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Innovation and patenting activities at universities in Taiwan: After Bayh-Dole-like acts

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A B S T R A C T

In this study, the author examines patents granted to 174 Taiwanese universities during the period of 2004–2009 to gain a better understanding of innovation and patenting activities of Taiwanese universities. The results show that the university administrations took very proactive roles in patenting the research inventions or works that resulted from the university-funded research after two Bayh-Dole-like acts were passed in Taiwan. There were 105 universities and colleges granted patents during the reviewed period. The distribution of patents granted shows that general universities were granted mainly invention patents and universities of technology were more active in gaining utility model patents.

1. Introduction

Universities have been seen as organizations dedicated to the creation and dissemination of knowledge. Today, the role of universities in fostering technology transfer and economic growth is considered to be a vital element of scientific and technological development. The Bayh-Dole act in 1980 was seen as an essential initiative in the United States technology policy and has been stated having a major contribution to the rapid emergence of new high-technology firms and high rates of economic growth in the United States during the 1990s. Two Bayh-Dole-like acts in Taiwan, *Fundamental Science and Technology Act and Government Scientific and Technological Research and Development Results Ownership and Utilization Regulations* passed in 1999 and 2000, have given universities and non-profit institutions intellectual property control over their inventions and work that resulted from university and organization funded research. These two acts encourage universities and non-profit institutions to pursue ownership of an invention in preference to the government. In this study, the author examines patents granted to 174 Taiwanese universities during the period of 2004–2009 by taking patent bibliometrics approach to have a better understanding of patenting activities of universities in Taiwan.

2. University patenting

Universities have been seen as organizations dedicated to the creation and dissemination of knowledge. It is widely acknowledged that science research is the driving force behind technology development and economic growth [1]. The Bayh-Dole Act in 1980 and other Bayh-Dole-like acts encourage universities and non-profit institutions to pursue ownership of inventions in preference to the government. Although some studies indicated that the effects of Bayh-Dole Act on the content of research were modest [2–4], others did show that the Intellectual Property Regulations influenced by Bayh-Dole-like acts have major impact on university patenting [5,6]. In her paper published in 2006, Baldini analyzed Danish universities' patenting in Denmark, the United States or Europe from 1982 to 2003. The results showed that the Bayh-Dole-like acts in Denmark encouraged innovation and better links between industry and science in Denmark [7]. Shane took the field differences into consideration to re-examine the impact of the Bayh-Dole Act on university patenting. The results of Shane's study showed that the Bayh-Dole Act had an important effect on the distribution of universities to concentrate their patenting in lines of business that were closer to basic science in which licensing was more effective [8]. Taiwanese universities started to set up intellectual property offices in charge of patenting activities after passing the two Bayh-Dole-like acts. The office establishment shows that the universities tend to take more active role in pursuing ownership of inventions of their affiliates [6]. Previous studies on Taiwanese universities patenting were carried out mainly by surveying the university patenting activities and tried to identify the influencing factors on universities patenting activities, such as the announcing of "Fundamental Science and Technology Act" and internal intellectual property right managerial capability, changes occurred under the impact and scientific-economic transformation by taking questionnaire approach [9–12] In this study, the author tried to take patent bibliometrics approach [13] to examine the patents granted to Taiwanese

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universities during the period of 2004–2009. The following questions are investigated:

- Are universities and colleges in Taiwan active in patenting activities?
– Which universities and colleges are patenting active?
– Is there patent type preference in patenting strategy?
- Have Bayh-Dole-like acts continuously affected patenting activities of Taiwanese universities and colleges?
– Have the numbers of patent granted to the universities and colleges increased after passing two Bayh-Dole-like acts?
– Have Bayh-Dole-like acts continued to affect universities' patenting activities?

3. Data and methods

This study tries to reveal patenting activities of 174 Taiwanese universities by examining the Taiwan Intellectual Property Office (TIPO) patents granted to these 174 universities during the period of 2004–2009. Although overseas patenting strategies was also seen as part of patenting strategies, Taiwanese universities focus mainly on domestic patenting activities. The results from previous studies also showed there was a limited number of patents granted to universities before 2004 [6,14,15]. Hence, the level of patenting by the universities studied is shown in the results of TIPO Patent Count for the period of 2004–2009. Two sets of TIPO patents related to the universities are included in this study. The patents in the first set are those granted to the universities as assignees of patents. The university could be sole assignee or co-assignee with other individuals or institutes. The patents in the second set are the ones originally granted to other assignees but re-assigned to the universities after the patent were issued during the period of 2004–2009. The data source used is Taiwan Patent Search provided by Intellectual Property Office, Ministry of Economic Affairs of R.O.C.[1] The distribution of productivities among different types of universities and various types of patents are further examined.

Taiwanese universities and colleges encompass 71 general universities, 92 universities of technology, and 11 military/police universities. Students of general universities, universities of technology and military/police universities are awarded a bachelor's degree upon completion of their undergraduate study, and a master's degree upon completion of their postgraduate study. However, the curriculum at most general universities focuses on academic studies and research, while universities of technology focus on practical and specific skills of training and military/police universities offer training to commissioned officers. Bachelor's programs at all types of higher education institutions require four years to complete, while master's programs usually require two years and a doctorate (PhD) needs at least three years to accomplish. Fig. 1 shows the current school system in Taiwan.[2]

The patent according to the Patent Act of Republic of China is classified into three categories: Invention patents, Utility model patents, and Design patents. The term "invention" used in Patent Act refers to all creation of technical concepts by utilizing the rules of nature. The "utility model" refers to all creation of technical concepts by utilizing the acts of nature, in respect of the form, construction or installation of an article, and the "design" refers to all creation made in respect of the shape, pattern, color, or combination thereof of an article through eye appeal.[3]

[1] http://twpat.tipo.gov.tw/tipotwoc/tipotwekm.

[2] The Current School System, 13 December 2010, <http://english.moe.gov.tw> (25 August 2011).

[3] Patent Act (2010), article 21, article 93 and article 109.

4. Results

The results of this study show that, the number of patents granted to Taiwanese universities continuously rose during the period of 2004–2009. Second, general universities and universities of technology have different patenting focus, while military/police universities have very limited number of patents granted. Third, 19 universities and colleges were granted more than 100 patents during the period of 2004–2009. Fourth, the number of patents obtained via re-assignment of patent rights of inventions and work that resulted from research to the affiliated universities and colleges has increased. Fifth, setting up intellectual property offices and internal policy to govern intellectual property rights of the inventions and work, which resulted from university-funded research, has become common practice for universities and colleges.

4.1. Number of patents granted to Taiwanese universities continuously rose

The results of patent count show that there are 5979 TIPO patents granted to Taiwanese universities and colleges during the period of 2004–2009. The annual counts of patents during the period are 446, 774, 1,008, 950 and 1,220, which makes 996.5 patents on average. Except for a 5.67% decrease from 2006 to 2007, the numbers of patents granted continuously increased during the 6-year period. Among the granted patents, 2985 (49.92%) patents were invention patents, 2881 (48.19%) were utility model patents and 113 (1.89%) were design patents. Comparing numbers of patents granted in each category annually, more invention patents were granted from 2004 to 2007 and the number of utility model patents exceeds that of invention patents for the first time in 2008, when 438 invention patents and 758 utility model patents were granted. Fig. 2 shows the number of patents granted from 2004 to 2009. Further looking into the possible cause, it is found that the examination of utility model patents was changed from substantive examination to formality examination. The change has encouraged universities to take more aggressive strategies in applying utility model patents, especially universities of technology, and the results show the influence.

4.2. General universities and universities of technology take different patenting strategies

Among different types of universities, Military/Police universities were granted with very limited patents, thus only General Universities and Universities of Technology are included in this section. Comparing numbers of various types of patents granted to General Universities and Universities of Technology, it is found that patenting activities of General Universities mainly concentrate on applying for invention patents, as 87.67% (2047) of the patents granted to General Universities were invention patents. Universities of Technology have taken different strategies in patenting. Taking the Universities of Technology as a group to examine the distribution of patents granted, 71.86% (2602) of the patents granted were utility model patents and 25.43% (921) of those were invention patents. Further checking the types of patents granted to Universities of Technology, two types of universities could be identified: invention patent oriented and utility model patent oriented. The former type includes National Formosa University, National Taiwan University of Science and Technology, National Taipei University of Technology, and National Kaohsiung University of Applied Sciences, which were granted more invention patents. The percentages of invention patents in these universities are 94.15%, 58.33%, 52.68% and 57.14%. Relatively, the other type of university is more utility model patent oriented. Among them,

Yuan-pei University, Oriental Institute of Technology, Chia Nan University of Pharmacy and Science, Technology and Science Institute of Northern Taiwan, Far East University, and Kao Yuan University are the major universities. The ratios of utility model patents granted in these universities are 96.97%, 95.83%, 93.33%, 88.89%, 87.78 and 87.10%. Fig. 3 shows the distribution of different types of patents granted to General Universities and Universities of Technology.

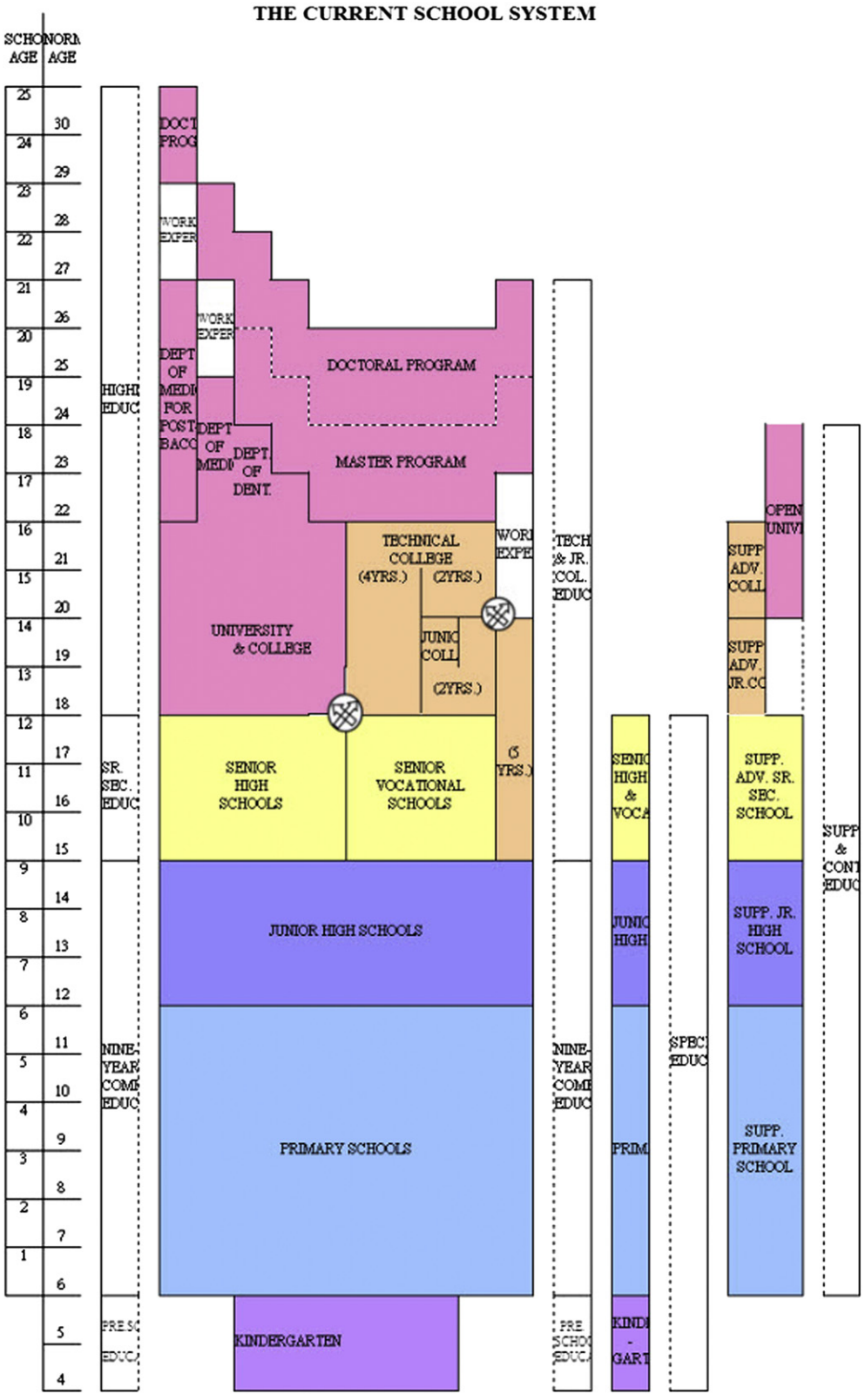
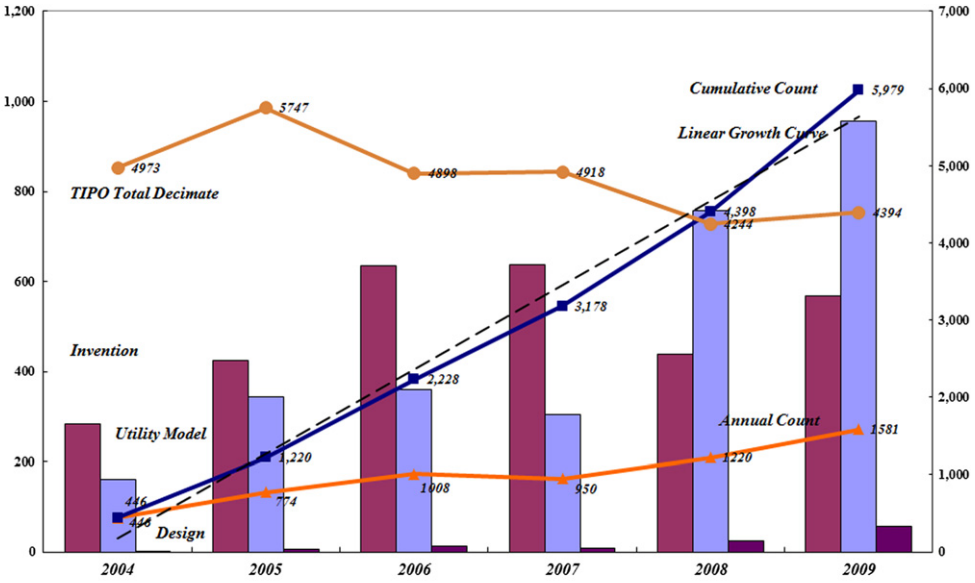


Fig. 1. Education System in Taiwan.[2]



Universities	2004	2005	2006	2007	2008	2009
Invention	283	425	635	636	438	568
Utility Model	161	343	359	305	758	955
Design	2	6	14	9	24	58
Annual Count	446	774	1,008	950	1,220	1,581
Cumulative Count	446	1,220	2,228	3,178	4,398	5,979
TIPO Total Decimate	49,725	57,472	48,977	49,183	42,444	43,942

Fig. 2. Patent Count and Growth Curve for Universities.

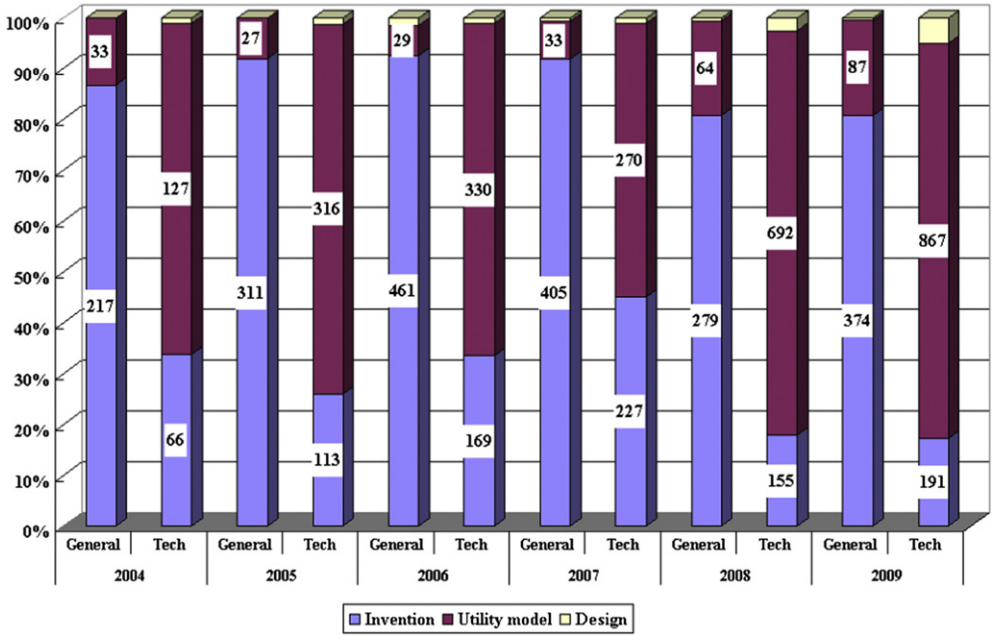


Fig. 3. Distribution of types of patents - by university types.

4.3. Most productive general universities and universities of technology

4.3.1. Top 10 productive general universities

National Cheng Kung University is the most productive General University out of 71 General Universities with 314 patents granted. Together with National Cheng Kung University, National Chiao Tung University, National Taiwan University, National Sun Yat-sen University and National Chung Hsing University are the top 5 productive General Universities. The latter four were granted 275, 240, 218 and 189 patents respectively, most being invention patents. Among the productive General Universities, Chung Yuan Christian University and Chang-Gung University take slightly different patenting strategies. The invention Patent is not the sole focus of Chung Yuan Christian University's patenting strategy, because 26.71% of the patents granted were utility model patents. Chung Yuan Christian University was also granted 12 design patents, more than the others in the top 5 productive General Universities. Chang-Gung University was granted 92 patents and 11.96% of them were utility model patents. Table 1 shows the numbers of various types of patents granted to the top 10 productive General Universities.

4.3.2. Top 10 productive universities of technology

Far East University is the most productive university, not only among Universities of Technology, but also among the 174 universities and colleges in this study. Far East University was granted 966 patents during the period of 2004–2009. The patents granted to Far East University were mainly utility model patents, which accounts for 87.78% out of 966. Next to Far East University is Southern Taiwan University of Technology, which took similar patenting strategy, as 70.80% (194) out of 274 patents granted were utility model patents. National Formosa University, listed 3rd, took very different patenting strategy, as 94.15% out of 188 patents granted were invention patents. National Taiwan University of Science and Technology and Chin-Yi University of Technology are among the other productive universities of technology. Table 2 shows the numbers of three types of patents granted to the top 10 productive Universities of Technology. The two different patenting strategies taken by Universities of Technology are shown by the distribution of different types of patents granted.

4.4. Strategy of re-assignment to the affiliated universities and colleges

Besides applying for patents as assignees, re-assignment of patent rights is also used as one of the patenting strategies to obtain more patents. There are 483 patents (8.08%) granted through re-assignment, out of 5979 patents granted to the universities and colleges. Reviewing the assignment documents, it is found that the patents were mostly re-assigned from individuals or affiliations that associate with universities and colleges within 3 years after the patents were granted.

Table 1
Top 10 productive general universities.

Types/Statistics University	Invention		Utility model		Design		Subtotal
	Patents	%	Patents	%	Patents	%	
Cheng Kung U.	283	90.13%	31	9.87%	0	0.00%	314
Chiao Tung U.	272	98.91%	3	1.09%	0	0.00%	275
Taiwan U.	221	92.08%	19	7.92%	0	0.00%	240
Sun Yat-sen U.	213	97.71%	5	2.29%	0	0.00%	218
Chung Hsing U.	183	96.83%	6	3.17%	0	0.00%	189
Tsing Hua U.	178	97.80%	4	2.20%	0	0.00%	182
Central U.	163	95.32%	8	4.68%	0	0.00%	171
Chung Yuan Christian U.	95	65.07%	39	26.71%	12	8.22%	146
Chang-Gung U.	81	88.04%	11	11.96%	0	0.00%	92
Feng Chia U.	75	96.15%	3	3.85%	0	0.00%	78
Total	1,764		129		12		1,905

Table 2
Top 10 productive universities of technology.

Types/Statistics university	Invention		Utility model		Design		Subtotal
	Patents	%	Patents	%	Patents	%	
Far East U.	117	12.11%	848	87.78%	1	0.10%	966
Southern Taiwan U. of Tech.	49	17.88%	194	70.80%	31	11.31%	274
Formosa U.	177	94.15%	11	5.85%	0	0.00%	188
Taiwan U. of Sci. & Tech.	84	58.33%	52	36.11%	8	5.56%	144
Chin-Yi U. of Tech.	32	22.70%	108	76.60%	1	0.71%	141
Hsiuping Inst. of Tech.	23	16.91%	106	77.94%	7	5.15%	136
Shu-Te University	12	8.96%	110	82.09%	12	8.96%	134
Nan Kai Inst. of Tech.	23	19.66%	93	79.49%	1	0.85%	117
Taipei U. of Tech.	59	52.68%	53	47.32%	0	0.00%	112
Tech. & Sci. Inst. of N. Taiwan	12	11.11%	96	88.89%	0	0.00%	108
Total	588		1671		61		2320

4.5. University technology transfer offices and internal governing policy of intellectual property right

Further checking the administrations of the productive universities and colleges, it is found that those universities and colleges set up offices in charge of patenting after two Bayh-Dole-Like acts were passed. All the top 10 productive General Universities have a designated division or office to take full responsibility and sole in charge of patenting business. Most of the divisions are positioned under an "Office of Research and Development" in universities and are often called "Technology Licensing Center" or "Division of Technology Transfer." For Universities of Technology, most of the productive schools assign the work to "Division of Technology Cooperation", "Innovation & Incubation Center" or "Section of Technical Services", which are mostly positioned under Office of Research and Development to govern patenting activities. Those offices or sections are not solely designated to handle patenting. However, Far East University and Formosa University are the only two exceptions. The Center of Technology and Authorization under the Office of Industrial Academic & Cooperation at Far East University oversees all the patenting of the affiliations. Technology Transfer Center under Research & Development Office at Nation Formosa University is the designated office in charge of patenting. Besides setting up the designated offices, all the productive universities and colleges have passed internal governing policy to encourage and regulate the patenting activities of affiliated individuals and institutes.

5. Observations

With findings from previous studies, the results of this study showed that Taiwanese universities are still active in patenting activities, not only in enhancing intellectual right managerial capacities, but also in numbers of patents gained. The following are observations from the study.

- Growth of Patenting Activities.

Technology Transfer Offices have been established in universities and the number of patents granted to Taiwanese universities continues to increase after two Bayh-Dole-like acts were passed.

- Different Patenting Strategies.

The numbers of patents granted in different types show that General Universities and Universities of Technology take different patenting strategies, General Universities obtained more Invention Patents and Universities of Technology were granted more Utility Model Patents.

- Shift of Patenting Strategies.

The distribution of patent productivity shows that General Universities take different approaches in their patenting strategy when pursuing Utility Model Patents, after the examination policy was changed from substantive examination to formality examination.

- Rising Star of Patenting.

The results show that several universities started patenting after the change of examination policy and had tripled the number of patents granted during the past two years. Those could be seen as rising stars. The rising star universities target Utility Model Patents and the numbers of patents granted increased significantly.

- Patenting Activities Abroad.

Taiwanese universities extend patenting activities abroad and the main area is the United States.

6. Conclusion

The universities started to take more aggressive strategies after two Bayh-Dole-like acts were passed in Taiwan. The influence of these two acts is extended to the set-up of intellectual property offices in the universities and colleges, the passing of internal intellectual property policy and the increasing numbers of patents granted to the universities and colleges. The results show that the number of universities and colleges with patenting activities continues to grow and the outcomes are also encouraging, as the number of patents granted increased 29.59% from 2008 to 2009. Different types of universities show productive strength in patenting with very diverse focus. General universities that focus on academic studies and research target invention patents and universities of technology that focus on practical and specific skills training mostly target utility model patents. The Patent Act of Republic of China and Bayh-Dole-like acts continue influencing the patenting activities by authorizing the universities and colleges to gain more control of the inventions and work that resulted from university and college funded research. The acts not only led to the establishment of designated departments in the universities and colleges, but also the internal policy to oversee the patenting activities. Also, the focus of strategies is also shifted with the change of examination mechanism.

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