Analysis on the Present Situation of Patent Transformation of Universities in Yunnan Province

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ABSTRACT

The research on patent transformation is of great significance to the practice of transformation of scientific and technological achievements in universities. Based on the perspective of patent transformation, this study excavated and analyzed the patent transformation information of 32 universities in Yunnan Province from 2008 to 2018, focusing on the number of authorized and transformed patents, the path of patent transformation, correlation analysis and regression analysis, and analyzed the status of patent transformation of universities in Yunnan Province from different dimensions. Transformed patents accounted for 0.06 % of the authorized patents, and invention patents accounted for 89.8 %; the total proportion of university-university mode and university-scientific research institution mode was 43 %; the transformation was concentrated in Kunming and Dali, which was also focused on biomedical (A61K, A61P), solid waste treatment (B09B), metal alloys (C22C, C22B), chemical analysis (G01B, C01F, C01N) and other fields to offer reference for universities to improve the quality of patents.

Keywords: Yunnan Province, Universities, Patent transformation

1. INTRODUCTION

Under the background of market economy, the quantity and quality of patent applications have become an important index to consider the technological innovation level and economic competitiveness of various countries. Universities are the treasure of scientific research, and the source and main force of innovation, which promote the economic development of society. Universities regard patent assignment and license implementation as an important way of patent transfer. Patent transformation performance can bring economic benefits, and has a high market prospect [1-3]. As the Ministry of Education mostly took the number of patents as the standard for the evaluation of universities, which led to the blind pursuit of the number of patents, the neglect of quality, and the problem of low conversion rate [4]. This issue is particularly prominent in local universities, and there is no literature on this aspect in universities in Yunnan Province. Therefore, this study took 32 universities in Yunnan recognized by the Ministry of Education as the research object, excavated and analyzed the number of authorized and transformed patents, the path of patent transformation, correlation analysis and regression analysis, and analyzed the current situation of patent transformation of universities in Yunnan Province from different dimensions to offer a basis for universities to promote patent transformation.

2. RESEARCH METHODS

2.1. Access to Patent Data

First, we went to the website of the State Intellectual Property Office to search the patent data of 32 universities in Yunnan Province. We took the name of each university as the "applicant", retrieved the number of authorized patents (including the patents that have been authorized but terminated due to no payment on the retrieval date) applied by each university from January 1, 2008 to December 31, 2018, and then screened out the effective patent implementation license contract filing, patent application right, and patent right transfer from the authorized patents as the source data.

There were two universities involved in the renaming: Yunnan University of Chinese Medicine (formerly known as Yunnan College of Traditional Chinese Medicine) and Dali University (formerly known as Dali College). The total number of patents of renamed universities was equal to the total number of patents before and after the name change.

2.2. Descriptive Statistical Analysis Method

Use Excel to do a simple descriptive statistical analysis on
the data, and study the situation of university patent transformation from the general situation, university situation, patent maintenance, subsidy policy, technology field distribution and other dimensions.

2.3. Correlation Analysis

SPSS 17.0 was used to analyze the correlation between the total number of university patents and the number of transformed patents [5].

2.4. Regression Analysis

The univariate linear regression model of R software was used to study the causal relationship between scientific research strength and patent transformation performance in universities [6].

3. MODEL THEORY

3.1. Correlation Analysis

Correlation analysis refers to the degree of correlation between two or more variables and the value range of correlation coefficient between variables is [-1,1]. In this study, SPSS software was used to analyze the correlation of variables, and the theoretical basis for judging the correlation is mainly introduced. There were four rows of data in each cell of SPSS. One was the Pearson correlation coefficient value, which represented the size of the correlation coefficient; one was the sum of square and cross product; the other was the covariance; the other was the sample size N, which represented how much of the data has been tested; the last was the significant test result, namely sig (bilateral), which can be used to show whether the results of correlation analysis are statistically significant.

Generally, it is considered to be statistically significant when sig < 0.05. If it is not significant, even if the correlation coefficient is very large, it can not show that the correlation is significant. At this time, the correlation relationship may be caused by sampling error, so it is necessary to increase the sample size to reduce the error.

3.2. Regression Analysis

Regression analysis is an analysis method to study the influence of a certain variable by other variables. It takes the affected factors as the dependent variables and the influencing factors as the independent variables to study the causal relationship between the dependent variables and the independent variables. The independent variables are generally represented by X1, X2, K Xp, and the dependent variables are generally represented by Y. The main problems of regression analysis are as follows:

1) Determine the quantitative relationship between Y and X1, X2, K Xp, which is called regression equation;
2) Test the reliability of the regression equation;
3) Judge whether the independent variable influences the dependent variable;
4) Use the regression equation obtained to predict and control.

This study mainly used R software to judge whether the scientific research strength of universities had an impact on patent transformation performance (corresponding to the above (3)). In the process of regression analysis, the P value in the regression results was compared with the significance level $\alpha$ (generally $\alpha = 0.05$). If $P < 0.05$, it was considered to be significant (i.e., there was a relationship between the two, otherwise, it was not significant.)

4. EMPIRICAL ANALYSIS ON THE PRESENT SITUATION OF PATENT TRANSFORMATION OF UNIVERSITIES IN YUNNAN PROVINCE

4.1. General Situation of Patent Transformation

As of December 31, 2018, the total number of authorized patents of universities in Yunnan from January 1, 2008 to December 2008 was 994, and 21 patents were transformed, accounting for 0.06% of the authorized patents during the investigation period. There was a phenomenon of "emphasizing authorization and neglecting transformation" in universities in Yunnan. The following Fig. 1 showed the patent transformation details of patent types from 2008 to 2018. From 2008 to 2018, 491 patents were transformed in universities in Yunnan Province. As shown in Fig. 2, 441 invention patents were transformed, and 114 patents were transformed in 2013, accounting for 89.8%; utility model transformation reached the peak value in 2011, accounting for 10.2%; appearance patents and other patents were not transformed.
4.2. The Situation and Statistical Analysis of Patent Transformation in Universities

There were 10 universities in Yunnan Province that had obtained patent authorization, of which only 3 were transformed. The details were presented in Table 1. In terms of transformation rate, the top three were Yunnan Agricultural University, Kunming University of Science and Technology, and Dali University. However, Kunming University of Science and Technology and Yunnan Agricultural University had been authorized from high to low. Dali University had been ranked tenth. Compared with the data in the table below, it was easy to see that there was no positive correlation between the University's scientific research ability and patent transformation performance.

| Ranking | Universities                        | Authorized patents number | Transformed patents number | Patenting rate (%) |
|---------|-------------------------------------|---------------------------|---------------------------|-------------------|
| 1       | Kunming University of Science and Technology | 799                       | 17                                      | 2.1               |
| 2       | Yunnan University                   | 89                        | 0                                       | 0.0               |
| 3       | Yunnan Agricultural University      | 53                        | 2                                       | 3.8               |
| 4       | Yunnan Normal University            | 25                        | 0                                       | 0.0               |
| 5       | Yunnan University for Nationalities | 10                        | 0                                       | 0.0               |
| 6       | Honghe University                   | 8                         | 0                                       | 0.0               |
| 7       | Chuxiong Normal University          | 4                         | 0                                       | 0.0               |
| 8       | Yuxi normal university              | 3                         | 0                                       | 0.0               |
| 9       | Dali University                     | 2                         | 2                                       | 1.0               |
| 10      | Yunnan University of Traditional Chinese Medicine | 1                         | 0                                       | 0.0               |

In order to verify the authenticity of the conclusion and ensure the reliability, the number of authorized patents was taken as an independent variable x and the number of transformation patents was taken as a dependent variable y for the following analysis using the data in the table below.

Table 2. Number of authorized patents and transformed patents of universities in Yunnan from 2008 to 2018

| Serial number | Authorized patents number x | Transformed patents number y | Serial number | Authorized patents number x | Transformed patents number y |
|---------------|-----------------------------|-----------------------------|---------------|-----------------------------|-----------------------------|
| 1             | 994                         | 21                          | 7             | 3218                        | 57                          |
| 2             | 1074                        | 22                          | 8             | 4296                        | 63                          |
| 3             | 1250                        | 24                          | 9             | 5364                        | 29                          |
| 4             | 1421                        | 65                          | 10            | 5196                        | 18                          |
| 5             | 1783                        | 63                          | 11            | 6031                        | 13                          |
| 6             | 2554                        | 116                         |               |                             |                             |
(1) The linear relationship: For the sake of intuition, firstly, the scatter diagram was drawn. If the 11 points in the above table are basically near a straight line, then it can be considered that there is a certain linear correlation between the two.

![Figure 2. Scatter diagram of the number of authorized patents and the number of transformed patents](image)

It was clear from Fig. 2 that the 11 points deviated from the straight line seriously and were not near it, so it could be concluded that there was no linear relationship between them.

(2) Correlation analysis. In order to effectively prove that there was no correlation between the scientific research ability of universities and the amount of transformation, we used SPSS17.0 software to do correlation analysis and test on the data from 2008 to 2018, and observed its correlation coefficient.

| Table 3. Descriptive statistics |
|---------------------------------|
| **Mean** | **Standard deviation** | **N** |
| Authorized patents number | 3016.45 | 1905.027 | 11 |
| Transformed patents number | 44.64 | 31.283 | 11 |

It can be seen from the descriptive statistics in Table 3 that the sample number of the two variables involved in the correlation analysis was 11, the average number of authorized patents and the number of transformed patents were 3016.45 and 44.64 respectively, and their standard deviations were 1905.027 and 31.283, respectively.

As shown in Table 4, the correlation coefficient between the number of authorized patents and the number of transformed patents was -0.208, and the significance level was 0.539, which was greater than the given significance level of 0.05. Therefore, there was no correlation between the number of authorized patents and the number of transformed patents.

| Table 4. Results of correlation analysis |
|---------------------------------|
| **Name** | **Related index** | **Authorized patents number** | **Transformed patents number** |
| Authorized patents number | Pearson correlation | 1 | -.208 |
| | Significance (bilateral) | | .539 |
| | Sum of square and cross product | 3.629E7 | -124058.182 |
| | Covariance | 3629129.273 | -12405.818 |
| | N | 11 | 11 |
| Transformed patents number | Pearson correlation | -.208 | 1 |
| | Significance (bilateral) | .539 |
| | Sum of square and cross product | -124058.182 | 9786.545 |
| | Covariance | -12405.818 | 978.655 |
| | N | 11 | 11 |

(3) In order to test the causal relationship between the number of authorized patents and the number of transformed patents, and whether there was an interaction between them, the following regression analysis was
selected.

Figure 3. Regression result of the number of authorized patents and the number of transformed patents

It can be seen from Fig. 3 that the available value was 0.5391, which was greater than the significance level of 0.05. Therefore, there was no causal relationship between them. In the regression analysis, the fitting degree of the regression equation was reflected, but the fitting degree obtained by the regression analysis was only 0.043, so the regression equation was meaningless. Therefore, it was concluded that there was no interaction between them. Based on the above three research methods, it can be proved that there was not a positive correlation between university's scientific research ability and patent transformation performance, but mainly lay in the university's emphasis and work strategy. The effective measures to improve patent transformation were summarized as follows:

First of all, incentive policies are conducive to improving the ability of innovation. The patent transformation rate of Yunnan Agricultural University was 3.8%, ranking second among universities in Yunnan. In order to encourage the majority of teachers and students to innovate independently, the "Reward Measures for Yunnan Agricultural University, Teaching, Scientific Research and Management" was promulgated on November 3, 2015 to establish the reward methods for relevant authorized patents and other achievements. According to the statistics, 16 patents were transformed in 2015, which showed that the policy effectively stimulated the enthusiasm of researchers to promote the transformation of scientific and technological achievements.

Secondly, the application prospect meets market demand. The number of authorized patents of Kunming University of Science and Technology ranked first in Yunnan universities, with a total of 799, showing a strong innovation ability. The number of patents transferred was 17, and the transformation rate was 2.0%. In addition, the university had 16 national, 9 ministerial, 114 provincial, 15 municipal and 23 university level research platforms to track the patents transformed, and found that the transferees were new energy materials and chemical companies. This may be due to the fact that the university can closely focus on its own discipline advantages, actively promote industry university cooperation, and research in new materials, new energy, ecological environment and other fields.

Finally, the structure of scientific research can improve the transformation rate. The number of authorized transfer patents obtained by Dali University was small, and there were only two patents, which belonged to invention patents. However, they had been completely transformed, and the transformation rate was as high as 100%, which was the highest in Yunnan Province. Through the database, it was found that Kunming sinopharma Co., Ltd. is the transferees of the two patents, and the school also had drug research institute, innovation and entrepreneurship training base, etc. The above situation showed that Dali University had a high ability of innovation and application of science and technology, and the efficiency of transformation had been improved mainly through the scientific research structure of university.

It is often difficult to achieve results if we do not attach importance to the transformation work or do not pay enough attention to it. Yunnan University is the key construction university of the national "211 Project", and is also the best university in Yunnan. It had the second patent authorized quantity of 89, but the number of transformed patents was 0. Effective patents accounted for 31.73%, and invalid patents due to non-payment accounted for 42.26%. Yunnan Normal University ranked the third in the number of patents among universities in the province, but the number of patents transferred from Yunnan Normal University to other universities was 0.

4.3. Management and Maintenance of Patent Transformation

Table 5 below showed the forms and effectiveness of patent transformation of Universities in Yunnan. Among the 491 patents transformed from 2008 to 2018, 415 patents were transferred, accounting for 88.11 %, and the proportion of license implementation was 11.41 %, indicating that patent right transformation is the main way for university patent transformation in Yunnan. There were 380 valid patents, accounting for 77.39 % of the total number of transformed patents. Although the transformed patents had a certain market value, there were also invalid patents in the transformed patents, accounting for 16.29 %. The patents were mainly applied for before 2008, but the
patent rights were terminated because of the expiration of the protection period and the annual fee was not paid. It can be seen that there are still loopholes in the management and maintenance of patent transformation.

**Table 5. Forms and effectiveness of patent transformation of universities in Yunnan**

| License implementation | Patent transfer | Valid | Invalid |
|------------------------|----------------|-------|--------|
| Total (pieces)          | 56             | 415   | 380    |
| Proportion (%)          | 11.41          | 88.11 | 77.39  | 16.29  |

### 4.4. Ways of Patent Transformation

During transformation process of university patent often accompanies patent person and patent ownership change. Through the analysis of the types and transfer ways of university patent technology transferor and transferee, the transfer mode and path of patent can be summarized into six types: university-university mode, university-enterprise mode, university-personal mode, university-scientific research institution mode, university-intermediary mode, university-intermediary-enterprise mode.

There were three modes of patent transformation of universities in Yunnan province. The total proportion of university-university mode and university-scientific research institution model was 43%. The transformation of these two modes only re-attributed the patent right, and did not put the patent into the market. The transfer of patent technology to enterprises was the main way for universities to transform scientific and technological achievements. In Fig. 4, the university-enterprise model accounted for the largest proportion, which was 57%. It showed that some patents were directly transferred to enterprises, which would have better market prospects and faster economic benefits. Universities regarded enterprises as the main carrier of patent transformation, and transferring patents directly to the market and enterprises as the main transfer path.

![Figure 4. The distribution of patent transformation paths of universities in Yunnan Province](image)

### 4.5. Technical Fields of Patent Transformation

Fig. 5 showed the distribution of patent technology fields of universities in Yunnan from 2008 to 2018. According to the analysis of the subcategory composition of patent IPC classification number [7], the top 10 technology regional
distribution of patent transformation of universities in Yunnan showed that the technology output of Yunnan University was mainly distributed in "agriculture, light industry and medicine" in part A, "chemistry and metallurgy" in part C and "physics" in part G. Among them, universities in Kunming area were the most widely distributed area in the technology field. The main output technologies involved biomedicine (A61K, A61P), solid waste treatment (B09B), metal alloy (C22C, C22B), chemical analysis (G01B, C01F, C01N), etc., and Dali mainly involves biomedicine (A61K, A61P) and other fields. It can be seen that the marketization level of patent transformation of universities in Yunnan Province was generally low except Kunming, and the overall regional distribution of technology was unbalanced.

5. SUMMARY

1) Through the analysis of the patent status of Yunnan universities, except Yunnan Agricultural University, Kunming University of Science and Technology and Dali University, the patent transformation status of other 29 universities was worrying. During the 14th Five Year Plan period, universities in Yunnan are expected to plan and arrange patent transformation promotion measures, increase cooperation with external institutions, and promote the number of transformation in more technical fields.

2) The main issues were insufficient attention to patent work, inadequate maintenance and management of patents, lack of communication channels with enterprises and the unbalanced distribution of technology fields. The degree of attention, work measure and scientific research level of different universities affected patent conversion rate greatly, and there was a phenomenon of unbalanced geographical distribution.

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