Received: November 30, 2017
Revision received: June 14, 2018
Accepted: June 17, 2018

Copyright © 2018 **ESTP**
www.estp.com.tr
DOI 10.12738/estp.2018.6.180 ♦ December 2018 ♦ 18(6) ♦ 2794-2807

Research Article

Empirical Research on the Influencing Factors of the Conversion Efficiency of Scientific and Technological Achievements in Colleges and Universities Based on Tobit Model

Feng Di[1]
Taiyuan University of Technology

Abstract

The two-step method of DEA and Tobit is used and the conversion efficiency of scientific and technological achievements in colleges and universities is taken as the output measurement index to evaluate the conversion efficiency of scientific and technological achievements of 24 universities in China and analyze the four major factors (human input, financial input, knowledge input and policy environment) and 9 sub-factors affecting the conversion efficiency of scientific and technological achievements in colleges and universities. The achievements show that the internal R&D expenditure, development expenses on new products, investment in scientific and technological activities, full-time equivalent of R&D personnel, patent application quantity and scientific papers included in the three core journals exert a positive impact on the conversion efficiency of scientific and technological achievements in colleges and universities; the cumulative number of relevant policies issued in the region has a negative impact on the conversion efficiency of scientific and technological achievements in colleges and universities. In response to this result, this paper proposes some suggestions for improving the conversion efficiency of scientific and technological achievements in colleges and universities from the aspects of manpower, financial resources, knowledge and related policies.

Keywords

Scientific and Technological Achievements • Tobit Model • Influencing Factors • Conversion Efficiency

[1]**Correspondence to:** Feng Di (PhD), College of Economic and Management, Taiyuan University of Technology, Taiyuan 030024, China. Email: difeng0815@163.com

Citation: Di, F., Empirical Research on the Influencing Factors of the Conversion Efficiency of Scientific and Technological Achievements in Colleges and Universities Based on Tobit Model, *Educational Sciences: Theory & Practice, 18(6),* 2794-2807. http://dx.doi.org/10.12738/estp.2018.6.180

Multiple subjects are involved in the complex and systematic process of the conversion of scientific and technological achievements in colleges and universities and each subject will inevitably have a certain impact on the conversion of scientific and technological achievements. At present, the total conversion quantity of scientific and technological achievements in colleges and universities in China continues to increase. About 10,000 scientific and technological achievements in colleges and universities have passed the appraisal every year in China. In 2015, the transaction amount of technology contracts was 983.579 billion yuan. However, the conversion rate of scientific and technological achievements in China is only about 10%, which is much lower than the 40% in developed countries, while the conversion rate of scientific and technological achievements in colleges and universities is even lower (Shao, Fang, Pan & Zhang, 2013; Ge, Song & Wan, 2015).

Although the status quo of unsatisfactory conversion of scientific and technological achievements in China's colleges and universities has attracted the extensive thinking and exploration of many scholars, and some research achievements have been obtained. However, the existing literature is mainly the overall analysis and evaluation of China's colleges and universities and the research conclusions are also relatively general. There are many unsatisfactory situations in the conversion of scientific and technological achievements in China and these problems are more prominent in the central and western regions, which is directly related to some of the problems in the three-key links in the conversion of scientific and technological achievements in China. According to the author's understanding, the conversion chain of scientific and technological achievements can be roughly divided into "donors" (scientific research institutions) that create and provide scientific and technological achievements, "recipients" (material production departments) that receive and materialize scientific and technological achievements and "media" that is responsible for the communication between the above-mentioned "donors" and "recipients". Therefore, in order to better analyze the conversion process of scientific and technological achievements in China's colleges and universities, it is necessary to analyze the conversion efficiency of scientific and technological achievements in China's universities from the four main influencing factors, namely human input, financial input, knowledge input and policy environment.

At present, scholars have carried out a series of studies on this topic. For example, Ge (2015) analyzed the current development trend of the conversion of scientific and technological achievements in China' colleges universities through policy analysis; Fu *et al*., (2015), Qi (2014) and Ren (2011) analyzed the problems and influencing factors of the conversion of scientific and technological achievements in colleges and universities from the perspective of industrial parks, universities and government; Liu *et al*., (2014) and Su (2015) discovered the enlightenment on the conversion of scientific and technological achievements in Chinese universities through the study of foreign experience. On the basis of calculating the conversion efficiency of scientific and technological achievements in various universities through the DEA model, this paper uses the panel Tobit model to test the impact of human input, capital investment, knowledge input and policy environment on the conversion efficiency of scientific and technological achievements in China's colleges and universities.

Panel tobit model and selection of influencing factors

Tobit Model

The Tobit model is also called the sample selection model, restricted dependent variable model and is a model in which the dependent variable satisfies the value under certain constraints. This model consists of two parts: one is the selection equation model that represents the constraint conditions and the other is a continuous variable equation model that satisfies the constraint conditions. In practical applications, the Tobit regression model is mainly used for the case where the dependent variable is limited; some values cannot be obtained or are fragmented. The dependent variable studied in this paper is the conversion efficiency of scientific and technological achievements of various universities calculated by the DEA model and the value range is [0,1]. Therefore, the standard Tobit model is used in this paper and the specific model expression is shown in equation (1).

$$\Pr\left(TE_{it} \mid X_{it}\right)=\int_{-\infty}^{+\infty}\frac{e^{\frac{-u_i^{\,2}}{2\sigma^2}}}{\sqrt{2\pi}}\left\{\prod_{t=1}^{T}F\left(X_{\text{it}}^{\,T}\beta+u_i\right)\right\}du_i \tag{1}$$

In this equation:$\mathrm{F}(X_{it}^{T}\beta+u_i)=\begin{cases}\frac{1}{\sqrt{2\pi}\sigma}e^{\frac{-(TE_{it}-X_{it}^{T}\beta-u_i)^2}{2\sigma_e^2}}, if, TE<1\\ 1-\emptyset\left(\frac{TE_{it}-X_{it}^{T}\beta-u_i}{\sigma_e}\right),\ if, TE\geq 1\end{cases}$

In this equation: X_{it} is the explanatory variable vector; β is the parameter to be estimated; ∅ is the cumulative probability distribution function of standard normal distribution; $\mathrm{Var}(u_i)=\sigma^2$ and $\mathrm{Var}(\varepsilon_{it})=\sigma_e^2$ represent the variance of heterogeneity effect (u_{i}) and error term (ε_{it}) respectively. Assume that the probability distribution of u_{i} and ε_{it}obeys the normal distribution $\mathrm{N}(0,\sigma^2)$ and $\mathrm{N}(0,\sigma_e^2)$ respectively. TE_{it}<1 is the non-truncated observed value and $TE_{\text{it}}\geq 1$ is the right truncated observed value. The Gauss-Ermite quadrature method is used to obtain the approximate integral of equation (1). The likelihood function can be obtained as follows:

$$\begin{aligned}L&=\sum_{i=1}^{n}w_i\log\left\{\Pr\left(TE_{it}\mid X_{it}\right)\right\}\\ &\approx\sum_{i=1}^{n}w_i\log\left\{\frac{1}{\sqrt{\pi}}\sum_{m=1}^{M}w_m^{*}\prod_{t=1}^{T}F\left(X_{\text{it}}^{\,T}\beta+\sqrt{\frac{2\rho}{1-\rho}}\,a_m^{*}\right)\right\}\end{aligned} \tag{2}$$

In this equation: w^*_{m} represents a four-dimensional weight; a^*_{m} represents a four-dimensional abscissa; $\rho=\frac{\sigma^2}{\sigma^2+\sigma_e^2}$; w_{i} is the weight, which is generally set as 1. Then, the equation (2) is maximized to obtain the estimation of the parameter to be estimated.

Selection of Influencing Factors

This paper classifies 24 universities according to their regions and divides them into universities in the eastern region (Peking University, Tsinghua University, Nankai University, Tianjin University, Northeastern University, Fudan University, Tongji University, Shanghai Jiaotong University, Nanjing University, Southeast Universityn, Zhejiang University, Xiamen University, Shandong University and Zhongshan University), universities in the central region (Jilin University, Hefei University of Technology, Wuhan University, Huazhong University of Science and Technology, Hunan University and Central South University) and universities in the western region (Chongqing University, Sichuan University, Xi'an Jiaotong University and Lanzhou University). As shown in Table 1, the dependent variable in the table is the conversion efficiency of scientific and technological achievements of various universities calculated by the DEA model, whose value range is [0, 1], so its value is in accordance with the applicable conditions of the Tobit model.

Table 1
Estimation of the Correction Efficiency of Bootstrap-dea in Scientific and Technological Conversion of Chinese Universities

University name	Year			
	2001	2002	2008	2009
Peking Univ	0.86	1.00	0.88	0.78
THU	1.00	1.00	0.86	0.94
NKU	0.89	1.00	0.78	0.72
Tianjin Univ	0.21	0.62	0.77	0.74
NEU	0.38	0.68	0.64	0.61
JLU	0.87	0.86	0.72	0.66
Fudan Univ	0.75	0.73	0.84	0.48
TJU	0.55	0.66	0.86	0.85
Shanghai Jiao Tong Univ	0.37	0.62	0.84	1.00
Nanjing Univ	0.57	1.00	1.00	1.00
SEU	0.84	0.86	1.00	1.00
Zhejiang Univ	0.78	0.92	1.00	1.00
HFUT	0.67	0.98	1.00	1.00
XMU	0.68	0.77	0.86	0.96
Shandong Univ	0.76	0.84	0.95	1.00
Wuhan Univ	0.56	1.00	0.72	0.86
HUST	0.88	0.64	0.34	0.48
HUNAN UNIV	0.26	0.41	0.57	0.94
Central South Univ	0.34	0.87	0.29	0.31
SYSU	0.69	1.00	1.00	0.97
CHONGQING UNIV	1.00	1.00	1.00	1.00
Sichuan Univ	0.34	0.27	0.56	1.00
Xi'an Jiaotong Univ	0.64	0.55	0.76	0.69
LANZHOU UNIV	0.35	0.37	0.42	0.38
Mean value	0.64	0.78	0.77	0.81
Standard deviation	0.20	0.18	0.16	0.18

The raw data analyzed in this paper are from *China Statistical Yearbook*, *China Science and Technology Statistical Yearbook* and *China Energy Statistics Yearbook*. Considering the lag phase is adopted in the performance evaluation, this paper uses the average value of the influencing factors and the model and applies the Eviews5.0 software for the regression analysis of the Tobit model. The influencing factors mainly consider four major factors and nine sub-factors, namely manpower input (number of R&D researches (X1), full-time

equivalent of R&D personnel (X2)), capital investment (R&D internal expenditure (X3), scientific and investment in scientific and technological activities (X4), development expenses on new products (X5)), knowledge input (quantity of patent applications (X6), quantity of patent authorization (X7), scientific papers included in the three core journals (X8)) and policy environment (the relevant policies (X9) issued in the region. See Table 2 for details.

Table 2
The Main Analysis Factors of Achievement Conversion Benefit in Universities

Factors	human input	R&D personnel Number (X1) R&D Researcher full time equivalent (X2)
	funding	R&D Internal expenditure (X3) Funding for scientific and technological activities (X4) New product development costs(X5)
	Knowledge input	Patent applications (X6) The number of patents granted (X7) Scientific and technical papers included in the three core journals (X8)
	policy environment	The cumulative number of relevant policies by the region (X9)

Result analysis of the factors affecting the conversion of scientific and technological achievements

Table 3 Factors affecting the conversion efficiency of scientific and technological achievements in colleges and universities

Table 3
Factors affecting the conversion efficiency of scientific and technological achievements in colleges and universities

influence factors	coefficient	Std. error	T	Sig.
R&D personnel Number (X1)	0.000	0.000	-2.180	0.042
R&D Researcher full time equivalent (X2)	1.652	1.493	1.110	0.383
R&D Internal expenditure (X3)	13.121	4.652	2.280	0.011
Funding for scientific and technological activities (X4)	40.456	10.347	2.060	0.037
New product development costs(X5)	66.068	24.784	2.670	0.015
Patent applications (X6)	0.090	0.218	0.420	0.682
The number of patents granted (X7)	-2.555	2.496	-1.020	0.319
Scientific and technical papers included in the three core journals (X8)	2.546	16.089	0.160	0.875
The cumulative number of relevant policy by the region (X9)	-3.041	1.472	-2.070	0.053
constant term	-0.725	0.709	-1.020	0.319
Sig	0.248	0.036		

The calculation achievements are shown in Table 3. The impact of human input, following is an analysis of the impact of human input, financial input, knowledge input and policy environment on the conversion efficiency of scientific and technological achievements in colleges and universities.

Human input

(1) Backward management concept. The first is the extreme “administration” of school management. In underdeveloped areas, the management concept and method of colleges and universities are still relatively

backward, basically adopting the method handed over from the planned economic system. The tough administrative means are adopted various management work, often ignoring the basic rights and feelings of teachers, which is likely to lead to talents' dissatisfaction and resistance to the school management. The second is the overstaffing in organizations and unreasonable faculty structure. The common problem in colleges and universities in underdeveloped areas is large number of administrative institutions and large proportion of non-teaching staff. In particular, the socialization reform of logistics is lagging behind, which leads to the situation of redundant staff. This has objectively affected the efficiency of school work and makes teachers feel exploitative. Furthermore, it is impossible to provide a free and relaxed environment for the development of outstanding talents. A free and relaxed development environment is an indispensable condition for the growth of outstanding talents. However, many colleges and universities in underdeveloped regions are relatively rigid in the way of talent management, such as asking them to participate in political studies and even assigning some administrative affairs to them. In short, an unreasonable management system makes it difficult for talents to have a sense of belonging to the school.

(2) Unsound incentive mechanism. In the vast number of colleges and universities in underdeveloped regions, generally there are following problems in the distribution system and incentive mechanism. First of all, in many colleges and universities, the work performance is not proportional to distributed income, which seriously dampens the enthusiasm of talents. Secondly, the phenomenon of "assigning priority according to seniority" is still prevalent on the professional title appraisal. Thirdly, there is a lack of a fair environment for talent competition. Many colleges and universities have failed to handle the relationship between "local talents" and "introducing talents", often paying more attention to the latter while despising or even ignoring the former, which is reflected in the allocation of scientific research funds and accommodation. In short, an unsound incentive mechanism makes it difficult for talent to have a sense of fairness.

(3) Inaccurate orientation of the school. Most colleges and universities in underdeveloped regions do not have a precise orientation in the school-running level, school-running direction and school-running characteristics. As universities in underdeveloped regions, there are "congenital insufficiencies" in many aspects. Therefore, it is necessary to be practical and realistic, foster strengths and avoid weaknesses and identify our own direction and level in school-running orientation. However, with the new round of upgrading and mergence of colleges and universities, many colleges and universities in underdeveloped regions are consciously or unconsciously divorced from the reality in school development. The key universities in developed regions have been used as the template for their own development, blindly pursuing larger scale and high level but ambiguous about their own characteristics. Therefore, they have entered the "Great Leap Forward" type of development. These colleges and universities mainly focus on hardware construction and neglect the talent construction. As a result, schools cannot achieve good development and the management is chaotic so that people cannot have a sense of belonging.

(4) Focusing on "introducing talents" while neglecting "local talents". There are still many problems in the process of talent introduction and personnel management in colleges and universities in underdeveloped regions. For example, for the introduction of high-level talents, the schools have given preferential policies in terms of job subsidies, professional title, housing, spouse placement and research start-up funds. Schools have provided better living and working conditions, but due to the hostile geographical environment, economic environment

and social environment of colleges and universities in underdeveloped regions, the introduced high-level talents are not satisfied with their current position, but have the purpose of pursuing short-term economic benefits. They have enjoyed the relevant preferential treatment, but not have played their role of academic leaders. Their scientific research achievements are not even comparable to the young masters and doctors. Although the school has formulated relevant policies for the introduction of high-level talents, there is a lack of mechanism for the management and use of talent introduction. There is no effective response to the above phenomena. On the one hand, introducing talents will cost a large sum of money; on the other hand, talents are left unused and cannot play their role. In addition, for local talents at the same level, schools are lacking in the same incentives and preferential policies due to the lack of funds, thus ignoring the cultivation and caring for them. The phenomenon of focusing on ″introducing talent" while neglecting "local talent" is obvious, which will inevitably lead to the psychological imbalance of the personnel of the same level in the school and dampen the enthusiasm of local talents. The personnel of the same level in the school may feel psychologically unbalanced and even find another job, which seriously affects the stability of talents in colleges and universities in underdeveloped regions.

Financial Input

In order to promote the conversion of scientific and technological achievements in colleges and universities, the nation has gradually begun to revise the science and technology laws and implement the reform of the management system of scientific and technological achievements. Local government and universities have also introduced a series of policies. China has basically confirmed the policy system of the conversion of scientific and technological achievements in colleges and universities with the "Science and Technology Progress Law" and "Law on Promoting the Conversion of Scientific and Technological Achievements" as the foundation, and "Several Opinions on Strengthening the Conversion of Scientific and Technological Achievements in Colleges and Universities" as an important reference and local laws and regulations as supplementary. The former advocates that universities should provide sufficient financial support and a more relaxed working environment for developers of scientific and technological achievements and also provide a series of legal and policy preferential measures for the conversion of scientific and technological achievements; the latter focuses on the key institutional issue restricting the conversion of scientific and technological achievements, mainly reflected in "decentralization" and "interest". On the one hand, promoting the decentralization of the right of disposal, usage and management of scientific and technological achievements. Colleges and universities can not only have the right to transfer, license or counted as investment in their own scientific and technological achievements, but also 100% of the converted revenue is attributed to colleges and universities. Also, it can also be used as rewards and to promote the conversion of further scientific and technological achievements. On the other hand, 50% of the lower limit of the income is guaranteed as the incentives and distribution of researchers.

In 1994, the State Education Commission, the International Science and Technology Commission and the State Reform Commission jointly promulgated the "Several Opinions on the Development of Science and Technology Industry in Higher Education Institutions", clearly stating that the scientific researchers can enhance the level of professional titles by increasing their research level, improving work performance and improving business capabilities. The "National Science and Technology Awards Regulation" was amended in 2003, which

stated that the State Science and Technology Top Awards would be awarded to researchers and enterprises that have promoted national scientific and technological progress and innovation, applied the scientific and technological achievements to production and created enormous social and economic benefits. In terms of the promotion and application of scientific and technological achievements, citizens who have made outstanding contributions to the conversion of scientific and technological achievements will be awarded Science and Technology Progress Award by the state. The "Rules for the Implementation of the National Science and Technology Awards" promulgated in 2004 made detailed provisions on how to properly define and refine the science and technology awards mainly based on social and economic benefits. Developers will be awarded State Science and Technology Awards as long as they have been implementing large-scale scientific research projects for more than one year and gained enormous social and economic benefits. In 2006, the State promulgated the "National Medium- and Long-Term Science and Technology Development Plan (2006-2020)", which clearly stated that it was necessary to construct a comprehensive evaluation mechanism for the quality of scientific research achievements, the collaborative and innovative management mechanism and talent cultivation, so as to form a comprehensive scientific evaluation mechanism to achieve the overall improvement of management level and innovation capabilities.

Knowledge Input

From the perspective of knowledge input, the quantity of patent applications, the quantity of patent authorization, scientific papers included in the three core journals have a significant positive impact on the conversion efficiency of scientific and technological achievements in colleges and universities.

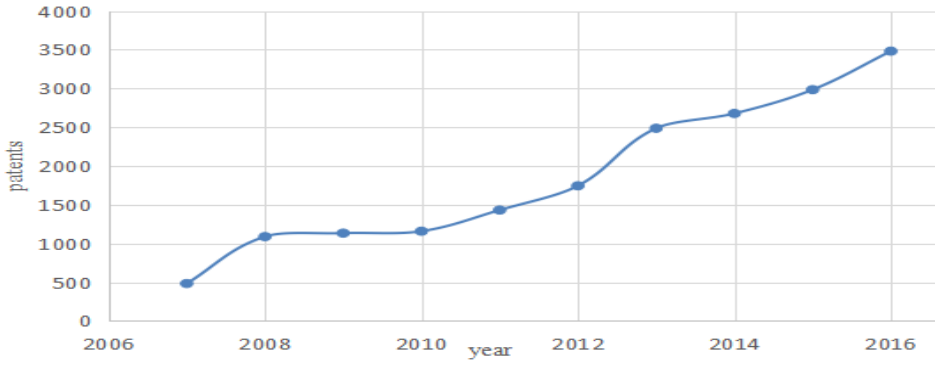

Figure 1. The patent application trend chart of Yunnan province.

Analysis of patent application quantity: With the implementation of the national intellectual property strategy and the further deepening of the reform of the education and science and technology management system, in 2008, the State Council promulgated the "Outline of the National Intellectual Property Strategy" and in 2015, the "Law on Promoting the Conversion of Scientific and Technological Achievements in People's Republic of China" was amended. The management of intellectual property rights has developed rapidly in colleges and universities. Institutions of higher learning have rich intellectual resource and accommodate nearly

half of the top researchers in China. They have outstanding advantages in disciplines, talents, information, laboratories, etc., and are an important force in technological innovation. The larger the quantity of patent applications, the higher the innovation capacity of a society and the more vital the society. It also reflects whether the technological development activities are active and the inventors are motivated to seek patent protection. Taking Yunnan Province as an example, the data for the seven years from 2010 to 2017 reflect the increasing quantity of patent applications in the selected colleges and universities, as shown in Figure 1. In the selected colleges and universities, the total quantity of patent applications of general undergraduate institutions of higher learning reaches 18,220 and it is expected that in the next few years, the quantity of patent applications in the selected colleges and universities will maintain a rapid and steady growth trend.

In 2007-2016, the quantity of patent applications in selected universities was extremely uneven, as shown in Table 4. The ranking of the quantity of patent applications in selected universities mainly reflects the factors related to subject areas, major settings and research directions. First of all, it can be seen from the analysis of the top ten selected colleges and universities in terms of the quantity of patent applications that the common point is that the proportion of invention patent applications is relatively high while the proportion of appearance design patent applications is relatively low. Secondly, in terms of the subject area and professional characteristics, patent achievements are more likely to be generated from science and engineering, agricultural medicine and comprehensive colleges. Therefore, the quantity of applications from such university's accounts for a large proportion. Among them: (related colleges and universities are analyzed according to the collected data) the quantity of patent applications in Kunming University of Science and Technology's ranks first in Yunnan province. The total quantity is 12,652, accounting for 69.44% of the total in selected colleges and universities; Yunnan Agricultural University ranks second, accounting for 7.73% of the total ranking second; Yunnan University ranks third, accounting for 6.75% of the total. The total quantity of patent applications in these three universities accounts for 83.92% of the total in Yunnan Province.

Table 4
Ranking of patent applications of universities in Yunnan province from 2007 to 2016

ranking	name of institution	Invention patent	utility patent	Design patent	total	Proportion of invention patents
1	KUST	7356	4877	419	12652	58%
2	Yunnan Agricultural University	824	558	27	1409	58%
3	YUN	1118	109	3	1230	91%
4	Yunnan Normal University	424	293	8	725	58%
5	Kunming University	342	237	7	586	58%
6	Southwest forestry university	286	49	8	343	83%
7	Yunnan Minzu University	309	16	0	325	95%
8	Kunming medical university	147	133	0	280	53%
9	Honghe university	77	163	1	241	32%
10	Yunnan college of traditional Chinese medicine	106	18	1	125	85%

Analysis of the status quo of patent authorization. Along with the continuous improvement of the comprehensive strength and innovation level of colleges and universities, the awareness of intellectual property protection in colleges and universities has also been continuously enhanced. The quantity of patent authorization is also an important manifestation of the comprehensive strength and innovation level of colleges and universities. In recent years, the quantity of patent authorization in selected colleges and universities has been

growing by leaps and bounds. More and more colleges and universities have begun to pay attention to intellectual property protection and achieved a series of breakthroughs. On the one hand, it benefits from the continuous improvement of the comprehensive strength and innovation level of colleges and universities so that they have attached more emphasis on patent protection. On the other hand, the patent innovation and entrepreneurship competition of college students held by Intellectual Property Office and the Education Bureau enables more colleges and universities to be aware of the importance of patent protection. As shown in Figure 2, in 2010-2017, the quantity of invention patents is 2,936; the quantity of utility model is 5,725; and the quantity of appearance design is 409, accounting for 32.40%, 63.17%, and 4.51% respectively of the total quantity of patent authorization in selected colleges and universities. For colleges and universities in the underdeveloped central and western regions, the proportion of invention patent authorization is generally low.

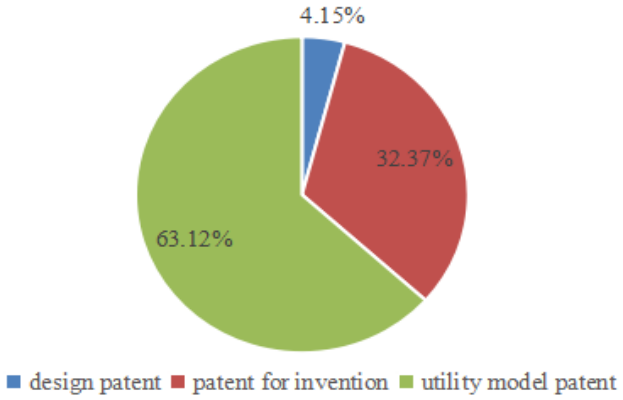

Figure 2. Structure chart of the types of patent authorization granted by universities in Yunnan province.

Analysis of the number of scientific papers included in the three core journals. China's higher education institutions are not only an important base for cultivating high-level innovative talents, but also a new force in the national innovation system. The scientific and technological innovation capacity of colleges and university is the decisive factor that affects their scientific research performance and academic level of and is also the key link in promoting the sustainable development of colleges and universities. As one of the important forms of scientific and technological innovation achievements, scientific papers reflect the scientific and technological innovation and international competitiveness level of this country or institution to a certain extent. The quantity and quality of scientific papers in colleges and universities reflect the output capacity of scientific and technological innovation and the activity of scientific and technological innovation activities in colleges and universities. The quantity and quality of papers collected by the three world-famous major retrieval systems SCI-E, EI and CPCI-S have become one of the important indicators for the objective evaluation of the scientific research development and innovation capability of academic institutions such as colleges and universities.

The number of papers included in three major retrieval systems is an objective and quantitative evaluation method for scientific research achievements, but not the only evaluation standard. While formulating scientific research management and incentive policies, schools must respect the development law of scientific research itself. The period of scientific research assessment can be appropriately extended because it is possible that

researchers might not produce scientific research achievements for a long time. On the basis of ensuring more achievements, they should be encouraged to produce more high-quality, high-impact academic achievements, thereby enhancing the academic influence of individuals and even institutions.

Policy Environment

The local policies in the underdeveloped central and western regions of China are poorly connected to the central policies, and the policy status of the might be shaken. The conversion of local scientific and technological achievements is often based on the development of regional economy, bearing local characteristics in terms of policy characteristics. Also, the related data or indicator settings are also relatively flexible, but the policy effect is only local regulations. There are questions that whether these policies are effective for institutions directly under the Ministry of Education, which has shaken the legal status of policies. All of these have reflected the problem of poor coordination and connection between local policies and central policies.

Some policy contents are ambiguous, which are reflected in: (1) Incomplete policy environment. The insufficient systematic effect of the conversion of scientific and technological achievements in colleges and universities in China is a key factor restricting the improvement of the conversion rate of scientific and technological achievements in colleges and universities. It is mainly reflected in two aspects: firstly, it lacks a well-established legal guarantee system. At present, China's science and technology legislation is mainly from the perspective of institutional reform, giving more consideration to the content of the national policy level, such as the “Law on Science and Technology Progress” and the “Law on Promoting the Conversion of Scientific and Technological Achievements”, etc. There is a lack of targeted and systematic laws on the conversion of scientific and technological achievements in colleges and universities. The policy system of the conversion of scientific and technological achievements has low legal hierarchy and weak implementation efficiency. Secondly, the lack of supporting policies affects the implementation effect of the main policy. The scientific and technological progress and the conversion of scientific and technological achievements involve many complicated factors, which not only calls for a systemic law combined with the actual situation of colleges and universities as a fundamental reference for policy implementation, but asks various departments, regions and universities to introduce supporting implementation regulations and management methods to form a complete policy system. On the one hand, the provisions in the “Law on Promoting the Conversion of Scientific and Technological Achievements” on state fiscal investment, tax preference, credit support, risk funds and value evaluation of achievements are too abstract and the state competent authorities have failed to introduce supporting policies, which makes it difficult to implement the conversion of scientific and technological achievements. On the other hand, the number of colleges and universities in China that have introduced the implementation regulations for supporting and promoting the conversion of scientific and technological achievements is still insufficient and the scope is still to be strengthened. Many colleges and universities fail to introduce the conversion system of scientific and technological achievements combined with the actual situation of colleges and universities so that the practical problems arisen in the conversion of scientific and technological achievements cannot be solved with reference to central or local policies. The effectiveness of policy

implementation is low and the conversion rate is stagnant or even retrogressive. (2) Irrational scientific research evaluation policies in colleges and universities. Most of the current research evaluation policies in colleges and universities in China adopt "quantitative" methods to evaluate teachers and scientific researchers whether in the introduction of scientific research talents, approval of performance or allowances or post promotion. Also, there is a rigid rule that personnel of different levels and titles must complete certain number of scientific research tasks, focusing on the evaluation indicators such as vertical projects, dissertations and awards. Which is taken as a basis for the appraisal and employment. The conversion efficiency of achievements and economic contribution rate, which play a key role in the conversion of scientific and technological achievements, are not included in the evaluation system. Therefore, this unscientific evaluation method may lead to two kinds of unhealthy phenomena. Firstly, some teachers and scientific researchers only do researches to cope with the task, which is of poor quality. There is a far distance between most scientific and technological achievements and the industrialization stage of achieving economic benefits. Or they are too anxious for success, neglecting the assessment, so that the conversion of scientific and technological achievements is of high risk. These are the important reasons for the low conversion rate of scientific and technological achievements in colleges and universities in China; secondly, some people seek quick success and instant benefits and simply carry out scientific research activities for the pursuit of material interests, which has fostered a bad atmosphere of academic corruption and exerted severe impact on the scientific and technological innovation level in colleges and universities.

Conclusion

Through the above analysis, the following conclusions can be obtained:

(1) Internal R&D expenditure (X3) has a positive impact on the conversion efficiency of scientific and technological achievements in colleges and universities. According to the analysis, the higher the internal R&D expenditure of a university, the more the convertible scientific research achievements in this university and the greater the conversion efficiency of scientific research achievements in this university.

(2) The development expenses on new products (X5) and investment in scientific and technological activities (X4) have a positive impact on the conversion efficiency of scientific and technological achievements in colleges and universities. The greater the investment in these two aspects, the stronger the output capacity of the scientific research of this university. Under the premise of relatively large base, the relatively low will lead to high conversion efficiency. This shows that for some colleges and universities, expanding the relative amount of development expenses on new products (X5) and investment in scientific and technological activities (X4) moderately can improve the conversion efficiency of scientific research achievements.

(3) The number of relevant policies (X9) issued in the region has a negative impact on the conversion efficiency of scientific research achievements in colleges and universities. The larger the number of policies on the conversion of scientific research achievements issued in a region, the lower the market rate of scientific research achievements in the region. This further indicates that the scientific and technological achievements of colleges and universities have not really taken the market economy route, which will damage the economic interest of the owners of scientific research achievements in colleges and universities and reduce the motivation for the conversion of scientific research achievements. Therefore, how to correctly guide the conversion of scientific research achievements in colleges and universities to the path of market economy and standardize the corresponding policies is a problem that must be faced in the future conversion of scientific research achievements in colleges and universities in China.

(4) Although the influencing factor of the number of R&D personnel (X1) has passed the significant test, the test results show that the number of R&D personnel (X1) has little impact on the conversion efficiency of scientific research achievements in colleges and universities (the number of R&D personnel (X1) in Table 3 is close to 0). This conclusion is contrary to the convention, which may due to the use of cross-section data and data insufficiency in this study. However, this conclusion can reflect a phenomenon that the conversion efficiency of scientific research achievements in colleges and universities is the result under a multi-factor influence. The number of R&D personnel (X1) cannot determine the conversion efficiency of scientific and technological achievements.

(5) Although the full-time equivalent of R&D personnel (X2), quantity of patent applications (X6), and scientific papers (X8) included in the three core journals are not statistically significant, they all have positive effect on the conversion of scientific and technological achievements in colleges and universities.

References

Fu, X. M., Wang, L., Wang, B. L., & Jia, J. (2015) Studies on the problems and Countermeasures During the Work of Technology Achievement Transformation of Universities in Zhongguancun haidian sciencepark. *Science & Technology for Development*, 109-113. https://dx.doi.org/10.11842/chips.2015.01.014

Ge, Z. Z., Song, W., Wan, M. (2015) Ming. Analysis on the development trend of policies to promote the transformation of scientific and technological achievements. *Chinese University Science & Technology, 1*, 116-119.

Liu, X. Z., Ren, Y. J., Ma, J., Wu, W. H., & Chen, D. S. (2014). Lawrence Berkeley national laboratory technology transfer system and benefit analysis. *Science and Technology Management Research*, 95-100.

Ren, J. Y. (2011). An analysis of the problems and solutions of university technology transfer from the government's point of view in China, *Science and Technology Management Research*, 87-91.

Shao, X., Fang, Y. Z., Pan, J. Q., & Zhang, Yu. (2013). On the problems of the transformation of scientific and technological achievements in local colleges and the ways to deal with them, *Science & Technology for development*, 49-53.

Su, Y., & Zhao, W. H. (2015). How dose China's research-oriented universities serve the development of global technology innovation center: Based on the experience of three research-oriented universities in New York City, *Education Development Research*, 1-7.

Zhai, R. Z. (2014). Problems and countermeasures of transformation of scientific and technological achievements in universities and research institutes, *China Science and Technology Information*, 172-173. https://dx.doi.org/10.3969/j.issn.1671-2064.2012.01.092