 2017 to conduct the analysis. The financial data of the listed companies were obtained from the RESSET financial database, and the economic and financial data are from the 2017 China City Yearbook and the 2017 Financial Statistical Yearbook of all cities in Jiangsu Province. On this basis, we use MATLAB software 2015a version to conduct the SOM analysis and calculate the financing niche.

4.2 Simulation Results

After 300 steps of simulation, the financing ecological niche parameters of the 22 listed enterprises tend to be stable (figure 1), and the financing ecological niche is formed (see Table 2).

Table 1. Observation Indexes of three Dimensions of financing niche

<p>Financial and economic basis</p>	<p>Balance of deposits (RMB100 million)</p> <p>Loan balance (RMB100 million)</p> <p>Premium income (RMB100 million)</p> <p>Gross Regional Domestic Product(RMB100 million)</p> <p>Added value of the tertiary industry (RMB 100 million)</p> <p>Total amount of FDI actually utilized the year(\$100 million)</p> <p>Total imports and exports for the year (\$100 million)</p> <p>Total fixed assets investment of the whole society (RMB 10,000)</p> <p>Average wage of on-the-job workers (RMB)</p>
<p>human resources and Level of science and technology</p>	<p>Number of students in Regular Institutions of Higher Ed (10,000)</p> <p>Total number of financial practitioners (persons)</p> <p>Number of patents granted (pieces)</p>
<p>Company's own strength</p>	<p>Earnings per share (\$/ share)</p> <p>Net assets per share (\$/ share)</p> <p>Provident fund per share (\$/ share)</p> <p>Rate of return on net assets (%)</p> <p>Net interest rate on assets (%)</p> <p>Current Ratio (%)</p> <p>Quick freezing ratio (%)</p> <p>Revenue growth rate (%)</p> <p>Net profit growth rate (%)</p> <p>Total asset growth rate (%)</p> <p>Inventory turnover (times)</p> <p>Turnover of total assets (times)</p> <p>Asset-liability ratio (%)</p>

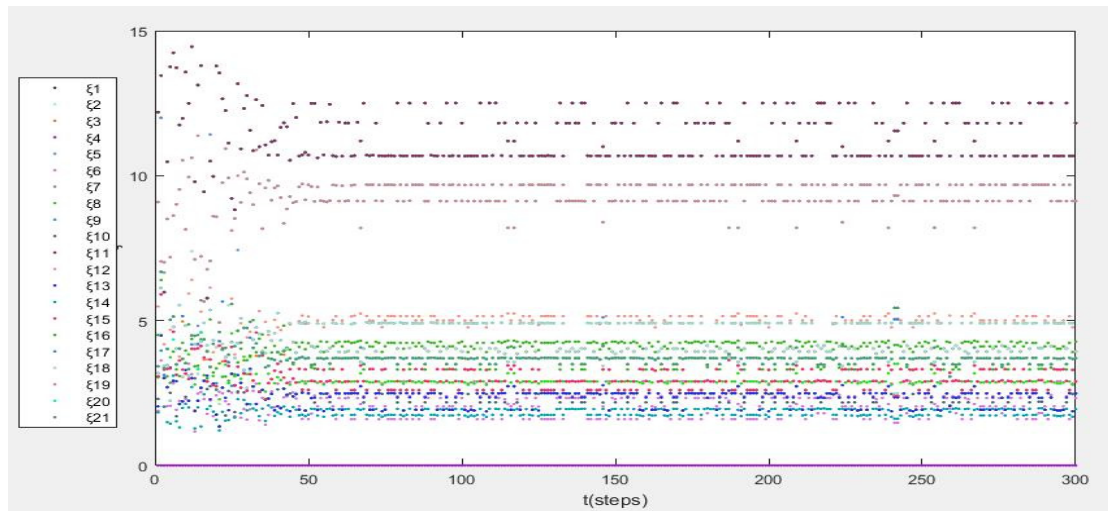


Fig. 1 The forming process of the financing ecological niche of the 21 New Energy listed companies in Jiangsu Province

Figure 1 clearly shows the picture of the evolution of financing ecological niche. Each enterprise exchanges actively with various elements of the financing system in the financing activities, and the maximum generalized entropy is obtained through the continuous and mutual interaction between the neurons under the constraint conditions. In this process, the enterprises in the financing process not only compete with each other, but also cooperate with each other, and finally achieve their own stable financing ecological niche. As can be seen from figure 1, the financing activities of almost all enterprises have reached a stable state after 50 steps of simulation. The above process shows that each enterprise is searching for its own financing niche, and eventually co-exist harmoniously in the whole financing ecosystem. In the process of searching, each enterprise's financing ecological niche is gradually formed.

Table 2. Finance ecological niche scores of 21 listed New Energy companies in Jiangsu Province in 2017

	Financial and economic basis	Ranking	Human resources	Ranking	Company's own strength	Ranking	Comprehensive	Ranking
CREATE TECHNOLOGY & SCIENCE CO.,LTD.	7.410754	1	2.999999	1	1.429326	18	11.38651	1
CNNC SUFATechnology Industry Co., Ltd.	7.410754	1	2.999999	1	1.696363	15	11.38651	1
Guoxuan High-tech Co.,Ltd.	0.678419	12	0.508448	8	1.554714	16	2.994442	15
JIANGSU DAGANG CO.,LTD.	0	21	0	21	1.745305	14	0	21

Sinoma Science & Technology	5.275274	6	0.746616	6	2.369748	7	9.35115	6
Jiangsu Jiuding New Material Co.,Ltd	0.678419	12	0.508448	8	1.967113	11	2.118251	19
ORIENTAL ENERGY CO., LTD.	7.410754	1	2.999999	1	2.296869	8	11.38651	1
Aotecar New Energy Technology Co., Ltd.	0.678419	12	0.508448	8	1.326285	20	3.229903	14
Jiangsu Zhongli Group Co.,Ltd	7.410754	1	2.999999	1	2.482712	5	11.38651	1
Kuangda Technology Group Co., Ltd	0.380929	18	0.093915	18	3.119104	4	2.262714	18
Titan Wind Energy(Suzhou) Co., Ltd.	7.410754	1	2.999999	1	1.964110	12	11.38651	1
Lomon Billions Group Co., Ltd	1.506835	8	0.291721	14	2.460433	6	4.570612	8
CHANGZHOU ALMADEN CO.,LTD.	0.380929	18	0.093915	18	2.199736	9	2.284873	17
Jiangsu Huasheng Tianlong Photoelectric Co.,Ltd.	0.380929	18	0.093915	18	1.536979	17	1.835457	20
JiangSu Jin Tong Ling Fluid Machinery Technology Co., Ltd	0.678419	12	0.508448	8	1.935367	13	2.994042	16

Wuxi Lead Intelligent Equipment CO.,LTD.	1.506835	8	0.291721	14	4.868366	1	3.976212	11
JIANGSU SUNSHINE CO.,LTD	1.506835	8	0.291721	14	1.371426	19	4.462557	9
Hareon Solar Technology Co.,Ltd.	1.506835	8	0.291721	14	0	21	4.394821	10
NARI Technology Co., Ltd.	5.275274	6	0.746616	6	2.132208	10	9.35115	6
Jiangsu Zhongtian Technology Co., Ltd.	0.678419	12	0.508448	8	3.316825	3	3.805967	12
Jiangsu Linyang Energy Co., Ltd.	0.678419	12	0.508448	8	4.145341	2	3.695828	13

Table 2 shows the financing ecological niche scores of 21 New Energy listed companies in Jiangsu Province in 2017. Because some listed companies belong to the unified city, they have the same scores in the dimensions of the financial and economic base, human resources and level of science and technology. The results show that although Suzhou has five New Energy listed companies, because of its high level of financial and economic base and abundant human resources, the New Nergy enterprises face more resources in financing. Although the companies have different strength, they can obtain sufficient resources in the financing activities, so Suzhou can also accommodate more New Energy enterprises.

5. Conclusions and Recommendations

The financing ecological niche of the enterprises in the strategic emerging industries not only shows the result of capital competition, but also reflects the degree of competition of market resources, which is closely related to the economic and ecological environment of different regions and the enterprises' own strength. As far as the New Energy industry of Jiangsu Province is concerned, the regional difference of financing ecological niche is great, and the ecological linkage effect of enterprise financing is remarkable. Based on the above conclusions, this article holds that the cultivation and development of the New Energy industry in Jiangsu Province should be promoted from focusing on the single industry individual to taking into account the ecological adaptability of the industry. According to the regional differences, the policy design and system arrangement of the financing and financing ecological optimization of different industries shall be adopted. First, we shall will give full play to the ecological advantages of financing in southern Jiangsu. Second, in the central region of Jiangsu, we should focus on supporting high-quality New Energy enterprises to further optimize the financial and ecological environment. Third, in the northern region of Jiangsu,

we should improve the economic level, develop a sound financial system, and strengthen the ecological construction of industrial financing, because the strategic emerging enterprises in the northern region of Jiangsu are at a disadvantage in the construction of financing ecological environment, the threshold of bank credit access for these enterprises should be lowered properly, and the right of bank credit examination and approval in the northern region of Jiangsu should be expanded.

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