

# **Policy Research on the transformation of scientific and technological achievements in Colleges and Universities —Based on International Comparison and Chinese practice**

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**Abstract.** Serving for economic development is the basic function and important task of higher education in the new era. Doing a good job in the transformation of scientific and technological achievements in Colleges and universities is conducive to promoting national technological innovation and industrialization. The successful transformation of scientific and technological achievements in Colleges and universities needs corresponding policies to guarantee. In this paper, through the perspective of the policy research on the transformation of scientific and technological achievements in Colleges and universities, we summarize and analyze the policies on the transformation of scientific and technological achievements in Colleges and universities in developed countries and China, find out the problems in related fields in China, and put forward some suggestions on improving the policies on the transformation of scientific and technological achievements in Colleges and universities in China.

**Keywords:** colleges and universities; transformation of scientific and technological achievements; policy improvement.

## **1. Introduction**

With the advent of the era of knowledge economy, the function of colleges and Universities Serving the society has been unprecedentedly strengthened. In particular, local colleges and universities should take promoting the construction and development of local economy as the first value measure of their own development and transformation<sup>[1]</sup>. At this stage, the state is implementing the innovation driven development strategy, which requires a large number of new technologies and products, and new technologies and products come from scientific research and technological development. If colleges and universities want to give full play to the function and task of serving economic development, they must solve the problem of "medium obstruction" that hinders the transformation of scientific and technological achievements in Colleges and universities. Theory and practice show that policies and regulations are an effective guarantee for the smooth progress of economic and social development and various reforms. In order to solve the problem of low transformation rate of scientific and technological achievements in Colleges and universities, the key point is that government departments should adjust policies, adjust measures to local conditions and formulate scientific, reasonable and targeted policies for the transformation of scientific and technological achievements, which can better and faster promote the transformation of scientific and technological achievements in Colleges and universities.

## **2. International Comparison of policies for the transformation of scientific and technological achievements in Colleges and Universities**

The degree of scientific and Technological Development in developed countries has attracted worldwide attention, which is closely related to its scientific and technological innovation system. The core of the system is the transformation policy and system of scientific and technological achievements in Colleges and universities. The transformation of scientific and technological achievements is not only the guarantee to realize the commercialization and industrialization of

scientific research achievements in Colleges and universities, but also a solid force to promote scientific progress and technological innovation.

## **2.1 Ideas and policies of scientific and technological achievements transformation in American colleges and Universities**

In 1912, Professor McCarthy of the University of Wisconsin summarized and refined the "Wisconsin concept", which believed that since the resources owned by the university are derived from the people, they should be used by the people. "The responsibility of universities lies not only in promoting the development of individual students, but also in promoting the welfare of the whole society<sup>[2]</sup>." Its core is cooperation, that is, the multilateral cooperation between the University and its external allies, which is enough to make the university recognized by the public, the government and the mainstream ideology of society, and change the way of resource allocation to meet the requirements of the social system.

In the late 1970s, the United States had accumulated great advantages in scientific research, but the competitiveness of many industries did not rise but fell. In 1980, only 5% of the 28000 such patents owned by the federal government were put into production through patent licensing; A large number of American universities have never obtained more than 250 patents per year before 1980<sup>[3]</sup>.

In order to reverse the low transformation rate of scientific and technological achievements in the United States in the 1980s, the U.S. government has incorporated the transformation of scientific and technological achievements into the responsibilities of relevant departments since 1980, and formulated a series of policies and bills to promote the transformation of scientific and technological achievements. At the end of 1980, the U.S. Congress passed the later far-reaching Baidu act, namely the amendment to the patent and Trademark Act, to stimulate the technology transfer of universities.

The core of the baidu act is to allow American universities, non-profit institutions and small enterprises to apply for patents and own intellectual property rights for federally funded scientific research achievements; The undertaking unit may authorize the enterprise to transfer technology through transfer or non transfer; The application of R & D achievements must meet the priority of American enterprises<sup>[4]</sup>. The baidu act changed the ownership of government funded scientific research achievements from government ownership to scientific research institutions, relaxed the restrictions on the generation of invention patents with federal funding and cooperation with the government, simplified the administrative examination and approval procedures for federally funded research patent applications, clarified the interest distribution relationship between units and scientific researchers, and encouraged universities and enterprises to jointly transform government funded scientific research achievements, Enable universities and other scientific research departments to more actively promote the transformation of achievements into enterprises, so as to realize the commercialization of achievements as soon as possible.

After the baidu act, the United States has successively issued some bills as supporting and supplement. As shown in Table 1.

Table 1 supporting bills issued by the United States since the 1980s

Release time	Bill name	Policy tendency
1980	Stevenson Wydler technological innovation act	Policy making should focus on technology transfer and strengthen technology transfer and personnel exchange between colleges and enterprises
1982	Small business innovation and Development Act	Government agencies shall increase financial support for scientific research activities of small enterprises within the scope of their functions and powers
1986	Federal Technology Transfer Act	Federal agencies are authorized to enter into cooperative research and development agreements with companies, universities and non-profit institutions, which aims to engage in activities beneficial to the federal government and partners, and provides a legal guarantee for deeper cooperation and Development Research of industry university research in the United States.
1988	Trade and competition act series	Encourage enterprises' technological innovation and improve competitiveness in the form of legislation.

Since the 1990s, in order to accelerate the transfer of federally funded technological achievements and improve the competitiveness of the national economy, the United States has revised and improved the federal technology transfer act for many times, such as the national technology transfer and promotion act of 1995, the federal technology transfer business act of 1997 and the technology transfer commercialization act of 2000. So far, the annual GDP generated by the transformation of university scientific and technological achievements in the United States has exceeded US \$50 billion, 300000 jobs have been created every year, and the tax revenue has exceeded US \$6 billion<sup>[5]</sup>.

## 2.2 Main policies and characteristics of the transformation of scientific and technological achievements in British Universities

In order to strengthen the coordination between science and economic development, the British government has implemented a number of plans to encourage cooperation between scientific and technological circles and industrial departments since 1975.

### 2.2.1 Contact plan

In 1986, in order to promote the cooperation between the scientific community and the business community in the pre research stage of scientific and technological achievements, the science and technology office directly under the British Prime Minister presided over the implementation of the contact plan. The key of the linkage plan is to regulate the scientific research cooperation between scientific research institutions and enterprises through the government's research and development fund. In order to apply for and use the government's R & D fund, the applicant of scientific research projects should be composed of at least one scientific research institution and one enterprise; An agreement shall be signed in advance between the project application subjects to determine the work details and the ownership of scientific research achievements; All government departments should comprehensively consider the scientific research strength of the project applicant and decide whether to grant the subsidy. The subsidy period is 2-3 years, and the amount can be up to 50% of the total budget of the project. The enterprise is responsible for the balance of the project. By convention, the government departments providing financial support are not required to own the intellectual property rights of scientific research achievements. This plan is good for both colleges and enterprises. For colleges and universities, they can get financial support from the government and enterprises to solve the problem of funds; For enterprises, it can accelerate the development of new products, reduce R & D costs and investment risks, and improve their innovation ability and popularity.

### 2.2.2 Knowledge transfer Partner Program

In the summer of 2003, the UK Department of trade and industry began to set up the "knowledge transfer Partnership Plan", which merged the "teaching and research company plan" and the "partnership plan between colleges and enterprises", referred to as KTP plan. KTP involves three aspects: enterprises, knowledge base units (universities, research institutes, or continuing education institutions) and KTP contacts. The implementation method is as follows: according to their own development needs, the enterprise consults the KTP coordination structure which knowledge base units can provide the required technical support and talent reserve, then negotiates with the selected knowledge base units, signs an agreement around the details of the R & D project, and finally submits an application for KTP project funding to the UK Ministry of trade and industry. The project will be started after being approved. KTP contacts are generally Postgraduates of the knowledge base unit and sign an employment agreement with the knowledge base unit, but they can work in the enterprise of KTP project and be responsible for transferring the technical achievements of the knowledge base unit, and the knowledge base unit sends tutors to the enterprise to guide KTP contacts to carry out R & D work. The government subsidizes part of the KTP project for 1-3 years, and the balance is provided by enterprises.

The KTP program is good for all three parties. First, knowledge base units represented by colleges and universities can increase income and gain practical experience through the transfer of technological achievements, which is conducive to improving the practicability of technology in the future; Second, enterprises can obtain the latest technology of scientific research institutions, reduce R & D costs, and tap potential talents from contacts as employees of the company; Third, the contact person has obtained rare engineering training and practice opportunities, and has good employment prospects in the future.

### 2.2.3 Faraday Partnerships Initiative

In 1997, with the promotion of non-governmental organizations and the support of the British government, Faraday partnership initiative was established to combine the technology and human resources of scientific research institutions and enterprises, promote the cooperation and exchange between scientific research institutions and enterprises and enterprises, and improve the scientific research capacity and international competitiveness of British industry. "Faraday partner initiative" has a certain operation mode: the initiator should establish multiple industry Faraday alliances in different fields, and scientific research institutions and enterprises belonging to relevant industries apply to join the corresponding alliances. Members of the alliance shall pay dues, undertake certain obligations, and enjoy the right to participate in conferences, exhibitions, training and cooperative scientific research organized by the alliance. The alliance employs senior industry experts as "technology translators". The experts find the needs of enterprises and connect scientific research institutions with enterprises. At present, 24 industry Faraday alliances have been established, which play a bridge and link role in the transformation of scientific and technological achievements.

## **2.3 New measures for the transformation of scientific and technological achievements in Japanese Universities**

In the 1990s, after experiencing the "lost decade" of economy and society, Japan deeply reflected and took scientific and technological innovation as the basic strategy of rejuvenating the country. In order to promote the smooth implementation of various reforms, Japan took the law as the guarantee for the reform, strengthened the leading role and service function of the government in the process of scientific and technological revitalization and transformation of scientific and technological achievements, achieved remarkable results, and solved the problem of low transformation rate caused by the poor scientific and technological system in a certain sense.

### 2.3.1 Give play to the leading role and service function of the government

In 1995, the Japanese parliament passed the basic law on science and Technology (hereinafter referred to as the basic law), which marked that Japan understood and strengthened basic research at

a new level and promoted the transformation of science and technology policy. The fundamental purpose of the basic law is to enhance the level of national scientific research, improve socio-economic conditions and national welfare, and then promote international scientific and technological progress and the sustainable and healthy development of human society. Since 1996, the central government of Japan has formulated a basic science and technology plan every five years. Each plan is to ensure that Japan's science and technology revitalization is planned, step-by-step, focused and effective. This fully shows that the Japanese government attaches importance to scientific and technological innovation projects from both the macro level and the micro level, and guides scientific and technological innovation to the established goals. Table 2 shows the tendentious policies of each issue of Japan's basic plan for science and technology in promoting the transformation of scientific and technological achievements in Colleges and universities.

Table 2 policy tendency of the basic plan for science and technology at each stage

Stage	Policy tendency
I	Improve the research environment of national universities and update all the equipment purchased for more than 10 years; Improve the area standard of research facilities and increase it by 20% on the original basis.
II	In reforming the scientific and technological system and creating and using excellent scientific and technological achievements, we should highlight the training of scientific researchers, especially young researchers.
III	Scientists' independent proposition projects need priority and key funding from competitive funds. For disciplines and fields where specific policy purpose projects can make great contributions to improving economic and social benefits, key resources should be allocated.
IV	It advocates to build a knowledge network between industry and university officials and promote the further expansion of cooperation between industry and university officials. Universities and scientific research institutions provide R&D results, and the government participates in strengthening cooperation with industry and technology transfer institutions; The government reformed the relevant cooperation regulations on intellectual property protection to ensure that domestic intellectual property rights are not infringed overseas; Encourage enterprises to set up R&D centers themselves or in cooperation with universities, and cooperate with investment institutions to support the whole process of creativity from R&D to the industrialization of achievements; Improve the evaluation mechanism and increase qualitative evaluation indicators such as market contribution, achievement popularization and employment promotion.
V	By strengthening industry university research cooperation and mobilizing the enthusiasm of venture capital enterprises, eliminate the obstacles between talents, knowledge and capital, and actively build an innovation system to create new value. Increase the number of cross sectoral researchers in enterprises, universities and public research institutions.

### 2.3.2 Build a platform for the transformation of scientific and technological achievements

The low transformation rate of scientific and technological achievements is a difficult problem perplexing Japan's economic development. The reason is that patents are out of touch with the market and lack of an effective channel to promote the transformation of scientific and technological achievements in Colleges and universities. In terms of technology transfer between Japanese and American universities in 2002, there were 6509 patent applications in the United States and 5085 in Japan, of which 3739 were transformed in the United States, accounting for 57% of the total number of applications, and 526 in Japan, accounting for only 12% of the total number of applications. Through investigation and analysis, it is found that: first, there is no technology transformation intermediary between universities and enterprises in Japan, and the supply and demand information between universities and enterprises is asymmetric; Second, there is a lack of communication carrier between colleges and enterprises. The basic R & D of colleges and universities is divorced from reality and does not connect with the needs of enterprises.

In order to solve this problem, the Japanese government promulgated the University and other technology transfer promotion law (hereinafter referred to as the Promotion Law) in 1998. This law is the first law in the history of Japanese science and technology development with the purpose of strengthening the transformation of university scientific and technological achievements. It shows that Japan will take promoting the transformation of university scientific and technological achievements as the breakthrough of science and technology revitalization, and reflects that the Japanese government strengthens the effective connection between university R & D and market application through policy and system innovation. The Japanese government has established a university science and technology transfer organization (TLO), which is specially responsible for excavating, evaluating and selecting the scientific and technological research achievements of colleges and universities with industrial potential. The construction mode of this institution is different from the patent institution within the framework of the general system. It is based on the industry university research model, follows the development law of higher education research and economy, integrates the two, and makes institutional innovation. The science and technology transfer institution of the university is jointly managed by the Ministry of economy, industry and science of Japan and the Ministry of education, culture and science. The ministers of the two provinces examine and approve it according to relevant standards and jointly determine the results. In terms of institutional operators, University Science and technology transfer institutions enjoy national preferential policies, especially in terms of scientific research funds, facilities and equipment and talent flow, which have received strong support and assistance from the Japanese government and social organizations. In terms of scientific research facilities, universities and other technology transfer institutions can use national public facilities and equipment free of charge. The Japanese government gives comprehensive support to new technology transfer institutions for the purpose of transforming scientific and technological achievements of colleges and universities, so as to build a platform and provide services for the application of scientific and technological achievements.

### **3. Policies and existing problems in the transformation of scientific and technological achievements in Colleges and universities in China**

#### **3.1 Policies and characteristics of the transformation of scientific and technological achievements in Colleges and universities in China**

In order to promote the transformation of scientific and technological achievements into real productive forces, standardize the transformation activities of scientific and technological achievements, accelerate scientific and technological progress, and promote economic construction and social development, the state has successively promulgated, implemented, revised and improved a series of policy documents (as shown in Table 3).

Table 3 list of scientific and technological achievements transformation policies issued by the state in recent years

Time of promulgation	File name	Main relevant contents
1996	Law of the people's Republic of China on promoting the transformation of scientific and technological achievements	Encourage enterprises and scientific research institutions to jointly transform scientific and technological achievements; A certain proportion of the state financial funds for science and technology, investment in fixed assets and technological transformation shall be used for the transformation of scientific and technological achievements; The State encourages the establishment of funds or risk funds for the transformation of scientific and technological achievements; In terms of technical rights and interests, if the unit that has completed the scientific and technological achievements transfers its job-related scientific and technological achievements to others, the unit shall withdraw no less than 20% of the net income from the transfer of the job-related scientific and technological achievements, and reward the personnel who have made important contributions to the completion of the scientific and technological achievements and their transformation.
1998	Regulations on the administration of intellectual property protection in Colleges and Universities	In order to effectively protect the intellectual property rights of colleges and universities, encourage the enthusiasm of teaching staff and students for invention and intellectual creation, give full play to the intellectual advantages of colleges and universities and promote the industrialization of scientific and technological achievements. The document stipulates the tasks and responsibilities of colleges and universities in intellectual property protection, defines the ownership of intellectual property, establishes intellectual property management institutions, and formulates reward and support standards.
1999	Several provisions on promoting the transformation of scientific and technological achievements	When scientific research institutions and institutions of higher learning transform their scientific and technological achievements on the job, they shall reward the persons who have completed the scientific and technological achievements on the job and other persons who have made important contributions to the transformation of the achievements according to law. The current preferential tax policies (exemption from individual income tax) shall be implemented for the transformation of scientific and technological achievements. Scientific and technological personnel may, on the premise of completing their own work, engage in research and development and achievement transformation activities part-time in other units. Scientific research institutions and colleges and universities that implement personnel competition for posts shall allow those who leave their posts to return to their original units for competitive posts within the time limit specified by the units (generally 2 years), and ensure that those who re take up posts enjoy the same benefits and treatment as those who work continuously.
2015	The state revised and improved: The Law of the people's Republic of China	First, delegate the power to transform and dispose of scientific and technological achievements. Scientific research institutions may independently decide to transfer, license or invest in the scientific and technological

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	on promoting the transformation of scientific and technological achievements.	achievements they hold. Second, the income from scientific and technological achievements is retained by scientific research institutions. All the income obtained by scientific research institutions from the transformation of scientific and technological achievements shall be retained by their own units, and the personnel who have made important contributions to the completion and transformation of achievements shall be rewarded and remunerated. Third, greatly increase the reward proportion of scientific researchers. The minimum standard of reward and remuneration for scientific researchers shall be raised from no less than 20% of the conversion income under the current law to 50%.
2016	Several opinions on strengthening the transfer and transformation of scientific and technological achievements in Colleges and Universities	Understand the transformation of scientific and technological achievements in Colleges and universities from a new height, propose simplifying administration and delegating power, encourage the transfer and transformation of scientific and technological achievements, establish and improve the working mechanism for the transfer and transformation of scientific and technological achievements, strengthen the capacity-building for the transfer and transformation of scientific and technological achievements, improve the income distribution policy guided by increasing knowledge value, and improve the personnel management system conducive to the transfer and transformation of scientific and technological achievements, Establish the development direction and requirements of the annual report system and performance evaluation mechanism for the transfer and transformation of scientific and technological achievements.

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### 3.2 The problems in the policy level of the transformation of scientific and technological achievements in Colleges and universities in China

Compared with foreign policies and regulations, there are still some problems in some fields, such as insufficient attention to the cooperative research between colleges and enterprises, too strong regulations and policies, and insufficient specific implementation and operability.

3.2.1 The existing policies on the overall layout and planning of the transformation of scientific and technological achievements in Colleges and universities are not reasonable, which is easy to cause repeated construction

At the national level, the unreasonable overall layout and planning of the transformation of scientific and technological achievements is a concentrated embodiment of the problems existing in the links of national science and technology management, and it is also the main obstacle to the improvement of the transformation rate of scientific and technological achievements. From the regional level, it is also the inaccurate positioning of scientific and technological innovation serving local development in the process of planning regional economic and social development. At present, there are discontinuities in the transformation of scientific and technological achievements from the national to the regional level. For example, there is a lack of effective connection between basic research and applied research and industrial technology development and the transformation of scientific and technological achievements. On the one hand, the original scientific research achievements of colleges and universities have not been effectively transformed into real productive forces, On the other hand, the technology required for the industrialization of scientific and technological achievements has not been supported by the technical achievements of basic research and applied research. At the same time, due to the problems of overlapping and repeated



construction in the technical fields guided by national policies, some regions have insufficient estimates of the problems faced by economic transformation and industrial structure optimization, resulting in inaccurate functional positioning of government departments and difficult to form joint forces, which directly affects the effect of industry university research cooperation and promoting the transformation of scientific and technological achievements.

3.2.2 The patent licensing system is not perfect, and the ownership of intellectual property rights related to scientific and technological achievements in Colleges and universities is not clear

China's policy stipulates that the intellectual property rights generated by the cooperation between schools and enterprises, if no consensus and agreement are reached in advance, the patent rights are generally owned by the person who completed the achievements, and there are no clear provisions on the intellectual property rights generated by the cooperation between School researchers and personnel of other units. For example, the patent law of the people's Republic of China points out that for inventions and creations completed by schools or individuals entrusted by other units or individuals, unless otherwise agreed in the power of attorney, their patent application right and patentee belong to the units or individuals that have completed or jointly completed them. Unless otherwise agreed, the right to apply for a patent belongs to the unit or individual that has completed or jointly completed the invention creation jointly completed by two or more units or individuals, or the invention creation completed by one unit or individual entrusted by other units or individuals. After the application is approved, the unit or individual applying for a patent shall be the patentee. China's "Regulations on the protection and administration of intellectual property rights in Colleges and universities" and its implementation rules stipulate that the right to apply for a patent for service invention and creation belongs to colleges and universities; After the patent right is granted according to law, it shall be held by colleges and universities; The right to use and transfer job-related technological achievements shall be enjoyed by institutions of higher learning.

3.2.3 The service support for the connection between the transformation of scientific and technological achievements in Colleges and universities and small and medium-sized enterprises is not enough, which limits the ways for colleges and universities to transform scientific and technological achievements for small and medium-sized enterprises

At present, there are a large number of small and medium-sized enterprises in China, which make an important contribution to the development of the national economy. However, their development faces many difficulties. The core problem is the weak ability of scientific and technological innovation and the immature external support environment. When the scientific and technological achievements of colleges and universities are transformed into small and medium-sized enterprises, they can not be simply attributed to the relationship between output and input. The verification of their achievements and the service guarantee of transformation are the key links to solve the problem of achievement transformation. Small and medium-sized enterprises have different needs for scientific and technological innovation products in different development periods. Some development stages need products with rapid production and short investment return cycle. In a certain period, the product R & D cycle and investment return cycle become longer, the enterprise's strategy will be adjusted, and the demand for scientific and technological achievements in Colleges and universities will naturally change. The existing policies encourage colleges and universities and small and medium-sized enterprises to establish an open mechanism and increase social support. The practical measures are not specific enough, especially how to establish a communication mechanism between colleges and universities and small and medium-sized enterprises, how to avoid information asymmetry in the transformation of scientific and technological achievements between colleges and Universities and small and medium-sized enterprises, and how to smoothly transform scientific and technological achievements of colleges and universities into the actual productivity of small and medium-sized enterprises, It is also an urgent channel to smooth the transformation of achievements.

### 3.2.4 The lack of mature scientific and technological achievements evaluation system and unreasonable interest distribution mechanism affect the transformation power of scientific and technological achievements in Colleges and universities

The value measurement of scientific and technological achievements in Colleges and universities is an inevitable problem in the process of transformation, which needs to be confirmed by patent examination, expert identification, detection, evaluation, market and other forms. As scientific and technological achievements embody the characteristics of intangible assets with scientific research value and market prospect, and there is a lack of mature evaluation standards and principles in operation, its price is difficult to be determined scientifically and reasonably. At present, the transaction price of scientific and technological achievements mostly adopts the mode of negotiated pricing between the two sides, but the understanding and consideration of scientific research value, market potential, investment return and cooperation conditions between the two sides are different, which often leads to the deviation between transaction price and value, resulting in contradictions and affecting the smooth transformation of scientific and technological achievements in Colleges and universities.

In addition, the core value of scientific and technological achievements in Colleges and universities is mainly mastered by inventors. When the law does not grasp the right to dispose of achievements or lacks a scientific evaluation and benefit distribution system, some researchers often lose the power to transform because they are worried about the damage of their own income and refuse to transfer the achievements to the outside. Some researchers have scientific and technological achievements with high scientific and technological content and good market prospects. They often choose to trade and transfer achievements privately in order to maximize their own interests. They usually obtain benefits by means of technical services or private transfer of achievements. This shows that the imperfect evaluation system and policy guarantee increase the worries of University researchers, frustrate the enthusiasm of achievement transformation, and greatly reduce the effect of university scientific and technological achievements serving economic development.

## **4. Thoughts and suggestions on perfecting the transformation policy of scientific and technological achievements in Colleges and universities in China**

During the national "two sessions" in 2017, Premier Li Keqiang stressed in the government work report: expand the autonomy of universities and scientific research institutes and cut down the red tape in scientific research management. We will implement policies and measures to support the transfer and transformation of scientific and technological achievements, improve preferential tax policies and dividend incentives for equity options, and encourage scientific researchers to start businesses and innovate. At present and in the future, it is an important policy measure to support the transfer and transformation of scientific and technological achievements in Colleges and universities, improve the scientific and technological innovation ability of colleges and universities, and promote the deep integration of science and technology and economy.

When learning from foreign advanced ideas and policies, we must not only look at the surface, but must remain objective and sober, fully consider the national conditions and seek the perfect combination of foreign experience and local reality. For example, the Bayh-Dole Act of the United States provides an institutional path for scientific research achievements to be owned by the federal government to colleges and universities. Colleges and universities have the realistic conditions for large-scale transformation of scientific and technological achievements, and the economic value of scientific research achievements is also valued by more people. However, the American business community believes that universities often obtain more ownership of research results in cooperative R & D with enterprises. Therefore, American enterprises prefer to cooperate with foreign universities not affected by the Bayh-Dole Act in order to avoid intellectual property disputes with local universities. At the same time, American universities are more obsessed with short-term applied

research and ignore the promotion of new technology and knowledge, which essentially damages the public service function of universities. Therefore, the transformation policy of scientific and technological achievements in Colleges and universities in China can not only enable colleges and universities to obtain material benefits, but also encourage colleges and universities to give back to the society better.

#### **4.1 The science and technology innovation policy pays attention to the combination of sections and blocks, and the reform of the science and technology system pays attention to the combination of points and areas.**

Scientific scientific and technological innovation and scientific and technological system reform will create a good policy environment for the rational layout of the transformation of scientific and technological achievements. At present, open innovation and cross domain cooperative innovation are the main forms to realize the breakthrough of scientific and technological innovation. In terms of scientific and technological innovation, many developed countries no longer promote innovation in key areas, but adopt goal orientation and problem orientation to lead innovation. For example, in the face of energy depletion, Japan does not focus too much on the energy field, but cooperates to give comprehensive solutions to problems from multiple fields such as energy supply system, energy-saving technology in manufacturing, information and communication and green city construction. In terms of the reform of the scientific and technological system, we should increase the top-down policy coverage and strengthen the bottom-up reform aimed at the problem points. For example, the National Conference on scientific and technological innovation and other comprehensive conferences should establish the direction of problem oriented scientific and technological system reform; Universities and scientific research institutions should cooperate to improve intellectual property protection and R & D management system, so as to meet the goal of strengthening the knowledge network of government, industry, University and research. Therefore, getting rid of the constraints of scientific and technological innovation and promoting the reform through the combination of point and area is of great significance to the cooperation of the transformation of scientific and technological achievements in many fields, and can better and faster establish an efficient innovation mechanism.

#### **4.2 Strengthen policy guidance and promote the combination of scientific research topics in Colleges and universities with market demand.**

From the perspective of economics, the demand of the market triggers the motivation of scientific research topics in Colleges and universities. The feedback of the market is the improvement direction of scientific and technological achievements in Colleges and universities, and the transformation of scientific and technological achievements in Colleges and universities is the result of the joint action of scientific and technological progress and market demand. The scientific research direction of colleges and universities should grasp the market demand, and the scientific research topics should consider the economic returns. This requires university researchers to fully understand the needs of enterprises for technological achievements, and then decide what topic to choose, rather than blindly doing the topic in order to complete the topic. According to the principle of "Pareto optimality" in Economics: various commodity (broad sense) markets constituting the economic system will approach the general equilibrium state when the system is relatively perfect and the competition is relatively sufficient, and the allocation efficiency of resources (including scientific and technological achievements) can reach or approach the optimal state. Therefore, the state and local governments should formulate corresponding policies to stimulate the vitality of the market, guide the market to fully reflect the demand for commodities, resources and production factors, broaden the information access channels of colleges and universities, and guide colleges and universities to actively participate in market competition, so as to continuously meet the market demand for scientific and technological achievements of colleges and universities. Different evaluation criteria should be formulated according to the value of

achievements in different scientific research fields, a scientific, reasonable and systematic rating mechanism should be formed, and the evaluation results of achievements should be related to personal treatment and rewards.

#### **4.3 Reasonably distribute the rights and interests related to the transformation of achievements, increase the incentive for scientific researchers in Colleges and universities.**

Colleges and universities should further lower the right to use, dispose of and benefit from scientific and technological achievements, so that scientific researchers and managers of achievement transformation have more autonomy. At present, the state is accelerating the decentralization of the right to use, dispose of and benefit from scientific and technological achievements to colleges and universities. Colleges and universities should give more rights and interests to the owners of achievements and further improve the income payment proportion and property right proportion of the transformation of existing achievements. All scientific and technological achievements that do not involve major issues such as national security and social and public interests can be delegated to the project undertaking team of colleges and universities. The state should reasonably distribute the income from the transformation of scientific and technological achievements in Colleges and universities. A stable income distribution of achievement transformation can make researchers have good expectations of personal income. Within the scope allowed by national policies, we should take into account the interests of colleges and universities, departments and achievement inventors, and appropriately increase the income proportion of achievement inventors and other relevant personnel. In the proportion of enterprise capital injection, intangible assets such as scientific and technological achievements can be increased to 20-35%; The one-time reward for achievement transformation can be increased to more than 20% of the net income; For those who have successfully transformed their own achievements, a proportion of more than 5% of the annual net income can be withdrawn for reward within 5 years.

#### **4.4 We will promote the transformation of achievements, diversify incentives, open personnel exchange mechanisms, and encourage innovation and entrepreneurship.**

Flexible use of equity incentives and preferential tax policies to encourage scientific and technological personnel and college students to carry out various forms of scientific and technological entrepreneurship. We should be in line with international practice, grasp the management system of scientific and technological innovation in Colleges and universities and the characteristics of high-tech enterprises, establish systems of technology shareholding and shareholding management, and encourage university scientific researchers to take shares at the price of scientific and technological achievements or patents to participate in enterprise operation and obtain benefits. We should establish an objective and standardized mechanism for the transformation of achievements, financial subsidies and tax relief, and make structural adjustments to the income of University researchers and their units. Qualified units can adopt diversified ways such as equity or option incentives to reward University researchers with outstanding contributions, so as to form a distribution mechanism linking work remuneration and achievement contribution. We should actively establish an open personnel exchange mechanism and create a humanistic environment for talent innovation and entrepreneurship. We should encourage and allow scientific researchers in Colleges and universities to flow between posts in scientific research, teaching and achievement transformation, and guarantee their job promotion, appointment and welfare treatment, so as to form a policy guidance conducive to achievement transformation; We should combine distribution according to work with distribution according to production factors, and directly link the income of talents with post responsibilities, work performance, actual contributions and benefits generated by the transformation of achievements, so that all kinds of talents with Entrepreneurship and innovation can be respected and benefit. At the same time, the government should pay attention to creating an innovation and entrepreneurship environment for high-tech talents, build a platform for talent competition and talent display, and create opportunities for development, innovation

mechanism and innovation cultural atmosphere by setting up a special fund for innovation and Entrepreneurship of University researchers, establishing an intellectual property incentive system, and improving entrepreneurship infrastructure (big data platform and network).

#### **4.5 Build a platform for science and technology transformation in Colleges and universities with market-oriented and policy innovation as a breakthrough.**

At present, most teachers in Colleges and universities in China focus on teaching and scientific research, and their ability and experience to grasp the market trend and meet the market demand are limited. Therefore, it is necessary to build an achievement transformation platform as a medium for transmitting scientific and technological information, trading and evaluating scientific and technological achievements between colleges and universities and the market. In this regard, we can learn from the OTL (American technology licensing office) model of Stanford University, put patent marketing in the first place, emphasize that the University personally manages patent affairs, and focus on patent marketing to promote patent protection with patent marketing. It is suggested that China's colleges and universities should establish a platform for the transformation of scientific and technological achievements by means of marketization, set up an achievement transfer office, deeply combine with enterprises, form a technological innovation industrial alliance, and promote the cooperation between government, industry, University and research; We should give further play to the role of local university science and technology parks and high-tech industry incubators, strengthen financial support, technical services and talent training, and create an all-round and well-developed service chain for the transformation of achievements; We should improve the information release platform of scientific and technological achievements, establish the information collection and release system of scientific and technological achievements, and realize the full docking between industry, University and research based on the market mechanism.

There are still some problems in the service of scientific and technological achievements transformation platform in China, such as insufficient strength and non-standard management. Therefore, we should make full use of the basic role of the market in resource allocation, build a university scientific and technological achievements transformation network, explore the docking service between university scientific and technological achievements and enterprise needs, timely and effectively promote achievements and promote the smooth transformation of achievements. At the same time, the government should give full play to the functions of public service and market supervision, create an external environment for the development of the platform, and formulate policies to focus on improving the service functions of the platform and improve the professional and large-scale service capacity of the platform. With the support and promotion of the government, gather various resources and forces of the whole society to build a university science park at a high level and from a high starting point; Realize the scale development of science and technology industry in Colleges and universities according to the method of modern enterprise system.

#### **4.6 Strengthen the cost control of scientific research in Colleges and universities, improve the venture capital mechanism of achievement transformation.**

The high cost of scientific and technological research and development in Colleges and universities is one of the important factors hindering the transformation of achievements. Controlling the cost of scientific research and reducing the pricing of achievements transformation is of great significance to enterprises with demand for scientific and technological achievements, especially small and medium-sized enterprises with insufficient funds. It is an important way to promote the transformation of scientific and technological achievements in Colleges and universities. From the perspective of cost control, colleges and universities should take corresponding measures actively. On the one hand, they should make full use of incentive means to encourage researchers to improve research efficiency; On the one hand, improve the time efficiency and technical efficiency of scientific research, and actively seek alternative solutions for high loss technical solutions to improve the value of achievements.

Another important reason for the low conversion rate of scientific and technological achievements in Colleges and universities in China is the lack of funds. It is suggested that China should seek diversified investment subjects in the transformation of scientific and technological achievements in Colleges and universities, and form a diversified investment system with government investment as the guide, enterprise funds as the main body, bank lending as the support, social capital as the guarantee and foreign capital introduction as the supplement, so as to ensure the adequacy and integrity of venture capital funds. The key factor affecting the development of venture capital is the national policy. The government should strengthen tax reform, financial subsidies, capital guarantee and other measures to mobilize the enthusiasm of venture investors and guide the transformation and flow of funds to scientific and technological achievements in Colleges and universities. The government, universities and enterprises should establish a scientific and reasonable risk assessment system for the transformation of achievements, strictly standardize the assessment procedures, and improve the ability to identify and control risks. In addition, we should broaden the financing channels of venture capital, flexibly use the strategies of portfolio investment and joint investment, and disperse the risk of capital investment.

## References

- [1]. Lu Linyue. Serving Regional Economic Construction: The Value Orientation and Pursuit of the Development and Transformation of Local Universities [J]. China Higher Education Research, 2009, (1): p.71.
- [2]. Bogue, A. G. The Wisconsin: One Hundred and 25 Years [M]. Madison: University of Wisconsin Press, p.1965:252.
- [3]. Jamison, Douglas W. Christina Jansen .Technology Transfer and Economic Growth, The Journal of the Association of University Technology Managers, Vol. VII [OL] Available ht-tp: / [www.autm.net/pubs/journal/00/teschtransfer.html](http://www.autm.net/pubs/journal/00/teschtransfer.html).
- [4]. US Government Office Report. Technology Transfer, Administration of Bayh-Dole Act by Research University (R) .may, 1998.
- [5]. National Science Foundation. National Patterns of Research and Development Resources: 2011 Data Update [R]. Washington D.C.
- [6]. Guo Kailang. Transformation and Enlightenment of Scientific and Technological Achievements in American Universities [J]. Higher Education in China, 2010(7): p.16-19.
- [7]. Du Haiping. Research on the Transformation of Scientific and Technological Achievements in Chinese Universities: A Policy Perspective [J]. Educational Development Research, 2015(z1): p.50-55.
- [8]. Zhang Yuqin. New measures for the transformation of scientific and technological achievements in Japanese universities [J]. Science and Technology in Chinese Universities, 2011(6): p.67-69.