ISSN : 0974 - 7435 Volume 10 Issue 21

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(21), 2014 [13313-13321]

Evaluation of competitive advantage of independent intellectual property rights for high-tech industry

Chen Heng[1], He Ping[2]*, Yang Zaoli[3], Li Jinqiu
School of Economics and Management, Harbin Engineering University, Harbin, 150001,China
* E-mail: 87048819@qq.com

ABSTRACT

High-tech industry belongs to technology-intensive industry, which is driven by technology innovation, combining with the characteristics of high-tech industry, based on the improved entropy method and catastrophe progression method, a high-tech industry competitive advantage evaluation model of independent intellectual property rights was constructed. Based on the evaluation index system of R&D input and patent output, according to data obtained, average processed evaluation value that from 2005 to 2012 the national 29 provinces and regions' competitive advantage of independent intellectual property rights for high-tech industry, then estimated the average level to determine the advantages regions and disadvantages regions based on competitive advantage of independent intellectual property rights for high-tech industry, on the basis we put forward the corresponding countermeasures.

KEYWORDS

Patent information; High-tech industry; Independent intellectual property rights; Competitive advantage.

INTRODUCTION

High-tech industry is a national strategic industry, which plays an extremely important role in national defense and national economy construction. Since the high-tech industry has characteristics of strategic and particularity, countries all over the world had always attached great importance to the development of high-tech industry. With the rapid development of China's national economy, economic restructuring and industrial upgrading, high-tech industry independent intellectual property rights competitive advantage has become the key to cultivate the country's core competitiveness and develop long-term national economy. Therefore, constructing the evaluation index system and model of high-tech industry independent intellectual property rights competition advantage, based on the patent information to evaluate the competitive advantage of high-tech industry independent intellectual property rights, for the improvement of competitive advantage of high-tech industry independent intellectual property rights, the promotion of industrial structure adjustment and optimization, achieving the sustainable development of national economy has important theoretical and practical significance.

EVALUATION MODEL FORMULATION

Calculation of index weight based on improved entropy method

Catastrophe theory was first proposed by Renethom the French mathematician in 1972. Catastrophe theory researches on the phenomena and laws that the transition from a stable configuration to another stable configuration. Catastrophe theory put forward a series of mathematical models to explain the process of discontinuous change occurs in nature and social phenomena, which is a mathematical theory describes various phenomena that a series of quantitative changes cause leap qualitative changes process[1-2]. According to the evaluation purpose, multi-level group for evaluation objectives, and constitute an inverted tree-like objective hierarchy structure, which is from the evaluation objective gradually decomposed to lower level indexes, until the lowest sub-indexes. In the process, we just need to know raw data of sub-indexes in the lowest level. Generally, control variables of state variables are no more than four in catastrophe system, therefore the number of decomposition of indexes in each level (sub-index of single index) is not more than four accordingly[3]. According to the catastrophe progression method, the evaluation objective is decomposed into a number of indexes, and sub-indexes of each above level are sorted left to right in terms of their importance, for the evaluation index of the same level in catastrophe progression method, the relatively more important indexes are ranked in the front, the less important ones are ranked at the back. To overcome the subjectivity of each index sorting, we use improved entropy method to calculate the index weight. Improved entropy method is a relatively precise objective weighting method, which can avoid subjectivity problem in the index weight distribution and ensure the order of each index in consistent with relatively their importance. The steps of determining the weight with improved entropy method are as follows[4]:
The following index standardization procedure to non-dimensionalize the original data:

$$x'_{ij} = \frac{x_{ij} - x_j}{\sigma_j} \tag{1}$$

In the above formula, x'_{ij} represents the value after quantify, x_{ij} refers to the original data of index j for evaluation object i, x_j is the mean of evaluation index j, σ_j is the standard deviation of evaluation index j. Secondly, to eliminate the negative effects of the dimensionless quantitative values, we need pan x'_{ij}, the process equation as follows:

$$x''_{ij} = x'_{ij} + D \tag{2}$$

In the formula (2), x''_{ij} is the value of index after panning; D represents the range of panning; Again, according to x''_{ij} calculate q_{ij} the proportion of every index:

$$q_{ij} = \frac{x''_{ij}}{\sum_{i=1}^{m} x''_{ij}} \tag{3}$$

Finally, based on the value of r_{ij} calculate e_j the entropy value of index j:

$$e_i = -\frac{1}{\ln m}\sum_{i=1}^{m} \ln r_{ij} \tag{4}$$

Thus, w_j which represents the weight of index j is concluded:

$$w_j = \frac{1-e_j}{\sum_{j=1}^{n}(1-e_j)} \quad (5)$$

For multilayer structure of evaluation index, add up the index utility values of the lower layer to get that of the upper layer, and then get index weights of the upper layer corresponding.

Determine mutation system model

Catastrophe progression method is on the basis of the elementary mutation model and its bifurcation equation, obtained a normalized model by derivation, and then applied normalized model gradual upward to calculate the index values of the next higher level of index system, until finally index values of the highest level are calculated. The normalized models of three kinds of mutation models which are commonly used (cusp mutation, swallowtail mutation and butterfly mutation) are as follows:

(1)Normalized model for cusp mutation

Based on the decomposition of bifurcation equations for cusp mutation, the formula are given as follows:

$$x_u = \sqrt{\frac{u}{-6}} \quad x_v = \sqrt[3]{\frac{v}{8}} \quad (6)$$

Where x_u represents the x value of u, and x_v corresponding to x value of v.

In order to facilitate the practical operation in mutation model, state variables x and control variables u, v must be limited ranging between 0-1.

When, then $u = 6$, if narrows u six-fold so that its range is between 0-1, i.e.

$$u = 1*6, x_u = \sqrt{\frac{u}{-6}} = \sqrt{u} \quad (7)$$

Similarly, narrow v eight-fold, and control v between 0-1, then

$$x_v = \sqrt{\frac{v}{8}} = \sqrt[3]{v} \quad (8)$$

Thus the normalized model of cusp mutation can be expressed as：

$$x_u = \sqrt{u} \quad x_v = \sqrt[3]{v} \quad (9)$$

(2)Normalization model for swallowtail mutation

Similarly, normalization model of swallowtail mutation is:

$$x_u = \sqrt{u} \quad x_v = \sqrt[3]{v} \quad x_w = \sqrt[4]{w} \quad (10)$$

(3)Normalized model for butterfly mutation

The same method can be used to deduce normalized model of butterfly mutation as follows:

$$x_u = \sqrt{u} \quad x_w = \sqrt[4]{w} \quad x_t = \sqrt[5]{t} \quad (11)$$

In the above formula x, u, v, w, t are in the range between 0 and 1, respectively.

The multi-objective fuzzy decision theory, on the same scenario, in the case of multiple objectives, such as set $A_1, A_2, ..., A_m$ for fuzzy goals, then the ideal strategy is: $C = A_1 \cap A_2 \cap ... \cap A_m$, its membership function is:

$u(x) = uA_1(x) \wedge uA_2(x) \wedge \ldots \wedge uA_m(x)$, where $uA_i(x)$ is the membership function of A_i, which is defined the membership function of scenario, i.e., the minimum of each objective membership function[6-9].

For different scenarios, such as set $G_1, G_2, \ldots, G_n$ express membership function of G_i as $u(G_i)$, according to the principle of "complementary" and "non-complementarity", obtain the total value of the mutation membership function. If the role between the control variables of system cannot replace each other, that is a weak correlation between the control variables, then in terms of the "non-complementary criteria", namely "mini-max" principle to process value; if all the control variables of the system can make up for theirs shortcomings with each other, that is showing a strong correlation between the control variables, then use the mean substituted, according to the principle of "complementary norms", namely " fetch big in small " principle to process value. Sort the evaluation object according to the size of the total evaluation score. Only follow the above principles, in order to meet the requirements of point set of bifurcation equation in mutation progression method.

EMIPIRICAL ANALYSIS

Data collection

The main purpose of evaluation of the competitive advantage for high-tech industry was to better understand the competitive advantage situation of high-tech industry. Through empirical researching on competitive advantage of high-tech industry, established a better, more scientific and more reasonable evaluation index system. By empirical analysis, to inspect the constructed evaluation model of competitive advantage for high-tech industry and the evaluation results under the perspective of patent information, which lay the foundation for evaluation activities of competitive advantage for high-tech industry under the perspective of patent information.

In this paper, the data were mainly from "China Statistical Yearbook (2005-2012)", "China IPR Yearbook (2005-2012)", "Chinese high-tech industry statistical Yearbook (2005-2012)" and the National Bureau of Statistics, the National intellectual Property Office, Ministry of Science and technology and other portals, etc. Through a lot of mathematical operation, get index values of 29 provinces, municipalities (because of two provinces including Tibet and Qinghai had more data missing, not included in the analysis category) in mainland of China.

Establishment of the index weights

TABLE 1 : Data of each index after standard normalization from the year 2005 to 2011

Index / Year	Staff full-time equivalents for R&D (person*year)	Proportion of R&D practitioners accounted for the number of total personnel in the industry	Industry annual internal appropriation of R&D (10^4yuan)	Proportion of R&D investment of government accounted for R&D funding (10^4yuan)	The number of annual owned invention patents	The number of patent applications	The annual output values of new products (10^4yuan)
2005	-1.13138	-0.42433	-1.0679	-1.02981	-0.92783	-1.10353	-1.20727
2006	-1.00385	-0.42988	-0.81556	-1.20044	-0.87404	-0.85482	-0.91122
2007	-0.52647	-0.39338	-0.57679	-0.55901	-0.68381	-0.51283	-0.46911
2008	-0.22952	2.26538	-0.28164	0.5918	-0.30192	-0.3372	0.00731
2009	0.6097	-0.33287	0.35478	0.49579	0.32391	0.73077	0.14511
2010	0.6891	-0.38189	0.55815	0.09518	0.65019	0.33791	0.7146
2011	1.59243	-0.30303	1.82895	1.6065	1.8135	1.73971	1.72057

Based on improved entropy method calculated the weight values of each index in the evaluation system, researching on competitive advantage of intellectual property rights for high-tech industry, the overall national data from the year 2005 to 2011 were the basis of weight calculation, using formulas (1) calculated the normalized values of each index that were shown in TABLE 1; By the formula (2) and (3), calculated the proportions of each index which were shown in TABLE 2; After obtaining standardized values and proportions of each index, by the formula (4) and (5) obtained the weight of each index were shown in TABLE 3.

Evaluation of competitive advantage of independent intellectual rights for high-tech industry

Calculated the weights of each index and ranked them, thus based on the mutation progression method under the perspective of patent information evaluating competitive advantage of independent intellectual rights for high-tech industry in order to determine a well order of control variables. For example, we used the data in 2012, evaluated the competitive advantage of independent intellectual rights for high-tech industry in 29 provinces of China. To avoid differences that brought by different dimensionless statistics units of evaluation index, according to the requirements of catastrophe theory, need to translate the original data of control variables into the numerical values in interval as [0,1], thereby using the formula (12) standardization processed with the data of each index[5]:

TABLE 2 : Proportions of each index from the year 2005 to 2011

Index / Year	Staff full-time equivalents for R&D (person*year)	Proportion of R&D practitioners accounted for the number of total personnel in the industry	Industry annual internal appropriation of R&D (10^4yuan)	Proportion of R&D investment of government accounted for R&D funding (10^4yuan)	The number of annual owned invention patents	The number of patent applications	The annual output values of new products (10^4yuan)
2005	0.035107	0.102445	0.041152	0.04478	0.054492	0.037759	0.02787907
2006	0.047252	0.101916	0.065185	0.028529	0.059615	0.061446	0.05607434
2007	0.092717	0.105392	0.087925	0.089618	0.077732	0.094016	0.09818009
2008	0.120998	0.358608	0.116034	0.199219	0.114103	0.110743	0.14355347
2009	0.200924	0.111155	0.176646	0.190075	0.173706	0.212454	0.15667729
2010	0.208486	0.106487	0.196014	0.151922	0.20478	0.175039	0.21091449
2011	0.294517	0.113997	0.317043	0.295857	0.315571	0.308544	0.30672124

TABLE 3 : Weight of each index

Competitive advantage of independent intellectual property rights for high-tech industry	Input index (A) 0.49	staff full-time equivalents for R&D (A_1)	0.27
		proportion of R&D practitioners accounted for the number of total personnel in the industry (A_2)	0.20
		industry annual internal appropriation of R&D (A_3)	0.25
		proportion of R&D investment of government accounted for R&D funding (A_4)	0.28
	Output index (B) 0.51	the number of annual owned invention patents (B_1)	0.32
		the number of patent applications (B_2)	0.33
		the annual output values of new products (B_3)	0.35

$$y_{ij} = \frac{x_{ij} - \min\limits_{1\le j\le n} x_{ij}}{\max\limits_{1\le j\le n} x_{ij} - \min\limits_{1\le j\le n} x_{ij}}, i = 1,2,\cdots,m; j = 1,2,\cdots,n \tag{12}$$

In the above formula, it represents the number of evaluation indexes, and j is the number of the evaluation objects. According to the formula (12) normalization processed the data in 2012 and the results are shown in TABLE 4. Through application of the above calculation steps of catastrophe progression method, we can get evaluation values of competitive advantage for high-tech industry in National provinces from 2005 to 2012, as shown in TABLE 5. TABLE 5 showed evaluation values of competitive advantage of independent intellectual property rights for high-tech industry based on patent information in the 29 major provinces of China.

RESULT AND DISSCUSS

We made a comparison of the main provinces including three northeastern provinces, several western provinces and eastern developed provinces in development trends of competitive advantage of independent intellectual rights for high-tech industry, the comparison results was shown in Figure 1:

TABLE 4 : Data of evaluation indexes after standardizing

Index / Year	Staff full-time equivalents for R&D (person*year)	Proportion of R&D practitioners accounted for the number of total personnel in the industry	Industry annual internal appropriation of R&D (10^4yuan)	Proportion of R&D investment of government accounted for R&D funding (10^4yuan)	The number of annual owned invention patents	The number of patent applications	The annual output values of new products (10^4yuan)
Beijing	0.099389	0.8183097	0.152956	1	0.090688	0.157644	0.206751
Tianjin	0.057296	0.4653005	0.065395	0.491238	0.038888	0.069601	0.0989
Hebei	0.035556	0.3745744	0.023077	0.109199	0.010364	0.012541	0.010257
Shanxi	0.007683	0.0553664	0.004149	0.144407	0.002945	0.00524	0.00338
Neimenggu	0	0	0	0	0.000332	0.000661	0.000317
Liaoning	0.037977	0.4310273	0.118596	0.304719	0.020861	0.033732	0.04572
Jilin	0.018178	0.2766748	0.011712	0.085127	0.005492	0.008318	0.009151
Heilongjiang	0.033924	0.9602427	0.034469	0.215527	0.010564	0.014347	0.006359
Shanghai	0.104992	0.3002335	0.147832	0.224171	0.07926	0.12727	0.135149
Jiangsu	0.444015	0.301652	0.437267	0.310968	0.151323	0.38812	0.491099
Zhejiang	0.231846	0.7617283	0.179598	0.588272	0.103089	0.183541	0.162547
Anhui	0.045403	0.8966398	0.041901	0.486398	0.014816	0.057517	0.040405
Fujian	0.125434	0.6842339	0.10839	0.679692	0.025202	0.060595	0.152697
Jiangxi	0.041662	0.2725658	0.032704	0.154466	0.008925	0.013559	0.019774
Shandong	0.161986	0.5897333	0.204591	0.398221	0.05222	0.142025	0.192024
Henan	0.053416	0.1987013	0.026859	0.071345	0.012667	0.040244	0.018269
Hubei	0.099825	0.9434984	0.097391	0.332328	0.04365	0.045078	0.044864
Hunan	0.032296	0.3377433	0.040898	0.337128	0.017761	0.052022	0.040663
Guangdong	1	0.4593766	1	0.566085	1	1	1
Guangxi	0.011317	0.2273087	0.01203	0.094815	0.004939	0.005953	0.005495
Hainan	0.002002	0.6299352	0.001652	0.099456	0.001661	0.004681	0
Chongqing	0.023456	0.4093282	0.013401	0.620359	0.007574	0.023684	0.052434
Sichuan	0.034857	0.3145668	0.075558	0.3398	0.065131	0.049275	0.086542
Guizhou	0.021561	0.7034485	0.015739	0.349333	0.008991	0.015492	0.009219
Yunnan	0.009276	1	0.007263	0.407154	0.006533	0.006182	0.005313
Shanxi[2]	0.074669	0.7512958	0.096219	0.331756	0.024161	0.032663	0.027187
Gansu	0.003333	0.4464365	0.003433	0.370714	0.00093	0.002824	0.001719
Ningxia	0.000962	0.9936546	0.000342	0.815076	0	0.002213	0.001592
Xinjiang	0.001208	0.5855445	0.001914	0.542268	0.000133	0	0.000292

The above figure reflected that three northeastern provinces which were similar in several factors, such as geographical place, population size, and historical development not only had the same characteristics but also had difference. We can see from the figure, the development trend of competitive advantage of independent intellectual rights for high-tech industry in the three northeastern provinces under the perspective of patent information presented declining before 2010, after 2010 it grew up rapidly; from the evaluation value of the provinces in recent years, Liaoning was in the lead position of three northeastern provinces in competitive advantage of intellectual property rights for high-tech industry, followed by Heilongjiang province, Jilin province ranked in the final, the development situation of above-mentioned provinces was consistent with the actual development of high-tech industry.

TABLE 5 : Evaluation values of competitive advantage in provinces from 2005 to 2012

	2005	2006	2007	2008	2009	2010	2011	2012
Beijing	0.648938	0.605899	0.744624	0.672248	0.766492	0.708884	0.745531	0.747414
Tianjin	0.578761	0.584383	0.628966	0.49589	0.696517	0.596644	0.676138	0.639786
Hebei	0.518124	0.5258	0.583043	0.512661	0.609209	0.583017	0.578329	0.586033
Shanxi	0.473334	0.487305	0.216933	0.452218	0.522914	0.479398	0.487897	0.482558
Neimenggu	0.182848	0.384189	0.354509	0	0.101796	0.048763	0.141402	0.402515
Liaoning	0.634633	0.664414	0.660907	0.604577	0.646728	0.587794	0.623127	0.634859
Jilin	0.535983	0.553809	0.533291	0.481458	0.56955	0.495594	0.538364	0.554171
Heilongjiang	0.610193	0.61158	0.590646	0.571023	0.585469	0.555581	0.574854	0.565649
Shanghai	0.62064	0.682018	0.722147	0.58168	0.745326	0.740617	0.730948	0.724263
Jiangsu	0.63925	0.626617	0.704181	0.603059	0.805731	0.70443	0.726189	0.540019
Zhejiang	0.62091	0.649165	0.648718	0.518585	0.762366	0.671286	0.699495	0.652296
Anhui	0.55983	0.517562	0.565985	0.516992	0.611256	0.602162	0.633886	0.646164
Fujian	0.608687	0.594317	0.635155	0.487423	0.701902	0.615254	0.638085	0.31837
Jiangxi	0.587365	0.623827	0.613791	0.569789	0.6026	0.577278	0.590415	0.592714
Shandong	0.576641	0.594371	0.655214	0.535822	0.7272	0.686249	0.691326	0.654784
Henan	0.527159	0.577184	0.620881	0.508562	0.650927	0.610296	0.621419	0.590995
Hubei	0.600574	0.60943	0.659404	0.520496	0.686108	0.655635	0.679288	0.684386
Hunan	0.598406	0.572045	0.559207	0.538264	0.612273	0.600426	0.621328	0.626405
Guangdong	0.742735	0.730265	0.793037	0.671498	0.934662	0.817991	0.832412	0.709625
Guangxi	0.493146	0.520981	0.522213	0.435142	0.510748	0.485315	0.51215	0.512612
Hainan	0	0.069901	0.271191	0.080476	0.449752	0.400427	0.426078	0.469116
Chongqing	0.572402	0.549648	0.590211	0.504757	0.600795	0.577649	0.589519	0.578679
Sichuan	0.661611	0.665851	0.67935	0.573369	0.702008	0.644817	0.656065	0.680704
Guizhou	0.607397	0.615312	0.58878	0.570547	0.576691	0.58213	0.55977	0.579396
Yunnan	0.520821	0.509193	0.511655	0.468341	0.50467	0.48689	0.509523	0.520087
Shanxi[2]	0.684002	0.648147	0.693544	0.600219	0.585278	0.635127	0.645386	0.646422
Gansu	0.495976	0.476945	0.435958	0.469452	0.438785	0.445312	0.43788	0.462821
Ningxia	0.479651	0.450327	0.427209	0.429811	0.137974	0.382495	0.350175	0.363893
Xinjiang	0.169529	0.159803	0.154285	0.13922	0.156253	0.107432	0.101842	0

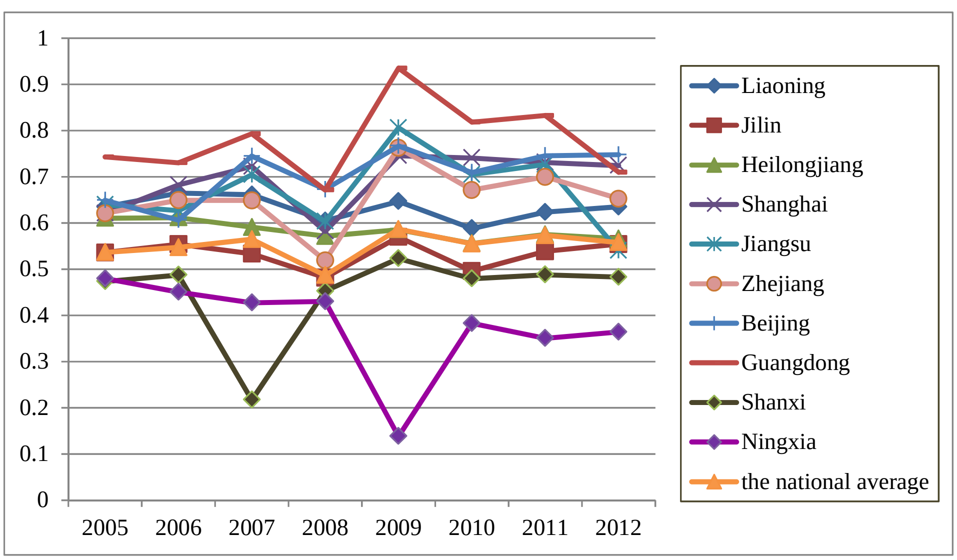

Figure 1 : Comparison for evaluation of competitive advantage in main provinces

In addition, we can see that the development of high-tech industry of western regions such as Shanxi, Xinjiang and Ningxia etc. was lower than the national average, and far behind in Shanghai, Jiangsu, Zhejiang, Beijing, Guangdong and other areas. From the development trend in recent years, the competitive advantage of independent intellectual rights for high-tech industry in western regions in a slow downtrend, but the growth trend is more obvious in eastern developed provinces, and both maintained a high level of development. In several eastern provinces, Guangdong was in an absolutely leading position in the competitive advantage of intellectual property rights for high-tech industry under the perspective of patent information, indicating Guangdong province had become a leader in high technology industry. Therefore three northeastern provinces and western regions had a large gap with the developed eastern provinces, particularly in Guangdong province.

To further study the evaluation results of competitive advantage of independent intellectual property rights for high-tech industry based on patent information, we made the process of value averaging on the evaluation of competitive advantage of independent intellectual property rights for high-tech industry from 2005 to 2012 in the country's 29 provinces and estimated the average level of development of those provinces in recent years, as shown in TABLE 6.

TABLE 6 : AVERAGE RANKING RESULTS OF EVALUATION

Province	rank	province	rank	province	rank	province	rank	province	rank
Guangdong	1	Shanxi^2	7	Hunan	13	Chongqing	19	Shanxi	25
Beijing	2	Shandong	8	Henan	14	Hebei	20	Ningxia	26
Shanghai	3	Hubei	9	Guizhou	15	Jilin	21	Hainan	27
Jiangsu	4	Liaoning	10	Heilong jiang	16	Yunnan	22	Neimenggu	28
Sichuan	5	Tianjin	11	Anhui	17	Guangxi	23	Xinjiang	29
Zhejiang	6	Jiangxi	12	Fujian	18	Gansu	24		

From TABLE 6 we can see that, for the average ranking result, the result is consistent with the level of the economy and technological development of each province. The top five are Guangdong, Beijing, Shanghai, Jiangsu and Sichuan, and the last five are Shanxi, Ningxia, Hainan, Neimenggu and Xinjiang province. The competitive advantage of independent intellectual property for high technology industry in each province has connection with its geographical position and economic development, but the connection is not an absolute link. For example, the high technology industry in Sichuan and Gansu province has a better performance in the evaluation of competitive advantage of the independent intellectual property rights (IIPRs). At the same time, competitive advantage of IIPRs of the high-tech industry in each province don't have necessary link with the area of each province. It also instructs that in the aspects of prompting the competitive advantage of the high technology industry's IIPRs, we can start from the aspects of government policy and the development of higher education. By doing all those, we can enlighten the competitive advantage of the high technology industry's IIPRs.

CONCLUSIONS

Considered the comparison between three northeastern provinces, several western provinces and developed eastern provinces in the horizontal perspective, with time going by, the gap between western provinces and the national average in the high-tech industry development was expanding, and the development trend of decline in high-tech industry in western provinces contrasted with developed eastern provinces was more apparent. Those showed that as a traditional northeast old industrial base, driven by the implementation strategy of revitalizing northeast old industrial base in the country, some industry received strong recovery and stimulating, but as a knowledge-intensive high-tech industry, of which development was relatively insufficient. In addition, from the statistical data of indicators in recent years, the data of the above indexes in the developed eastern provinces showed an increasing trend which was more obvious, and three northeastern provinces, several western provinces had a declining trend, which eventually led to the competitive advantage of independent intellectual property rights for high-tech industry situation in those provinces that committed to R&D investment and patent output was quite weak, much lower than Beijing, Shanghai, Guangdong and other developed provinces in the east.

ACKNOWLEDGEMENT

The research is supported by National Social Science Fund Project "Research on collaboration and industrial upgrading of strategic management system of regional intellectual property" (No.14BGL007), Natural Science Fund Project of Heilongjiang Province "Research on formation mechanism and evaluation method of continuous innovation ability for civil-military integration enterprise" (No.G201209) and National Soft Science Project "Study on the pattern of industry-academia cooperation to cultivate innovative talents" （No.2013GXS5B190).

REFERENCES

[1] K.William Innovation needs patents reform, Research Policy, **3,** 403-423 **(2001)**.
[2] H.Diana, B.Tony, O.Dominic, H.Kimberly; The changing composition of innovative activity in the US-a portrait based on patent analysis. Research Policy, **30,** 681-703 **(2001)**.
[3] Zhou Qiang, Zhang Yong; Research on performance evaluation of Green Supply Chain based on catastrophe progression method, China Population &Resources & Environment, **5,** 108–111 **(2008)**.
[4] Guo Xianguang; Improved entropy method and its application in economic evaluation, Systems Engineering Theory and Practice, **12,** 98 -102 **(1998)**.
[5] Li Bozhou, Su Yi; Research on evaluation of regional scientific and technological innovation ability based on improved catastrophe progression method, China Soft Science, **6,** 90-101 **(2012)**.
[6] D.E.Kash, W.Kingston; Pantents in the world of complex technologics, Master. s Thesis, Mason University, Mimco **(2000)**.
[7] K.Kusunoki, I.Nonaka, A.Nagata; Organizational capabilities in product development of Japanese firms: a conceptual framework and empirical findings, Organization Science, **9,** 699-718 **(1998)**.
[8] B.Jungwook et al.; Analysis of the factors to affect technology transfer fee in the intellectual property management, Portland, 2821-2833 **(2009)**.
[9] F.M.Scherer; The propensity to patent. International Journal of Industrial Organization, **1,** 107-128 **(1983)**.