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# **Empirical Analysis on Brand Extension Size Mode Based on Ecological Characteristics**

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**Abstract** Firstly, the paper establishes a brand-extension size mode and adopts the marginal analysis to analyze the optimal solution of it. Secondly, research the brand-extension condition of G brand by questionnaire survey. There are 240 questionnaires handed out, with 211 withdrawing and 187 valid, by doing this to test the influencing degree of each factor in brand-extension size model; At the same time, use analytic hierarchy process to analyze the size of brand extension and and use principal component analysis to find out the main factors that influence brand extension of G brand. Finally, the paper makes an empirical analysis on brand extension size model based on ecological characteristics, the results show that the order of the total information reflected by each principal component which obtained from the principal component analysis is somewhat different from that of analytic hierarchy process; With the continuous improvement of living standards, the consumers pay more attentions to the convenience of shopping and comfort of shopping environment day by day. Therefore, the brand enterprises must strengthen environmental construction of brand group and satisfy the growing material and cultural demand of consumers. Success rate of brand extension to a great extent has a close relationship with the products and product channel, compared to foreign brand, consumers are relatively weak in brand communication and association of the products.

Key words Mode; Size; Demonstration; Brand extension; Ecological characteristics; China

Since the 21<sup>st</sup> century, the international management scholars have put forward the new direction of the development of management thoughts---- "Organizational Life", it uses the principle of ecology for reference and studies brand extension by taking together the brand attributes, environment and interaction among brands, which undoubtedly accord with the development of management thought. Aaker comprehends the brand from a new perspective, puts forward the concept of "brand population", for the first time brings population concept in ecology into the theoretical research of brand. Then, in 2000, he further puts forward a new management model which is Brand Leadership based on creation, protection and sustainable development of the brand system of enterprise[1]. Winkler proposed the concept of brand ecological environment and considers that brand ecological environment is a complex, energetic and constantly changing organic organizational system<sup>[2]</sup>. Domestic scholar professor Wang Xingyuan proposes brand ecosystem theory comparatively early[3], and further puts forward the background of brand ecology and the framework of research[1]. Wang Dongmin considers that brand system is an open system far from balance and it can constantly form new properties or new functions to adapt to the external challenge or change<sup>[4]</sup>. Peng Yun and others think that adaption is a phenomenon fit for characters and properties of environment conditions and formed through the competition, which is the result of

from enterprises to value chain until the whole of brand ecosystem can greatly enrich perspective, method and content of brand research<sup>[6]</sup>. **1 Selection of brand-extension size mode**Brand population size is affected by many factors, some external forces may drive its expansion and some factors may restrict its growth. Therefore, in combined action of all sorts of

market choice<sup>[5]</sup>. Therefore, from current research results,

bringing the basic theory and method of ecology in the research

of brand and studying by expanding the research perspective

external forces may drive its expansion and some factors may restrict its growth. Therefore, in combined action of all sorts of advantages and disadvantages, brand population expansion or brand extension size changes in a relatively stable balance point, its proceed is the sum of proceeds worked by every factor. The new members will be accepted by the brand population only when the proceeds increase. In ideal conditions, the optimal value of brand extension size should be the number of members when the overall revenue is optimal. The model is as follows. [7]

$$f(a_i, x_i) = \sum_{i=1}^n \overline{a_i x_i^i} (i=1, 2, 3, \dots, n),$$
 (1) where,  $f$  is overall revenue of the brand population after the new members entering into;  $a_i$  is the weight of the  $i$ th influence

factor,  $\sum_{i=1}^{n} a_i = 1$ ;  $x_i$  is the proceeds after the new members entering into;  $j_i$  is the undetermined parameter of the ith influence factor.

The vector in the model is the change direction of brand population proceeds under the influence of each factor<sup>[2]</sup>. The author uses the marginal analysis method to analyze the optimal solution of the brand extension size model. Marginal analysis method compares the marginal benefit with the marginal cost. When they are equal, the optimal solution comes out.

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When the overall marginal benefit of the brand population is zero (the overall marginal benefit of the brand population is income minus cost), the brand extension size is optimal in theory. The first and second derivative of  $f(a_i, x_i)$  is respectively show in formula (2):

$$f'(a_i x_i) = \sum_{i=1}^n a_i j_i x_i^{j-1}, f'(a_i x_i) = \sum_{i=1}^n a_i j_i (j_i - 1) x_i^{j-2},$$
 (2)

$$f'(a_ix_i) = \sum_{i=1}^{n} a_ij_ix_i^{j-1} = 0.$$
 (3)

We can get from formula (3) that  $X^* = (x_1^*, x_2^*, x_3^*, \cdots, x_n^*)^T$ . According to Extreme Value Theorem, we get a maximum value when the first derivative is equal to zero and the second derivative is less than zero.

If  $x^*$  makes  $f'(a_ix_i) = \sum\limits_{j=1}^n a_jj_i(j_i-1)x_i^{j_i-2} < 0$ , the brand population size is optimal, that means the brand extension size is maximum. Actually, j has at least one value less than 1, the enterprises can evaluate j in regression analysis by relevant data.

#### 2 Data sources and research methods

**2.1 Data sources** Research the brand-extension condition of G brand by questionnaire survey. There are 240 questionnaires handed out, with 211 withdrawing and 187 valid, by doing this to test the influencing degree of each factor in brand-extension size model. Analyze the reliability by using Cronbach  $\alpha$ . Through calculating by SPSS15.0, the reliability of questionnaire survey is 0.857, between 0.7 and 0.9. The value can ensure the stability and validity of the research [8].

#### 2.2 Research methods

**2.2.1** Analytic hierarchy process. In order to study the size of brand extension model, analytic hierarchy process were used. Firstly, select evaluation indicator, start from the factors influence the population size in ecology, find out the ecological factors that influence the brand extension size model and begin to analyze it. Secondly, build hierarchical analysis structure, decompose layer upon layer according to the properties of problems and target, build the hierarchical analysis structure according to the logical relationship and the correlative degree among factors. Thirdly, build a judgment matrix, the hierarchical structure reflects the relationship among factors, but the proportion of each criterion in target measure is not necessarily the same, in policymakers' eyes, they take up a proportion respectively. Saaty and others suggest that confirm the value of aij by using the 1 - 9 scale method and build a judgment matrix [2] (Formula 4). Finally, calculate weight vector and make a consistency test, calculate the maximize eigenvalue and corresponding eigenvector in every pairwise comparison matrix and make a consistency test by using consistency indicator, random consistency indicator and consistency ratio. If the test is passed, eigenvector (after normalization) is the weight vector; If not, it is necessary to reconstruct pairwise comparison matrix in order to avoid the paradox among the judgments.

2.2.2 Principal component analysis. Using principal compo-

nent analysis to determine main factors that influence the brand extension of the G brand, so as to achieve the purpose of testing the model above<sup>[9]</sup>. The principal component analysis is a mathematical transformation method, it changes a group of relevant variables given into another group irrelevant variables by the linear transform, these new variables arrange in accordance with the order of gradual decrease of variance. In mathematics transform, maintain the total variance of variable, make the first variable have the maximal variance and call it the first principal component. The variance of the first variable is the second largest and is irrelevant to the first variable, we call it the first principal component. Analogized in turn, I variables have I principal components. Usually the number of principle component required to extract-k > 0.8.

#### 3 Results and analysis

**3.1** Evaluation of each ecological factor The structure of hierarchical analysis is got by using analytic hierarchy process to analyze the ecological factors that influence the brand extension size (Fig. 1) [6].

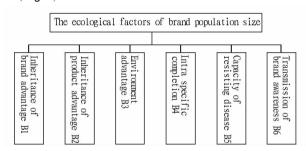


Fig. 1 Hierarchical structure of the ecological factors of brand population size

Table 1 Scores from experts

| Factor           | B <sub>1</sub> | B <sub>2</sub> | <i>B</i> <sub>3</sub> | $B_{\scriptscriptstyle 4}$ | <i>B</i> <sub>5</sub> | <i>B</i> <sub>6</sub> |
|------------------|----------------|----------------|-----------------------|----------------------------|-----------------------|-----------------------|
| $\overline{B_1}$ | 1              | 1/2            | 6                     | 3                          | 2                     | 4                     |
| $B_2$            | 2              | 1              | 7                     | 4                          | 3                     | 6                     |
| $B_3$            | 1/6            | 1/7            | 1                     | 1/3                        | 1/4                   | 1/2                   |
| $B_4$            | 1/3            | 1/4            | 3                     | 1                          | 1/2                   | 2                     |
| $B_{5}$          | 1/2            | 1/3            | 4                     | 2                          | 1                     | 3                     |
| $B_6$            | 1/4            | 1/6            | 2                     | 1/2                        | 1/3                   | 1                     |

Constitute an expert group by inviting experienced experts on the basis of their research on brand theory, judge and score the ecological factors that influence the brand in Fig. 1, we get the relative weight of the six criterions- $B_1$ ,  $B_2$ ,  $B_3$ ,  $B_4$ ,  $B_5$ ,  $B_6$  (Table 1) [6].

Transform it to a judgment matrix-N:

$$N = \begin{bmatrix} 1 & 1/2 & 6 & 3 & 2 & 4 \\ 2 & 1 & 7 & 4 & 3 & 6 \\ 1/6 & 1/7 & 1 & 1/3 & 1/4 & 1/2 \\ 1/3 & 1/4 & 3 & 1 & 1/2 & 2 \\ 1/2 & 1/3 & 4 & 2 & 1 & 3 \\ 1/4 & 1/6 & 2 & 1/2 & 1/3 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0.5 & 6 & 3 & 2 & 4 & -1 \\ 2 & 1 & 7 & 4 & 3 & 6 \\ 0.167 & 0.143 & 1 & 0.333 & 0.25 & 0.5 \\ 0.333 & 0.25 & 3 & 1 & 0.5 & 2 \\ 0.5 & 0.333 & 4 & 2 & 1 & 3 \\ 0.25 & 0.167 & 2 & 0.5 & 0.333 & 1 & -1 \end{bmatrix}$$

If the corresponding eigenvector of the maximum eigenvalue  $\lambda_{\max}$  is  $\overline{W} = (w_1, \cdots, w_n)^T$ . Through calculating, the eigenvector of judgment matrix-N is

$$\overline{W} = \frac{W_i}{\sum_{i=1}^{6} W_i} = \begin{bmatrix} 0.25 \\ 0.39 \\ 0.04 \\ 0.10 \\ 0.16 \\ 0.06 \end{bmatrix}$$

The maximum eigenvalue  $\lambda_{max} = 6.089$ 

Consistency test 
$$CI = \frac{\lambda_{max} - n}{n - 1} = \frac{6.089 - 6}{6 - 1} = 0.017 9$$

When n=6, looking up in the Table, we know that the random coincidence indicator RI=1.26

Random consistency ratio 
$$CR = \frac{CI}{RI} = \frac{0.0179}{1.26} = 0.0142 \le$$

0.1

These show that N is not a consistent matrix but with a satisfying consistency, the inconsistency degree of N is acceptable. Thus the weight of each ecological indicator is got, that means inheritance of brand advantage ( $B_1$ ) is 0.5, inheritance of product advantage ( $B_2$ ) is 0.39, environment advantage ( $B_3$ ) is 0.04, intra specific completion ( $B_4$ ) is 0.10, capacity of resisting disease ( $B_5$ ) is 0.16, transmission of brand awareness ( $B_6$ ) is 0.06. From this, we get that  $B_2 > B_1 > B_5 > B_4 > B_6 > B_3$ , This ecological weight order is in accordance with ecological characteristics. In ecology, the biggest influence on brand population is product, and then is micro-environment (including inheritance of brand advantage, implication effect, seesaw effect), the last is macro-environment.

The decomposition of total variance and the establishment of factor loading matrix From the exploration of the reason for the success of the world famous sports brand-G , we find that except the product innovation, it is important to make the consumer's demand as the starting point. So, we choose brand G to make an empirical research, through data analysis, extend the brand from sportswear to sports equipment, and talk over about the influence factors of brand extension size. In sports field, informants have a great evaluation of G brand. So when it extends from sportswear to sports equipment, alternative of the two is little, and the brand extension won't generate strong seesaw effect. Therefore, in the analysis of the questionnaire, we can ignore the seesaw effect. Make a data calculation and analysis of the questionnaire by using the SPSS15.0 and get each principal component, the author takes the key point of the principal component analysis which is the table of decomposition of total variance and the factor loading matrix (Table 2). From Table 2, the total contribution of the former four new variables is 81.5% more than 80%, the other variables contribute little and the effect is relatively small. For this, we get four principal components by calculating, the factor

loading[2] is shown in Table 4. From Table 4, the first principal component has a high relevance with product style  $(X_0)$ , aftersale service( $X_6$ ), product quality( $X_4$ ), product function( $X_5$ ), channel sharing  $(X_7)$ , channel terminal advantage  $(X_{11})$ , take about 41% of the total information, so the first principal component includes product advantage and channel advantage. The second principal component has a high relevance with brand awareness  $(X_{12})$ , brand loyalty  $(X_{13})$ , brand recognition  $(X_{10})$ , takes 18% of the total, so the second principal component is brand equity. The third principal component reflects each capacity indicators of the enterprise, it consists of research and development capacity ( $X_2$ ), production capacity ( $X_8$ ), operation capacity  $(X_3)$  of the enterprise. The fourth principal component consists of brand communication  $(X_1)$  and brand association  $(X_{14})$ , it reflects the consumer's awareness of brand. Through the empirical analysis of the influence factors of brand extension of G brand, we find that the empirical results correspond with the ecological law besides rare individual [9].

Table 2 Decomposition of total variance

| _     | Initial Eigenvalues |    |            |            |              | Squared Loadings Rotation Sums |             |               |  |
|-------|---------------------|----|------------|------------|--------------|--------------------------------|-------------|---------------|--|
| Com-  | _ F                 | er | centage of | Cumulative | <del>-</del> | P                              | ercentage o | of Cumulative |  |
| ponen | Total               | ٧  | /ariance   | percebtage | Э            | Total                          | Variance    | percebtage    |  |
|       |                     |    | %          | %          |              |                                | %           | %             |  |
| 1     | 5.731               | 8  | 40.944     | 40.944     | 4.           | 126 1                          | 29.473      | 29.473        |  |
| 2     | 2.500               | 1  | 17.858     | 58.802     | 2.           | 765 8                          | 19.755      | 49.227        |  |
| 3     | 1.770               | 1  | 12.643     | 71.445     | 2.           | 757 9                          | 19.699      | 68.926        |  |
| 4     | 1.408               | 2  | 10.058     | 81.502     | 1.           | 761 3                          | 12.576      | 81.502        |  |
| 5     | 0.990               | 1  | 7.068      | 88.570     |              |                                |             |               |  |
| 6     | 0.532               | 7  | 3.809      | 92.379     |              |                                |             |               |  |
| 7     | 0.322               | 1  | 2.299      | 94.678     |              |                                |             |               |  |
| 8     | 0.263               | 3  | 1.882      | 96.560     |              |                                |             |               |  |
| 9     | 0.221               | 6  | 1.586      | 98.146     |              |                                |             |               |  |
| 10    | 0.129               | 1  | 0.918      | 99.064     |              |                                |             |               |  |
| 11    | 0.067               | 8  | 0.482      | 99.546     |              |                                |             |               |  |
| 12    | 0.035               | 9  | 0.257      | 99.803     |              |                                |             |               |  |
| 13    | 0.025               | 2  | 0.176      | 99.979     |              |                                |             |               |  |
| 14    | 0.003               | 6  | 0.021      | 100.000    |              |                                |             |               |  |

- **3.3 Results analysis** The empirical results above show that the selection of the ecological factors in the model roughly corresponds with the results of principal component analysis, specific analysis expresses in the following four aspects.
- (1) The order of total information reflected from each principal component through the method of principal component analysis is different from that of analytic hierarchy process.

Among them, the order of product advantage, brand advantage, capacity of resisting disease and the transmission of brand awareness is roughly consistent. The environment advantage changes a little  $^{[6]}$ .

(2) In theoretical analysis, the experts score the index stated according their research on brand theory for many years, they pay more attention to the most advanced theoretical research abroad. However, many foreign researches are based on the survey of foreign market. And the environment of foreign market is relatively good, so they pay little attention to the domestic environment [10]. And the author's market research is aimed at G brand in domestic market, the differences of mar-

ket environment may lead to different levels of influence brought by environmental factors. Domestic market is not mature yet with many unsatisfactory points, so the people relatively pay more attention to the domestic market environment. From the market survey results in empirical analysis, we can see that the consumers pay more attentions to the convenience of shopping and comfort of shopping environment day by day, therefore, it reminds brand enterprise to strengthen environmental construction of brand group and satisfy the growing material and cultural demand of consumers<sup>[6]</sup>.

Table 3 Factor loading

| Factor   | Principal   | Principal   | Principal   | Principal   |
|----------|-------------|-------------|-------------|-------------|
| racioi   | component 1 | component 2 | component 3 | component 4 |
| $X_9$    | 0.910 1     | 0.015 2     | 0.186 1     | 0.170 1     |
| $X_6$    | 0.8639      | 0.351 8     | 0.078 9     | 0.059 2     |
| $X_4$    | 0.8542      | -0.108 1    | 0.158 2     | 0.3343      |
| $X_{5}$  | 0.7788      | -0.0598     | 0.430 8     | -0.344 6    |
| $X_7$    | 0.722 8     | 0.415 1     | 0.292 3     | -0.261 1    |
| $X_{11}$ | 0.611 2     | -0.1208     | 0.532 7     | -0.360 6    |
| $X_{12}$ | 0.095 1     | 0.927 1     | 0.1632      | 0.1292      |
| $X_{13}$ | 0.205 9     | 0.907 9     | -0.153 2    | -0.060 1    |
| $X_{10}$ | 0.0938      | 0.742 3     | 0.399 1     | -0.065 2    |
| $X_2$    | 0.242 2     | 0.0187      | 0.828 2     | -0.067 1    |
| $X_8$    | 0.1229      | 0.151 1     | 0.801 4     | 0.345 2     |
| $X_3$    | 0.395 1     | 0.355 9     | 0.745 6     | 0.0543      |
| $X_1$    | -0.090 1    | 0.1823      | 0.1932      | 0.852 5     |
| $X_{14}$ | -0.143 9    | 0.145 7     | 0.048 3     | -0.650 1    |

- (3) Beacause the first principal component has a high relevance with product  ${\rm style}(X_{\!\scriptscriptstyle 9})$ , after-sale service( $X_{\!\scriptscriptstyle 6})$ , product  ${\rm quality}(X_{\!\scriptscriptstyle 4})$ , product  ${\rm function}(X_{\!\scriptscriptstyle 5})$ , channel sharing  $(X_{\!\scriptscriptstyle 7})$ , channel terminal advantage( $X_{\!\scriptscriptstyle 11})$ , take about 41% of the total information, we know that success rate of brand extension to a great extent has a close relationship with the product and product channel, therefore, we should pay attention to the development of the product, the quality and the product distribution channels in brand extension. The fourth principal component consists of brand communication ( $X_{\!\scriptscriptstyle 1}$ ) and brand association ( $X_{\!\scriptscriptstyle 14}$ ), it reflects the consumer's awareness of brand. Therefore, compared with foreign brands, consumers are relatively weak in brand communication and brand association.
- (4) From Table 4, the first principal component has a high relevance with product style ( $X_9$ ), after-sale service ( $X_6$ ), product quality ( $X_4$ ), product function ( $X_5$ ), channel sharing ( $X_7$ ), channel terminal advantage( $X_{11}$ ), take about 41% of the total information, so the first principal component includes product advantage and channel advantage. The second principal component has a high relevance with brand awareness ( $X_{12}$ ), brand loyalty( $X_{13}$ ), brand recognition( $X_{10}$ ), takes 18% of the total, so the second principal component is brand equity. The third principal component reflects the capacity indicators of the enterprise, it consists of research and development capacity ( $X_2$ ), production capacity( $X_8$ ), operation capacity( $X_3$ ) of the enterprise. The fourth principal component consists of brand communication( $X_1$ ) and brand association( $X_{14}$ ), it reflects the

consumer's awareness of brand. Through the empirical analysis of the influence factors of brand extension of G brand, we find that the empirical results correspond with the ecological law besides tare individual<sup>[9]</sup>.

#### 4 Discussion

To sum up, in order to constantly improve the brand awareness and the success rate of the brand extension, it is necessary for enterprise to increase the relevant investment and pay attention to the environment construction of brand. Enterprise also need to pay attention to the construction of the channels besides the product, , it should be the focus of brand extension. After brand extension, enterprises should timely feedback all kinds of information of brand extension from consumers and adjust the market strategy of extending the product through these information. And the enterprises also need to have a strategic adjustment multi-dimensional and multi-level from the angle of product channel, brand equity, enterprise's capacity index and brand communication and make the product extension meet the consumers' demands<sup>[7]</sup>.

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gray model can extend from the initial value to any time in future and provides basis for the long – term planning of food output. However, as time goes on, future factors will access to the system and affect the prediction results. Therefore, it is impossible to achieve the degree of complete whitening due to the impact of climate national policy and other uncertainties. We can only obtain a level within a certain range, that is, the level within gray boundary.

#### 3 Conclusion and discussion

The Construction of Henan Grain Production Core Region of National Grain Strategic Project, put forward by Henan Province at August, 2008, pointed out that grain output will be improved from 50 billion kilograms at present to 65 billion kilograms in the year 2020. Thus, Henan Province becomes an important core area of food production in China and has made greater contribution to ensure the national grain security<sup>[3]</sup>. The expected target can be divided into three stages. Firstly, grain output reaches 55 billion kilograms in the year 2010 and the added value of primary industry achieves 250 billion yuan according to the price in the year 2007. Per capita net income of farmers reaches 5 000 yuan and the Engel coefficient in rural areas becomes 35%. Secondly, until the year 2015, grain output reaches 60 billion kilograms and the added value of primary industry grows to 300 billion yuan. Per capita net income of

farmers reaches 7 000 yuan and the Engel coefficient in rural areas becomes 32%. Thirdly, grain output reaches 130 billion kilograms in the year 2010 and the added value of primary industry achieves 370 billion yuan. Per capita net income of farmers reaches 10 000 yuan and the Engel coefficient in rural areas becomes 30%.

According to the forecast result of gray model, grain output in Henan Province will reach 51 988 thousand tons in the year 2010 (about 52.00 billion kilograms). In the year 2015, annual output will reach 58 595 thousand tons (about 58.60 billion kilograms). In the year 2020, it is forecasted that the grain output of Henan Province will achieve 66 042 thousand tons (about 66.05 billion kilograms). Therefore, it can be concluded that the planning target is feasible. And it can be realized if there is no major accidents (natural disasters, etc.) during this period.

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### 河南省粮食生产能力预测

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摘要 首先,介绍了河南省粮食生产现状,指出河南省粮食生产的飞速发展既解决了河南省人民的温饱问题,支持了工农业生产发展,保持了全社会大局稳定,又为保障国家的粮食安全作出了巨大贡献。其次,考虑到研究对象为小样本、贫信息的不确定信息,对数据及其分布的限制要求少,一般利用时间序列数据,通过 GM(1,1)模型进行灰色预测。为确保所建立的灰色模型有较高的精度并应用于实践预测,该研究采用残差检验法。再次,选用 1996~2008 年河南省粮食产量数据,建立河南省粮食产量灰色预测模型,经灰色系统建模软件运算得到模拟及预测结果,表明河南省粮食产量在今后的发展中仍将呈现平稳攀升的态势,反映了粮食产量变化的规律。最后,规划将预测目标分为3个阶段,通过分析指出,规划目标切合实际,具有可行性。

关键词 粮食生产;灰色预测;粮食增产

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## 基于生态特征驱动的品牌延伸规模模型实证分析

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摘要 首先,建立了品牌延伸规模模型,采用边际分析法分析品牌延伸规模模型的最优解。其次,采用问卷调查法对 G 品牌的品牌延伸情况进行调研,调查共发放问卷 240 份,收回 211 份,其中有效问卷 187 份,以此来检验品牌延伸规模模型中各因素的影响程度;同时采用层次分析法分析品牌延伸规模的大小,采用主成分分析找出影响 G 品牌进行品牌延伸的主要因素。最后,进行了基于生态特征的品牌延伸规模模型实证分析,结果表明,通过主成分分析方法得出的各主成分反映出的全部信息的顺序与采用层次分析法分析得出的顺序有所不同;随着消费者生活水平的不断提高,人们对购买产品的方便性和购物环境的舒适程度的关注度日渐提高,为此品牌企业要加强品牌种群的环境建设,满足消费者日益提高的物质文化需求;企业品牌延伸的成功率很大程度上与产品本身及产品渠道关系紧密,与国外品牌相比,消费者对企业产品品牌的传播、品牌联想相对较弱。

关键词 模型;规模;实证;品牌延伸;生态特征