Conclusion

Education cost efficiency can be used as an important measure index of the utilization effect of research university education resource. This paper uses DEA super-efficiency combined with DEA minimum cost to evaluate the education cost efficiency. According to the result of evaluation, we can promote the university education cost efficiency in specific aspects, and then we can make a reasonable control for the education cost.

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Scientometric analysis of researches in Chinese Universities

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Abstract

The performance evaluation results published by the Institute of Higher Education in December 2009 have attracted wide attentions worldwide. This paper explores find gap between Chinese universities and world-class as well as the gap among Chinese universities. Research performance is measured by taking the indicators, including the number of publications and patents, total cites , h-index received by each research institute. We discussed scaling relationships between number of citations and number of publications and patents.

Keywords: PERFORMANCE EVALUATION, BIBLIOMETRICSY, RANK, R&D EXPENDITURE (KEY WORDS)

1. Introduction

Increasing market-based orientation and international character of higher education institutions around the globe have led students, universities and governments to take a great interest in knowing the position that particular centre, university or other higher education entity have in comparison with other entities.

Quantitative and qualitative measure of input and output are frequently applied to construct performance indicators used to inform decision makers. Metrics, rather than peer review will be the focus of the new system and it is expected that bibliometrics (using counts of journal articles and their citations) will be the central quality index of the

System [1]. Bibliometric assessment of research performance is based on one central assumption: scientists, who have to say something important, do publish their findings vigorously in the open, international journal literature. This assumption unavoidably introduces a bibliometrically limited view of a complex reality. Up to 2005, the traditional bibliometric indicators were based on simple statistical functions, for instance, means, relative frequencies and quantiles. In 2005, a new indicator for the assessment of the research performance of scientists was proposed by Hirsch (2005) [2], intended to measure simultaneously the quality and sustainability of scientific output. The purpose of this paper is to evaluate and compare research performance of Chinese university, based on the numbers of publications and patents. The results of the assessment are aimed at guiding future directions for Chinese research in the country. Bibliometric statistics are used to evaluate the research quality and productivity of their faculty. With careers, funding, and individual, journal and institutional reputations at stake, the establishment of bibliometric indicators and standards has become vital [3].

This article mainly studies following questions: 1.China has risen to become the number two ranked nation in the world in terms of total number of scientific publications. However, what about the quality of the publications? 2. What about the correlation for patent counts versus paper counts? If have all universities with more papers have higher patents counts?

2. Data

Before 1987, few Chinese knew how many papers were published by Chinese scientists in the world and no one knew how many papers were published domestically. In July of 1987, the then Minister of the State Science and Technology Commission, which was renamed as the Ministry of Science and Technology in later years, directed the Institute of Scientific and Technical Information of China (ISTIC) to carry out such a paper count. As a result, China Scientific and Technical Papers and Citations (CSTPC), a database dedicated to the partial evaluation of research performance of Chinese scientists and engineers, initiated by ISTIC and sponsored by the Ministry of Science and Technology (then the State Science and Technology Commission) was born. It is based on representative domestic S & T journals. In 1988, CSTPC covered 1,189 journals while in 2000, the source journals totaled 1,411.

Unlike SCI, ISTIC counts all kinds of literature in a journal as long as it is accepted as source journal, who manually select papers to be processed into the database from all stuff in a given journal. The basic rules are as follows: For academic journals, all the scientific articles are selected. For engineering and technology journals, items to be selected are scientific articles and papers that explain new technology, new materials, new process and new products. No matter what kinds of journals, ISTIC hope that through such strict selection, the database would become better evaluation tools. Using Statistical Data of Chinese S&T Papers issued by China's scientific and technological information research institute (ISTIC), we valuate and compare research performance of Chinese university.

3. RESULTS AND DISCUSS

3.1. Quality vs. quantity

Invariably an evaluation of scientific activity of universities includes bibliometric measures of :

- P --- SCI-covered papers of a university in the specified period, which exclude the papers without received citation. We think low quality for the papers without received citation;
- C----number of citations to papers;
- CPP---average number of citations per publication;
- DPP--- Domestic average number of citation per publication, 5.2 times;
- WPP--- World average number of citation per publication, 10.06 times.

Top 20 universities ranked by total SCI-covered papers of a university in the studied period are given in Table1. As shown, there is substantial variation across universities in number of SCI-covered papers. This is largely due to difference in innovative capability and performance. In terms of total (P), Tsinghua university with a score of 14129 takes the first position, followed by Zhejiang university. On the other hand, with regard to the average number of citations per publication (CPP) in universities exhibits much less variation.

3.2. Patents statistics in Chinese universities

Technology innovation plays an important role to address sustainable development. Patents are the most commonly used indicator of technology change in the literature. As an acceptable proxy for innovative activity, patents have become increasingly important in recent years. Patents and patent citations have been used for construction of technology indicator [4]. The technological value of a patent can be captured through a patent count [5]. The more often a patent has been cited, the more technologically important it is , as that means it is playing significant roles in succeeding roles in succeeding innovations.

Table 2 displays the Chinese patents amounts corresponding above 20 universities.

- NP--- number of patents;
- MC--- maximum of citations to per patent;

Patent h-index: Like the h-index in bibliometrics, we define the h-index pertaining to patents, that is, the number h such that, for a general group of patents, h patents received at least h citations from later patents, while other patents received no more than h citations. The Derwent Innovation Index database offers a very simple way to determine the h-index of an assignee without any off-line data processing.

We can retrieve all patents of a given assignee in a given time span and sort them by citation up to the time of accessing the database. Here we accessed the database on December 17, 2009.Comparative analyses of 20 national university ranked by total publications are given in Table 1.

The number of patents for the 20 universities varies from 10,665 to 221,taking into account both the frequency of indicators and the assigned weights. As seen from Table 2, the two universities, Beijing university and Zhejiang university, with10,835 and 10,665 patents, occupy the first and second positions, respectively. China university of science and technology has 8534 SCI-covered papers, ranked 5th by patper counts, while sorted the 20th by patent counts, with a relatively low score of 221. Particularly, maximum of citations to per patent (MC), Tsinghua university rank number one on the list with a relatively far higher score of 87. h-index results further confirm the conclusion that Tsinghua university is the best university in China when we take account into the quantity and quality of innovation performance together.This conclusion is consistence with the appendix. Zhejiang university and Beijing university, with 22 and 18 MC , occupy the second and third positions, respectively. In terms of h-index, Beijing

Table 1. Top 20 universities ranked in descending order of P, 1999-2009.8

Univ	P	C	CPP	CPP/DPP	CPP/WPP
1	14129	110241	7.80 (6)	1.50	0.78
2	13379	87838	6.57 (13)	1.26	0.65
3	11236	98317	8.75 (4)	1.68	0.87
4	9080	62560	6.89 (12)	1.32	0.68
5	8534	75875	8.89 (2)	1.71	0.88
6	8289	75085	9.06 (1)	1.74	0.90
7	7587	62532	8.24 (5)	1.58	0.82
8	5401	32944	6.10 (15)	1.17	0.61
9	5262	39755	7.56 (8)	1.45	0.75
10	5087	35927	7.06 (10)	1.36	0.70
11	4837	34995	7.23 (9)	1.39	0.72
12	4828	36673	7.60 (7)	1.46	0.76
13	4633	40639	8.77 (3)	1.69	0.87
14	4449	26428	5.94 (16)	1.14	0.59
15	3918	19801	5.05 (20)	0.97	0.50
16	3739	26022	6.96 (11)	1.34	0.69
17	3601	22878	6.35 (14)	1.22	0.63
18	3580	19790	5.53 (17)	1.06	0.55
19	3343	18371	5.50 (18)	1.06	0.55
20	2993	15536	5.19 (19)	1	0.52

Note: 1.Tsinghua Univ 2.Zhejiang Univ 3. Beijing Univ 4.Shanghai jiaotong Univ 5. Univ of Chin Sci&Tech 6. Nanjing Univ7. Fudan Univ 8. Shandong Univ 9. Jilin Univ 10. Sichuan Univ11. Wuhan Univ 12.Nankai Univ 13. Sun yat-sen Univ14. UnivHuazhong Sci&Tech 15. Harbin industrial Univ 16. Lanzhou Univ 17. Univ Dalian Tech 18. Tianjin Univ19. Univ Xian Jiaotong20. Zhongnan Univ

Table 2. Top 20 most active universities in patents around the world, ranked in descending order

Univ	NP	MC	h-index
1	10835	4	6
2	10665	18	4
3	6864	87	13
4	6588	294	51
5	5914	2	3
6	5648	14	3
7	4221	3	2
8	3515	4	2
9	3132	93	13
10	2653	3	2
11	2628	9	4
12	2420	151	34
13	2215	280	51
14	2103	9	7
15	1990	4	1
16	1916	4	3

Note: 1.Beijing Univ(CN)2.Zhejiang Univ(CN) 3. Tsinghua Univ(CN) 4.Univ California (US) 5. Shanghai jiaotong Univ(CN)6. Nanjing Univ(CN)7. Tianjin Univ(CN)8. Wuhan Univ(CN)9. Univ Tokyo (JP) 10. Shandong Univ(CN)11. Fudan Univ(CN)12. Univ Texas System (Us)13. Massachusetts Inst Tech(Us)14. Univ Seoul Nat Ind Found(KR)15. Sichuan Univ(CN)16. Univ Southeast(CN)17. Univ Donghua (CN)18. Univ Michigan(US)19. Univ Tohoku (JP)20. Univ Xian Jiaotong(CN) university, ranked the second, is higher than Zhejiang university. In term of h-index, the other universities is striking low. Itseems two possible explanation for it.

The possible reason is value of patents in these universities is relatively lower when another key issue---the quality of patent is considered, while the patent h-index is more closely linked to the technological advance of the patented invention. So, the quality of patent is key factor for Chinese universities to solve. An other possible reason is that 70% of all patents are either never cited, or cited only once or twice (Smith, 1993).

In order to compare patenting activities of Chinese universities with other elite research universities worldwide, we counted the number of patents issued to universities during 1999-2009.12.20 and used it as a university-level patenting activity indicator. The top 20 most active universities in patents are listed in Table 2. To our astonish, however, taking pride in China, China occupy 13 of the top positions of prolific universities. Furthermore, Beijing university, Zhejiang university, Tsinghua university, jump to first, second and third , respectively, in spite of their relatively lower patent h-indexs. However, in term of MC and h-index, Chinese universities lag far behind peer universities. For example, Chinese Donghua university with a total of 1848 patents has just a higher than American Michigan university, with a total of 1842 patents. However, The impact of patents of Donghua university is far less than that of Michigan university , as showed in table 3. We can noted from table 2, Chinese university lie in advantageous position in patent quantity, however, quality of that has much gap compared with foreign universities.

3.3. Input and output

We can not obtain the R&D expenditure in these universities, so we make use of the data of provinces in China. Ratio---the ratio of the total number of papers and patents to R&D. We take last year (2008) for example. Based on our experience, we employ two-year lags. So R&D expenditure is the total R&D expenditure of 2006 and 2007 years. It should note that though the total output of science (papers) and technology (Patents) in relatively poor Province in china, such as Province Hainan, Province Xinjiang, Province Guangxi, Province Gansu is low, the ratio of the total number of papers and patents to R&D is higher than relatively rich Province in china, such as Bejing, Shanghai(see table 3, we only show 10 provinces for space). So china should input more R&D funds into the universities in these disadvantage provinces so as to acquire more marginal utility.

Table 3. the output to R&D input in descending order

province	Sum	Invention patent	R&D	Ratio
Hainan	2245	47	4.7	487.66
Xinjiang	5293	82	18.5	290.54
Guangxi	9268	204	40.2	235.62
Hunan	28246	1196	127.2	231.46
Gansu	10393	211	49.7	213.36
Chongqing	16022	532	83.9	197.31
Hubei	38612	1152	205.7	193.31
Heilongjiang	22741	740	123	190.90
Guizhou	4967	270	28.2	185.71
Shanxi	37869	962	223.1	174.05

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