Research on the Influencing Factors of University Patent Renewal Decisions

Wenchang Li[1], ZhenYa Wang[1,*] and Meng ZHAO[2]

[1]School of Economics and Management, Jiangsu University of Science and Technology, Zhenjiang 212003, Jiangsu, China

[2]Positec Technology (China) Co., Ltd., Suzhou 215123, Jiangsu, China

1370894863@qq.com

*corresponding author

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Abstract: Patent renewal time is a key factor to reflect the quality of patent, and also an important indicator to measure the value of patent. Patent renewal decision, in which many-sided factors need to be considered, is a necessary link in the later stage of patent life cycle. Taking 3783 invention patents filed in 2010 of universities in Jiangsu Province among them 1372 are alive and 2411 are dead. Mann-Whitney U Test, Kruskal-Wallis H Test and Binary Logistic Regression Analysis were used to analysis the influencing factors of university patent renewal decisions. The results showed that there is no significant correlation between the patent renewal decisions and the level of universities, the number of IPC classification numbers, the number of pages, but there is a significant correlation between the patent renewal decisions and the number of inventors, the number of claims, the period of publication and the period of examination.

1. Introduction

In early 2020, China and the United States signed the Economic and Trade Agreement between the Government of the People's Republic of China and the Government of the United States of America (hereinafter referred to as the "Agreement") in Washington, the United States. In the first chapter of the "Agreement", China and the United States agreed on intellectual property rights[1]. At present, my country is changing from an important intellectual property consumer country to an important intellectual property producer [2]. As the main base for the training of national innovative talents, colleges and universities are also important organizations for basic research and technology development, and they are the key players in implementing the national innovation strategy. Important roles [3]. In recent years, the number of patent applications in Chinese universities has shown a large increase . Among them, Tsinghua University, Shenzhen University, South China University of Technology, and Dalian University of Technology have ranked among the top 10 PCT educational institutions in the world in terms of PCT applications, reflecting the good performance of some universities. awareness of overseas patent layout. When the number of applications reaches the expected level, the relevant state departments adjust their strategies and are committed to improving the quality of university patents and improving the unfavorable situation of "emphasizing quantity over quality"[4]. However, relevant survey reports show that most university patents are still There are structural problems such as short maintenance period, low industrialization, and insufficient awareness of overseas layout [5]. Moreover, most colleges and universities lack professional patent management personnel and institutions, and rely too much on external resources. Therefore, incomplete professional knowledge reserves and insufficient management experience have become the main obstacles restricting the development of patents in colleges and universities.

The patent annual fee evaluation and maintenance decision is a necessary link in the later stage of the patent life cycle, and this link needs to be carried out by integrating various influencing factors. As an organization with relatively backward patent development, colleges and universities urgently need targeted research to guide them to improve their patent level. In recent years, studies

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have shown that patent maintenance time is a key factor reflecting patent quality and an important indicator for measuring patent value. Not useful for reference [6]. Based on this, this paper takes universities in Jiangsu as the research object, selects corresponding indicators for patent texts, and studies the influencing factors of university patent maintenance decisions through scientific and reasonable statistical analysis methods, and interprets and analyzes the results.

2. Data and Methods

2.1. Research object

Inclusion criteria: From January 1, 2010 to December 31, 2010, the applicant is an authorized invention patent of a university (public university) in Jiangsu area, with a total of 3,783 patents. The database adopts Derwent Innovation, which is commonly used and authoritative in patent search. Exclusion criteria: (1) national defense patents; (2) authorized invention patents transferred from applicants outside the province to universities in Jiangsu.

2.2. Research Indicators

(1) Applicant indicators, including university grades and the number of inventors; (2) Text indicators, including the number of claims, IPC classification numbers, and literature pages [7]; (3) Strategic indicators, including disclosure cycle and review Period, where the disclosure period is the difference between the patent publication date and the patent application date, and the examination period is the difference between the grant announcement date and the substantive examination entry date, in months. The determination of the above indicators of each phase is based on the text of the authorization announcement.

2.3. Statistical method

This study used SPSS 24.0 statistical software for analysis. Mann-Whitney U test and Kruskal-Wallis rank-sum test were used for univariate analysis, and binary logistic regression was used for multivariate analysis. Due to the sufficient sample size in this study, $P<0.10$ was considered to be statistically significant in univariate analysis; Forward: LR method was used in multivariate analysis, and $P<0.05$ was considered statistically significant.

3. result

3.1. descriptive analysis

This study included 3,783 authorized invention patents, 889 from 985 colleges, and 1,478 from 211 colleges; 1,183 documents with more than 10 pages; the number of inventors in the valid group was (4.68±2.177), and the number of inventors in the invalid group was (4.45±2.219).); the number of claims in the valid group is (3.83±2.754), and the number of claims in the invalid group is (3.56±2.390); the number of IPC classification numbers in the valid group is (2.70±1.957), and the number of IPC classification numbers in the invalid group is (2.57±1.928); the disclosure period of the valid group is (5.96±3.759), and the disclosure period of the invalid group is (5.65±3.061); the review period of the valid group is (19.24±7.310), and the review period of the invalid group is (18.56±6.924).

3.2. Univariate analysis

The results are shown in Table 1. It was found that there were statistically significant differences between the number of inventors, the number of claims, the number of IPC classification numbers, the publication period, and the review period between the valid group and the invalid group ($P<0.10$), while the university level, literature The difference between the number of pages was not statistically significant ($P>0.10$).

Table 1 Univariate analysis

index	valid group	failuregroup	*P value*

	（n=1372）	（n=2411）	
college level [n(%)]			0.174
985 college	298（21.7）	591（24.5）	
211 college	541（39.4）	937（38.9）	
others	533（38.9）	883（36.6）	
number of inventors	4.68±2.177	4.45±2.219	0.001
number of claims	3.83±2.754	3.56±2.390	0.035
IPC numbers	2.70±1.957	2.57±1.928	0.025
pages [n(%)]			0.824
Within 10 pages	946（69.0）	1654（68.6）	
more than 10 pages	426（31.0）	757（31.4）	
Public cycle (month)	5.96±3.759	5.65±3.061	0.014
Review(months)	19.24±7.310	18.56±6.924	0.002

3.3. Multi-factor analysis

Taking the patent invalidation as the dependent variable, the indicators with statistically significant differences in the above univariate analysis were included in the independent variables for binary Logistic regression analysis, and the entry method was the Forward: LR method. The regression analysis results show that the number of inventors, the number of claims, the disclosure period, and the examination period are all protective factors for patent invalidation, which are reflected in the number of inventors and the number of claims. The longer the disclosure period and the examination period, the greater the risk of patent invalidation. Low.

Table 2 Logistic regression analysis (Forward: LR method)

index	B	Wald	*P* 值	OR	95%CI
Inventors	-0.043	7.826	0.005	0.958	0.930~0.987
Claims	-0.037	7.775	0.005	0.964	0.939~0.989
Public(month)	-0.023	5.391	0.020	0.977	0.958~0.996
Review(months)	-0.013	7.270	0.007	0.987	0.978~0.996

4. Discuss

After the patent application is granted, it is necessary to pay the corresponding annual fee within the specified time limit in order to continue to maintain the validity of the patent right. If the corresponding annual fee is not paid within the prescribed time limit, the patent will be invalidated in advance before the expiration of the patent term, and the monopoly and protection of the technical solution will be lost. It can be seen that maintaining the validity of a patent is the basic condition for maintaining the quality and value of its patent. In recent statistical research and practical work, the patentee's assessment of the annual fee of the patent or the prediction of the risk of early patent invalidation, and even the identification of the quality and value of the patent, have received extensive attention. However, due to the complexity and diversity of the subjective behavior of patentees, and the differences in the research field and market environment, the research conclusions are always controversial.

Zhu Honghui et al. [8] studied the factors affecting the maintenance time of the granted patents in the agricultural field of the Corps through the Cox proportional hazard (CPH) model of survival data analysis. The lower the risk of early expiration of its patents, the longer the patent will last. Zhang Kequn et al. [9] took the authorized patents of public auction as the research object, and explored the influencing factors of patent value. The results showed that the number of inventors

and patent value showed a significant negative correlation. Bao Zhiyan et al. used patent enforcement as a proxy indicator of patent quality, and the results showed that the number of inventors was not correlated with patent quality. In this study, the inclusion conditions of the research subjects are limited to the same region and the same filing time, in order to ensure the accuracy of statistics and analysis results under the same environmental background. The results show that the greater the number of inventors, the lower the risk of early patent invalidation , patents tend to have longer durations. The "Patent Law" clearly stipulates that the unit that is granted the patent right shall pay the inventor or designer a corresponding reasonable bonus. The intent of a patent application is often different from that of a business. Moreover, the distinguishing feature of patents, which is different from papers and works, is that the legal status of the patentee and the inventor is absolutely equal in terms of legal status unless other agreements are signed. In this context, scientific researchers often pay more attention to the patent signature of major scientific research results. According to the statistics and analysis shown in Figure 1, among the research subjects, the proportion of inventors with 2 to 6 inventors reached 78.2%, and as the number of inventors increased, the number of authorized inventions decreased significantly. From the linear trend line of the effective proportion, it can be seen that with the increase of the number of inventors, the effective proportion basically shows an increasing trend. Therefore, this paper believes that for universities with special nature, the more inventors, the higher the quality and technical importance of the patent, and the patent quality and technical importance are the most important factors to consider when evaluating the patent annual fee, so the invention The greater the number of people, the lower the risk of premature patent expiration.

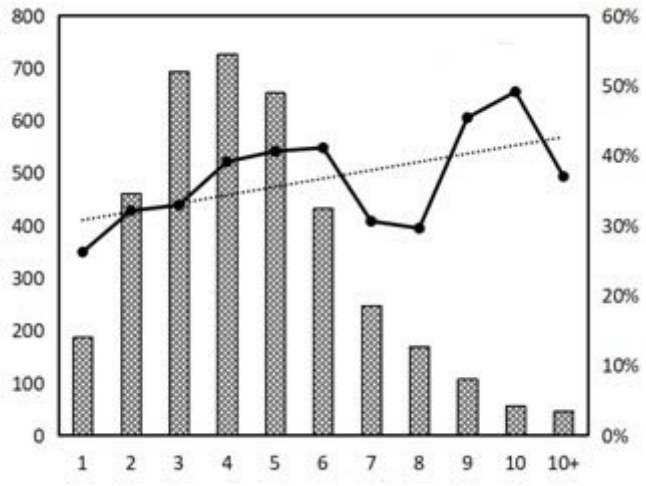

Figure 1 The number of authorized inventions and the effective ratio corresponding to the number of inventors

The claims are the core part of the patent text, the main embodiment of the quality and value of the patent, and the most technical part when the application is written. In the existing research, the conclusions are basically the same on the effect of the number of claims on the patent maintenance time and patent quality. Among them, Liu Qi [10] studied the factors affecting the survival time of invention patents authorized by 985 engineering universities, and the results show that the number of claims can significantly and positively affect the survival time of invention patents. Guo Liang et al. compared and analyzed the factors affecting the maintenance time of invention patents of South China University of Technology and Huawei, and the results showed that the number of claims can positively affect the maintenance time of Huawei's invention patents, while the influence on the maintenance time of invention patents of South China University of Technology did not. Significantly. Qiao Yongzhong et al. analyzed the influence of the number of claims in the granted invention patents in China and Japan on the maintenance time, and the results showed that the correlation between the number of patent claims and the maintenance time in China was higher than

that in Japan, and the increase in the number of claims could Extend patent retention time. In the current market environment and competitive environment, colleges and universities are often a large group of "ignored" groups. First of all, from a subjective analysis, colleges and universities' understanding of the nature of patents has not completely changed from cost to asset, and the application of patents basically stays in scientific research. Basic needs such as evaluation and project conclusion. Even if national and local policies continue to guide universities to improve the quality of patents and avoid the unfavorable situation of "emphasizing quantity over quality", it will be difficult to implement the policy substantively if the concept has not changed. Secondly, from an objective analysis, as a non-profit organization, colleges and universities usually do not have market competitors, and most of the patented technical solutions are not actually industrialized. It is impossible to estimate the value and impact of patents, and it will not make foreseeable preparations for subsequent infringement lawsuits or invalidation requests. It is understandable that colleges and universities often only write technical solutions with substantial value into the claims to ensure the quality of the claims, and at the same time, it can save the cost of patent applications and reduce the waiting period for patent authorization. As can be seen from Figure 2, the effective proportion of university patents shows an upward trend with the increase in the number of claims. From the above analysis, it can be seen that the increase in the number of claims can undoubtedly improve the quality of patents, thus making patents have a longer maintenance. time. However, it cannot be ignored that, as can be seen from Figure 2, the proportion of research objects with excessive claims is less than 1%, and even the proportion of research objects with more than 5 claims is only 21.1%, and Deng Jie et al. indicates that the stability of my country's currently authorized invention patents is generally weak, and more claims can significantly improve the stability of patents. In addition, Qian Kun et al. showed that the larger the number of claims, the larger the scope of patent protection, and the higher the value of the patent in the transaction scenario. Therefore, when applying for a patent, colleges and universities should fully consider the complete life cycle of the patent, respond to possible subsequent legal events, and the economic benefits that the patent may bring, and make more adequate and reasonable predictions and claim.

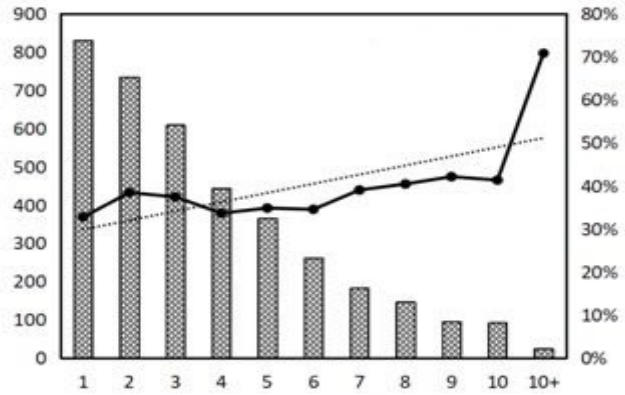

Figure 2 The number of authorized inventions and the effective ratio corresponding to the number of claims

As can be seen from Figure 3, most of the research objects tend to be disclosed earlier, among which 85.8% are authorized invention patents with a disclosure period of 4 to 7 months, but according to the linear trend line of the effective proportion shown in the figure It can be roughly seen that the effective ratio increases with the extension of the disclosure period. The extension of the disclosure period means that the patent applicant has put more consideration into the application strategy. On the one hand, the delay in disclosure can fully protect the premature disclosure of the technical solution. During this time interval, the applicant can fully evaluate the extension of the application and the divisional processing. and other practical operations to expand the scope of protection, so as to make a comprehensive patent mining and layout for the entire technical scheme; on the other hand, the delay in disclosure can make full use of the fuzzy space in this time interval in the stage of technical promotion or product promotion, and release the uncertainties. Signals,

which can make it difficult for competitors to judge the actual protection content of the patent, so as to strive to occupy an active position in the competition.

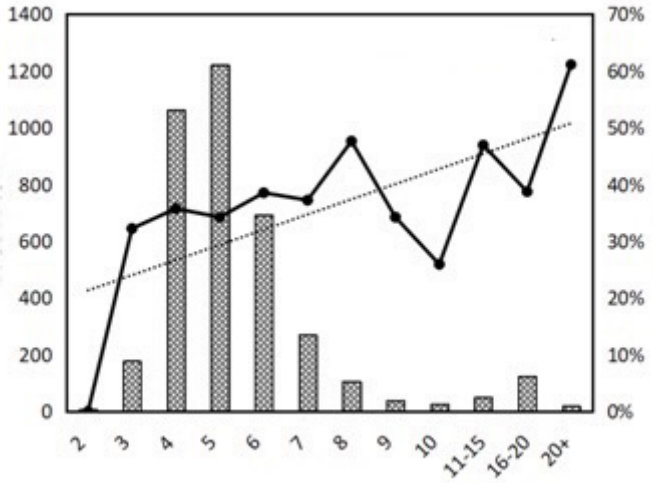

Figure 3 The number and effective ratio of authorized inventions corresponding to different disclosure periods

5. Conclusion

Due to the independence of the patentee's application behavior, the diversity of the attributes of the patentee's organization, and even the differences in the policies of the patent office and various regions, the patent maintenance decision has become a complex and unpredictable process. This paper tries to make the research objects in the same background as much as possible to avoid the result error caused by uncertain factors, and finally takes 3,783 authorized invention patents of universities in Jiangsu with the application date in 2010 as the research object to study the influencing factors of university patent maintenance decision-making. The research results can be used in important practical work such as patent annual fee evaluation and early patent expiration prediction. The disadvantage of this paper is that different colleges and universities often have different subject classifications, which leads to great differences in the technical fields to which each college's patents belong, and different patent incentive policies related to the cities where colleges and universities are located. The next step will focus on refining the research objects, incorporating relevant indicators of the policy environment and market competition into the research model, in order to provide ideas for the improvement of patent quality in universities.

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