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Analytic hierarchy process and research on tax incentive policies to enterprise innovation performance influence

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ABSTRACT

Nowadays, economic construction is primary mission of China. However main impetus that drives Chinese economic continuous development is from Chinese economic structural innovation, from which innovation on enterprises is core of impetus. To find out tax incentive policies influential aspects on enterprise innovation, the paper according to analytic hierarchy process, it gets that in case considering the structure of enterprise network, technical system, enterprise policy and social resources as well as other influence factors, tax incentive policies to enterprise innovation performance influence links are mainly as income tax preferential, the transformation of scientific achievements, technology and equipment updates such three links. Therefore, it gets Chinese tax incentive policies most influential link on enterprise innovation performance, and makes Chinese economic development corresponding policies for these links.

KEYWORDS

Tax incentive policies; Enterprise innovation; Analytic hierarchy process; Performance assessment; Economic structure.

INTRODUCTION

Whether a country comprehensive strength is strong or not is up to how the nation economic development is to a great aspect. The cause is economic base decides superstructure; first step to develop a country is strengthening economic construction, and driving national other aspects development by developing economy. Therefore under our party's correct guiding, China now is centered on economic development, makes all-round development of every aspect, and builds a prosperous, democratic, civilized and harmonious socialist harmonious society.

Due to in Chinese economic structure, enterprise takes very important positions, regards enterprises as innovation subjects are main impetuses of Chinese economic advancement. However, due to China is still in the initial phase of socialism, domestic most enterprises have not their own core techniques, therefore they still have strong attachment on foreign enterprises and techniques, and domestic most enterprises lack of innovation capacity. And due to enterprises economic characteristics that lead to Chinese market resources cannot arrive at optimization allocation. In this case, nation should incent enterprise innovation by some beneficial policies, from which tax incentive is a kind of effective incentive way. In order to more clearly understand tax incentive influence on enterprise innovation, the paper will analyze and research on the issue.

MODEL ESTABLISHMENTS

Construct hierarchical structure

To find out tax incentive policies influence on enterprise innovation performance, firstly it should find out tax incentive policies most influential links on enterprise innovation that is to find out tax incentive policies to enterprise innovation performance main influence aspects. And then, the paper bases on analytic hierarchy process to make quantization on tax incentive policies to enterprise innovation performance most influential links. After that, establish target layer, criterion layer and scheme layer relations.

Target layer

The incentive of the most influential

Criterion layer

Scheme influence factors, Y_1 is the structure of enterprise network, Y_2 is technical system, Y_3 is enterprise policy, Y_4 is social resources.

Scheme layer

V_1 is income tax preferential, V_2 is the transformation of scientific achievements, V_3 is technology and equipment updates, it gets hierarchical structure as Figure 1 shows.

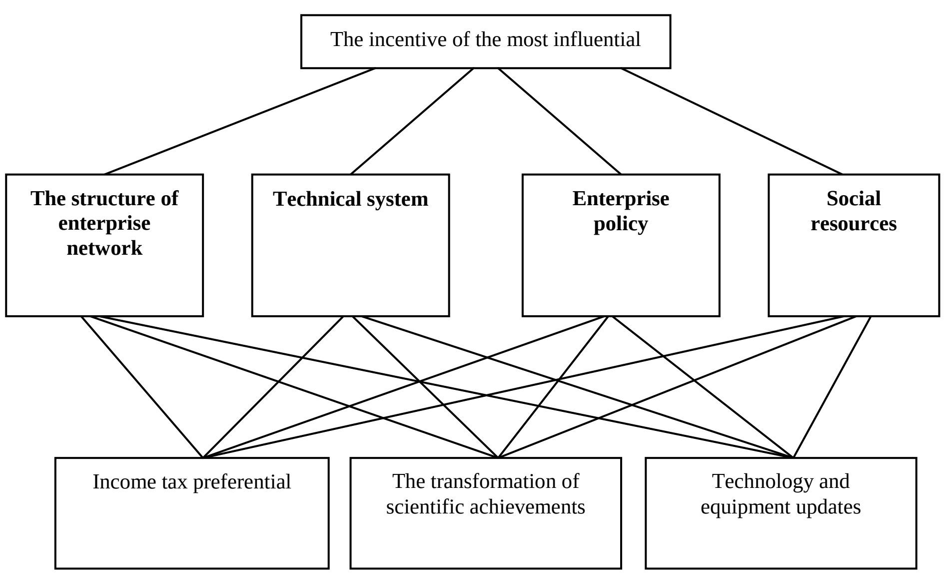

Figure 1 : Hierarchical structure

Construct judgment matrix

In order to get each factor comparison quantified judgment matrix, here set 1~9 scale, as TABLE 1 shows.

TABLE 1 : 1~9 scale table

Scale a_{ij}	Definition
1	factor i and factor j have equal importance
3	factor i is slightly more important than factor j
5	factor i is relative more important than factor j
7	factor i is extremely more important than factor j
9	factor i is absolute more important than factor j
2, 4, 6, 8	Indicates middle state corresponding scale value of above judgments
Reciprocal	If i factor compares to j factor, it gets judgment values is, a_{ji} =1/ a_{ij} , a_{ii} =1

Now set a_{ij} to represent ratio of β_i and β_j to G influence, and get judgment matrix A, in the paper set judgment matrix between layer two and layer one is A_1, element a_{ij}, divisor α_i, α_j, factor is A_1, then it has following formula showed judgment matrix A_1:

$$A_1 = \begin{bmatrix} A_1 & \alpha_1 & \alpha_2 & \alpha_3 & \alpha_4 \\ \alpha_1 & a_{11} & a_{12} & a_{13} & a_{14} \\ \alpha_2 & a_{21} & a_{22} & a_{23} & a_{24} \\ \alpha_3 & a_{31} & a_{32} & a_{33} & a_{34} \\ \alpha_4 & a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$

And in above formula, for a_{ij} values defining, we generally adopt 1~9 proportion scale to assign value on influence extent, as Figure 2 shows.

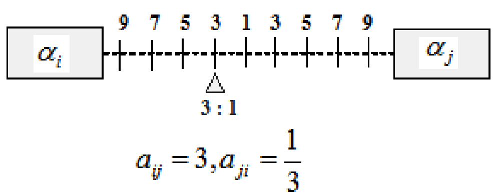

Figure 2 : Nine scale assignment schematic diagram

According to lots of experts experiences and refer to lots of documents as well as 1~9 scale setting, it gets paired comparison matrix that are respective as TABLE 2-6.

TABLE 2 : Comparison matrix G

G	Y_1	Y_2	Y_3	Y_4
Y_1	1	1/5	5	4
Y_2	5	1	5	4
Y_3	1/5	1/5	1	1
Y_4	1/4	1/4	1	1

TABLE 3 : Comparison matrix Y_1

Y_1	V_1	V_2	V_3
V_1	1	1	1/5
V_2	1	1	1/5
V_3	5	5	1

TABLE 4 : Comparison matrix Y_2

Y_2	V_1	V_2	V_3
V_1	1	4	4
V_2	1/4	1	3
V_3	1/4	1/3	1

TABLE 5 : Comparison matrix Y_3

Y_3	V_1	V_2	V_3
V_1	1	3	4
V_2	1/3	1	5
V_3	1/4	1/5	1

TABLE 6 : Comparison matrix Y_4

Y_4	V_1	V_2	V_3
V_1	1	6	5
V_2	1/6	1	4
V_3	1/5	1/4	1

Consistency test

Use consistency indicator test formula as: $CI = \dfrac{\lambda_{\max} - n}{n-1}$. From which $\lambda_{\max}$ is comparison matrix maximum feature value; n is comparison matrix order. It is clear that judgment matrix is inversely proportional to CI value.

$$C = \begin{Bmatrix} 1 & 1/5 & 5 & 4 \\ 5 & 1 & 5 & 4 \\ 1/5 & 1/5 & 1 & 1 \\ 1/4 & 1/4 & 1 & 1 \end{Bmatrix}$$

$$\xrightarrow{\text{Column vector normalization}} \begin{Bmatrix} 0.155 & 0.114 & 0.417 & 0.4 \\ 0.775 & 0.571 & 0.417 & 0.4 \\ 0.031 & 0.114 & 0.083 & 0.1 \\ 0.039 & 0.143 & 0.083 & 0.1 \end{Bmatrix}$$

$$\xrightarrow{\text{Solve sum by line}} \begin{Bmatrix} 1.086 \\ 2.163 \\ 0.328 \\ 0.365 \end{Bmatrix}$$

$$\xrightarrow{\text{Normalization}} \begin{Bmatrix} 0.275 \\ 0.549 \\ 0.083 \\ 0.093 \end{Bmatrix} = W^{(0)}$$

$$CW^{(0)}=\begin{Bmatrix}1 & 1/5 & 5 & 4\\ 5 & 1 & 5 & 4\\ 1/5 & 1/5 & 1 & 1\\ 1/4 & 1/4 & 1 & 1\end{Bmatrix}\begin{Bmatrix}0.275\\0.549\\0.083\\0.093\end{Bmatrix}=\begin{Bmatrix}2.752\\5.459\\1.183\\1.196\end{Bmatrix}$$

$$\lambda_{\max}^{(0)}=\frac{1}{4}\left(\frac{2.752}{0.275}+\frac{5.459}{0.549}+\frac{1.183}{0.083}+\frac{1.196}{0.093}\right)=4.32$$

$$w^{(0)}=\begin{pmatrix}0.260\\0.515\\0.112\\0.113\end{pmatrix}$$

Judgment matrix is:

$$C_1=\begin{Bmatrix}1 & 1 & 1/5\\ 1 & 1 & 1/5\\ 5 & 5 & 1\end{Bmatrix},C_2=\begin{Bmatrix}1 & 4 & 4\\ 1/4 & 1 & 3\\ 1/4 & 1/3 & 1\end{Bmatrix},C_3=\begin{Bmatrix}1 & 3 & 4\\ 1/3 & 1 & 5\\ 1/4 & 1/5 & 1\end{Bmatrix},C_4=\begin{Bmatrix}1 & 6 & 5\\ 1/6 & 1 & 4\\ 1/5 & 1/4 & 1\end{Bmatrix}$$

Corresponding maximum feature value and feature vector in successive are:

$$\lambda^{(1)}{}_{\max}=4.43,w^{(1)}{}_1=\begin{Bmatrix}0.345\\0.345\\0.424\end{Bmatrix}$$

$$\lambda^{(2)}{}_{\max}=4.52,w^{(1)}{}_2=\begin{Bmatrix}0.526\\0.269\\0.058\end{Bmatrix}$$

$$\lambda^{(3)}{}_{\max}=2.30,w^{(1)}{}_3=\begin{Bmatrix}0.652\\0.230\\0.103\end{Bmatrix}$$

$$\lambda^{(4)}{}_{\max}=3.61,w^{(1)}{}_4=\begin{Bmatrix}0.614\\0.240\\0.148\end{Bmatrix}$$

According to $CI=\frac{\lambda_{\max}-n}{n-1}$ it gets RI value that can refer to TABLE 7.

TABLE 7 : RI value

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

For judgment matrix C, $\lambda^{(0)}{}_{\max}=4.52,RI=1.01$

$$RI=\frac{4.52-4}{4-1}=0.17$$

$$CR = \frac{CI}{RI} = \frac{0.17}{1.01} = 0.017 < 0.1$$

It shows C inconsistency degree within permissible range, at this time it can use C feature vector to replace weight vector. Similarly, to judgment matrix C_1, C_2, C_3, C_4, all passed consistency test by using above principle. Therefore, calculation results from object layer to scheme layer can refer to Figure 3.

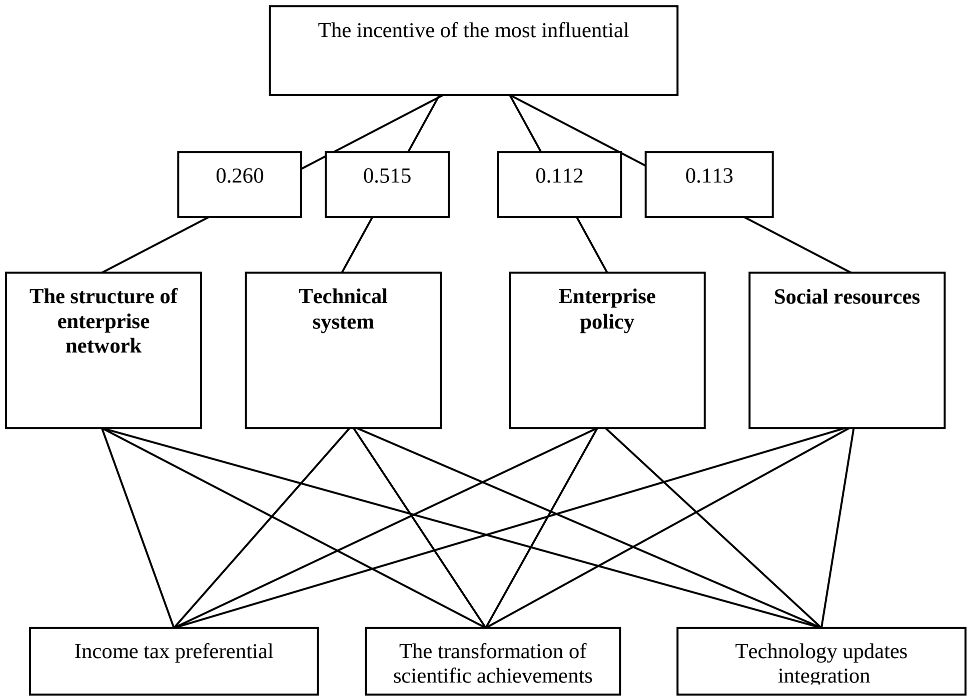

Figure 3 : Target layer to scheme layer calculation result

$$\begin{Bmatrix} 0.345 \\ 0.345 \\ 0.424 \end{Bmatrix}, \begin{Bmatrix} 0.526 \\ 0.269 \\ 0.058 \end{Bmatrix}, \begin{Bmatrix} 0.652 \\ 0.230 \\ 0.103 \end{Bmatrix}, \begin{Bmatrix} 0.614 \\ 0.240 \\ 0.148 \end{Bmatrix}$$

Calculation structure is as following:

$$\begin{aligned} w^{(1)} &= (w_1^{(1)}, w_2^{(1)}, w_3^{(1)}, w_3^{(1)}) \\ &= \begin{Bmatrix} 0.345 & 0.526 & 0.652 & 0.614 \\ 0.345 & 0.269 & 0.230 & 0.240 \\ 0.424 & 0.058 & 0.103 & 0.148 \end{Bmatrix} \end{aligned}$$

$$\begin{aligned} w &= w^{(1)} w^{(0)} \\ &= \begin{Bmatrix} 0.345 & 0.526 & 0.652 & 0.614 \\ 0.345 & 0.269 & 0.230 & 0.240 \\ 0.424 & 0.058 & 0.103 & 0.148 \end{Bmatrix} \begin{Bmatrix} 0.260 \\ 0.515 \\ 0.112 \\ 0.113 \end{Bmatrix} \\ &= \begin{Bmatrix} 0.445 \\ 0.286 \\ 0.269 \end{Bmatrix} \end{aligned}$$

By above analysis, it is clear that Chinese tax incentive policies influence on enterprise innovation performance have various aspects. According to analytic hierarchy process, it gets in case considering the structure of enterprise network, technical system, enterprise policy and social resources as well as other influence factors, tax incentive policies to enterprise innovation performance influence links are mainly as income tax preferential, the transformation of scientific achievements, technology and equipment updates such three links, the proportions are respectively 0.445、0.286 and 0.269. Therefore, it gets Chinese tax incentive policies most influential link on enterprise innovation performance, and makes Chinese economic development corresponding policies for these links.

CONCLUSION

The paper firstly analyzes national economic development required main impetus that is enterprise innovation system. And then according to analytic hierarchy process, it gets in case considering the structure of enterprise network, technical system, enterprise policy and social resources as well as other influence factors, tax incentive policies to enterprise innovation performance influence links are mainly as income tax preferential, the transformation of scientific achievements, technology and equipment updates such three links, the proportions are respectively 0.445、0.286 and 0.269. Therefore, it gets Chinese tax incentive policies most influential link on enterprise innovation performance, and makes Chinese economic development corresponding policies for these links.

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