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Exploring the scientific and technological achievement transformation policies in Chinese universities: based on policy text analysis and PMC-index model

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The transformation of scientific and technological achievements in universities urgently needs to be implemented. To assess the effectiveness of scientific and technological achievement transformation policies in Chinese universities, this study develops an evaluation system using the PMC-index model. This study quantitatively evaluates 10 key policies on the transformation of scientific and technological achievements in Chinese universities based on PMC-index values and PMC-surface analysis. The results show that the PMC-index scores of the selected 10 policies range from 3.85 to 7.99, with an overall upward trend. The average PMC index score for the 10 policies was 6.21. Of the policies, five were rated as excellent in terms of consistency, four were rated as acceptable, and one was rated as low. This study further analyzes the overall effectiveness, primary variables, and PMC-surface results for the policy samples. The findings suggest that China's current university scientific and technological transformation policies perform well in four areas: policy content, policy evaluation, policy implementation agencies, and policy functions. However, there is still a need for adjustments and optimizations in terms of policy issuing agencies, policy implications, and policy safeguards. And countermeasures and suggestions are proposed from three aspects: joint departmental release, establishment of a conversion platform, and establishment of an incentive mechanism. This study helps identify the strengths and weaknesses of scientific and technological transformation policies, providing a foundation for developing future policies in Chinese universities.

KEYWORDS

universities, scientific and technological achievements transformation policy, PMC-index model, policy effectiveness, consistency

1 Introduction

In the era of economic globalization, science and technology have evolved into more than just symbols of a country or region's competitiveness. They have become pivotal drivers of global social progress and sustainable development (Lou et al., 2024). The transformation of research and development (R&D) achievements is an important part of national innovation and development strategies (Xie and Wu, 2024). Universities, as integral components of the National Innovation System (NIS), play a primary role in

advancing innovation, disseminating knowledge, and nurturing talent (Shi et al., 2022; Shao et al., 2022). In the context of the knowledge economy and digital revolution, the role of universities in transforming scientific and technological achievements is steadily growing in importance.

Colleges and universities are an important source of knowledge and technological innovation and are rich in scientific, technological, and human resources. In the era of the knowledge economy, universities are gradually becoming the center of knowledge innovation and will play an increasingly important role in the construction of a national innovation system and an innovative country. However, in stark contrast to the rapid increase in the scientific and technological innovation capacity of universities, China plays a weaker role in the transformation of scientific and technological achievements of universities. The conversion rate of scientific and technological achievements in our country is at most around 30%, which is lower than the 60% to 70% in developed countries. This is mainly because there are certain differences between the scientific and technological achievements of universities from research and development to application and those of general enterprises. On the one hand, the transformation of scientific and technological achievements as a social service is only one of the tasks of colleges and universities, and colleges and universities also have the functions of personnel training and scientific research. On the other hand, the scientific and technological achievements of universities pay more attention to public welfare, fundamentality, strategy and overall nature, and may have certain disadvantages in terms of industrialization maturity and cost control (Xu, 2021). This issue has attracted significant attention from the state. In recent years, the national government has gradually introduced policies specifically targeting the transformation of scientific and technological achievements in universities, with the aim of promoting practical work in this field and supporting the country's transformation and development. In particular, since the amendment of the Law of the People's Republic of China on Promoting the Transformation of Scientific and Technological Achievements in 2015, the effectiveness of the policy on the transformation of scientific and technological achievements in universities has become increasingly prominent, and the acceleration of the transformation of scientific and technological achievements in universities has become the endogenous driving force and the fundamental guarantee for the development of national economic quality.

The issue of transforming scientific and technological achievements in universities has become an important theoretical and practical issue that has received wide attention. In recent years, scholars have conducted in-depth discussions on this theme from multiple perspectives. Currently, research on the transformation of scientific and technological achievements in Chinese universities has shifted from institutional and policy suggestions to the implementation paths of knowledge transfer, coordinated development, and scientific and technological innovation. Scholars have conducted in-depth research on the effectiveness of policies for the transformation of scientific and technological achievements in Chinese universities from multiple perspectives, including the overall effectiveness of the policies, differences in regional implementation effects, influencing factors of the policies, and

the efficiency of achievement transformation (Du, 2017). They also proposed specific suggestions and measures to enhance the effectiveness of these policies. In terms of quantitative research on policies, Wang et al. quantitatively and qualitatively analyzed 153 policy texts involving the transformation of scientific and technological achievements in universities in China during the period of 2009–2016, summarized the contents of the policy texts into 11 dimensions, such as capital investment and talents, and put forward suggestions for improvement in response to the deficiencies of the policies (Wang and Zhang, 2018). Johnes and Tone assert that, within the constraints of limited government funding, universities should strive to deliver educational outcomes efficiently. Consequently, assessing the efficiency of transforming scientific and technological achievements in Chinese universities is of paramount significance (Johnes and Tone, 2017).

To sum up, policy evaluation, the most important link in the process of the formulation and administration of public policy, is a comprehensive analysis of the past (causes) and future (effects) of specific policies by using different theories as well as quantitative models and techniques. It can not only make a scientific judgment on the value of the policy itself, but also test the actual effects of policy formulation and implementation. There are many studies on the evaluation of policies for the transformation of scientific and technological achievements in Chinese universities, but the existing literature still has some deficiencies. Firstly, there are many studies on the performance of the transformation of scientific and technological achievements in colleges and universities from the perspective of policy implementation and execution, but few literatures analyze the quality of policies for the transformation of scientific and technological achievements from the perspective of policy formulation. Secondly, the PMC-Index model has not yet been used for the quantitative evaluation of the policies on the transformation of scientific and technological achievements issued by the Chinese national government. Therefore, this study aims to address these gaps by examining the policies on the transformation of scientific and technological achievements in China, designing an evaluation index system, and conducting quantitative evaluations using the PMC-Index model. The aim is to gain a thorough understanding of the current situation of the policies on the transformation of scientific and technological achievements in Chinese universities and contribute to their future improvement.

2 Materials and methods

2.1 Data sources

Policies on the transformation of scientific and technological achievements of Chinese universities are mainly documents and notices issued by the Ministry of Education and other departments. To systematically and comprehensively obtain the texts of policies on the transformation of universities' scientific and technological achievements, this study is based on the Global Laws and Regulations Network (GLRN) and searches using specific keywords, such as transformation of scientific and technological achievements of universities, scientific and technological achievements of universities, and invention patents of

universities. At the same time, the official websites of the ministries that promulgated the policies (e.g., Ministry of Education, Ministry of Science and Technology, etc.), Peking University Fabulous (<http://www.pkulaw.cn/>, accessed on 9 November 2022), and China Legal Resource Library (<http://data.lawyee.net>, accessed on 9 November 2022) were utilized to check, supplement, and calibrate the above policies. After collecting policy texts from 1994 to 2023, 218 policy texts were initially screened. By applying text mining methods to analyze them, 10 policy texts with the strongest correlation to the transformation of scientific and technological achievements in universities were finally selected as the research objects. The basic situation and reasons of the selected policy samples are shown in Table 1.

2.2 Research methodology

The Omnia Mobilist hypothesis and the PMC index model proposed by Estrada were used for quantitative evaluation in this study (Estrada et al., 2010). The PMC-index model is mainly used to visualize the strengths and weaknesses of a policy and its level of internal consistency. The model is a policy evaluation model through text mining to obtain the original data, the evaluation dimensions are rich, and through the increase of evaluation dimensions to replace the calculation of the index weight, effectively avoiding the index weight error, subjective evaluation bias, making the evaluation results more objective and accurate (Gong et al., 2025; Hong et al., 2024). However, policy score determination depends heavily on expert reviews, indicating that the evaluation process is likely to be influenced by subjective factors (Sha et al., 2024). Simultaneously, by plotting the PMC surface, it is possible to visualize the strengths and weaknesses of the policy based on the concavity index of the surface (Ruiz Estrada, 2011). The quantitative analysis of the PMC index model is divided into four phases, as shown in Figure 1. At present, scholars have widely used the PMC-index model to analyze the quantitative effectiveness of relevant policies in the fields of agriculture, science and technology, education, and other areas of research (Kuang et al., 2020; Wang and Xing, 2022; Cui and Wang, 2024).

2.2.1 Variable classification and parameter setting

First, the 10 selected policy texts were sorted and summarized, combined with the adjustment and improvement of the setting standards of policy evaluation index variables by domestic and foreign scholars. The policy evaluation index system of scientific and technological achievement transformation in universities from the perspective of the PMC-index model is determined, which is in accordance with the policy nature, policy timeliness, policy issuing agency, policy content, policy evaluation, policy implementation agency, policy function, policy implication, policy safeguard, and policy disclosure. Ten primary and 44 secondary variables were identified, and the variable design and scoring standards are presented in Table 2.

After the selection and identification of the variables, the parameters of each variable must be set. To ensure that all secondary variables have the same weight (Ruiz Estrada, 2011),

a binary number 0 or 1 is applied to each secondary variable. Specifically, (1) if the content described in the policy can comply with the corresponding secondary variable, then that secondary variable is set to 1; (2) if it does not, then the secondary variable is set to 0 to ensure that each secondary variable is equally important and plays the same role for the multi-input-output tables have the same impact.

2.2.2 Establishment of multi-input-output tables

According to the PMC-index model, after selecting and determining the index variable system for the evaluation of scientific and technological achievements transformation policy in universities, it is necessary to construct a multi-input-output table. The 10 primary variables and 44 secondary variables were input into the multi-input-output tables. Combined with the interpretation of the secondary variables and the criteria for assigning scores, all the secondary variables have the same importance and obey the [0, 1] distribution, and the assignment is taken as 0 or 1 without the need for repetitive sorting, thus obtaining the multi-input-output table after the assignment in Table 3.

2.2.3 Measurement of the PMC-index model

The PMC-index model is calculated using the following steps. First, the primary and secondary variables were quantified and placed in the multi-input-output table. Second, according to Equations 1, 2, based on the content of the policy paper, the primary and secondary variables are quantified individually and tabulated. Third, the score of each level variable is calculated according to Equation 3. Finally, the PMC-index score of the policy sample is calculated using Equation 4, which is equal to the sum of all primary variables.

$$X \sim N[0, 1] \quad (1)$$

$$X = \{XR : [0 \sim 1]\} \quad (2)$$

$$X_i \left[\sum_{j=1}^n \frac{X_{ij}}{T(X_{ij})} \right] \quad (3)$$

$$PMC - Index = \sum_{i=1}^m \left(X_i \left[\sum_{j=1}^n \frac{X_{ij}}{T(X_{ij})} \right] \right) \quad (4)$$

where i denotes the primary variable, $i = 1, 2, 3, \dots, m$; j denotes the secondary variable, $j = 1, 2, \dots, n$. T denotes the number of secondary variables. The size of the PMC index score indicates the degree of policy consistency.

In addition, according to Ruiz Estrada's four levels of evaluation standards for the PMC-index, four levels of policy consistency are determined (Table 4), considering the actual situation of the

TABLE 1 Information on the sample of selected university policies for the transformation of scientific and technological achievements.

Policy number	Policy name	Policy issuing agency	Policy issuing time	Reason
P1	Key Points for Strengthening Science and Technology Work in Colleges and Universities by the Ministry of Science and Technology and the Ministry of Education in 2003	Ministry of Education, Ministry of Science and Technology	May, 2003	The policy of strengthening scientific and technological innovation was first proposed for universities
P2	Several Opinions on Further Strengthening Scientific and Technological Innovation Work in Local Higher Education Institutions	Ministry of Education, Ministry of Science and Technology	March, 2006	For the improvement and perfection of scientific and technological innovation work in colleges and universities
P3	The 12th Five-Year Plan for the Development of Science and Technology in Higher Education Institutions	Ministry of Education	March, 2012	An important representative policy of China's scientific and technological innovation during the 12th Five-Year Plan period
P4	Several Opinions on Strengthening the Transfer and Transformation of Scientific and Technological Achievements in Higher Education Institutions	Ministry of Education, Ministry of Science and Technology	August, 2016	The opinions on the transformation of scientific and technological achievements in colleges and universities were explicitly put forward for the first time
P5	Action Plan for Promoting the Transfer and Transformation of Scientific and Technological Achievements in Higher Education Institutions	Ministry of Education	October, 2016	Important policies for promoting the transformation of scientific and technological achievements in colleges and universities
P6	Notice on Further Promoting the Implementation of Policies on the Transformation of Scientific and Technological Achievements in Colleges and Universities	Ministry of Education	December, 2017	Further implement the important policies for the transformation of scientific and technological achievements in colleges and universities
P7	Action Plan for University Science and Technology Innovation to Serve the Belt and Road Initiative	Ministry of Education	November, 2018	An important initiative policy for the transformation of scientific and technological achievements in colleges and universities
P8	Several Opinions on Expanding the Autonomy of Universities and Research Institutes in Scientific Research	Ministry of Science and Technology, Ministry of Education, Development and Reform Commission, Ministry of Finance, Ministry of Human Resources and Social Security, Chinese Academy of Sciences	July, 2019	Important policies regarding independent property rights in scientific and technological innovation in colleges and universities
P9	Several Opinions on Improving the Quality of Patents in Higher Education Institutions and Promoting Their Transformation and Application	Ministry of Education, State Intellectual Property Office, Ministry of Science and Technology	February, 2020	Important policies regarding patents in scientific and technological innovation in colleges and universities
P10	Notice on Organizing and Carrying Out the "Hundred Schools, Thousand Projects" High-Value Patent Cultivation and Transformation Action	Ministry of Education, State Intellectual Property Office, Ministry of Science and Technology	December, 2022	Practical and important policies for the transformation of scientific and technological achievements in colleges and universities

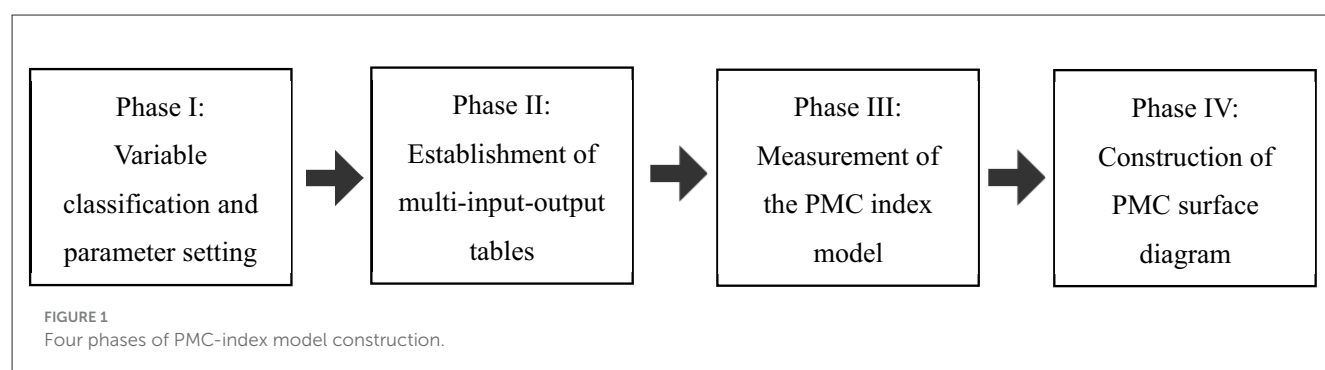


TABLE 2 Quantitative variation settings for the quantitative evaluation of scientific and technological achievement transformation policies in Chinese universities.

Primary variable	Secondary variable	Marking standard	References
Policy nature (X_1)	Opinion ($X_{1,1}$) Notice ($X_{1,2}$)	Determining whether the policy is an opinion Determining whether the policy is a notice	Chen et al., 2025
Policy timeliness (X_2)	Long-term ($X_{2,1}$) Medium-term ($X_{2,2}$) Short-term ($X_{2,3}$)	Determine whether the policy involves long-term content (>3 years) Determine whether the policy addresses medium-term elements (1–3 years) Determine whether the policy involves a short-term component (<1 year)	Zhang et al., 2025b
Policy issuing agency (X_3)	Ministry of Education ($X_{3,1}$) Ministry of Science and Technology ($X_{3,2}$) National Development and Reform Commission (NDRC) ($X_{3,3}$) Ministry of Finance ($X_{3,4}$) Ministry of Human Resources and Social Security ($X_{3,5}$) Chinese Academy of Sciences ($X_{3,6}$) Intellectual Property Office ($X_{3,7}$)	Determining whether the policy was issued by the Ministry of Education Determine if the policy was issued by the Ministry of Science and Technology Determine whether the policy was issued by the National Development and Reform Commission (NDRC) Determine if the policy was issued by the Ministry of Finance Determine if the policy was issued by the Ministry of Human Resources and Social Security Determine if the policy was issued by the Chinese Academy of Sciences Determine whether the policy was issued by the Intellectual Property Office	Kuang et al., 2020
Policy content (X_4)	Vesting of interests ($X_{4,1}$) Principal incentives ($X_{4,2}$) Platform construction ($X_{4,3}$) Title evaluation ($X_{4,4}$) Publicity and guidance ($X_{4,5}$) Legal protection ($X_{4,6}$)	Determining whether the policy involves vesting of interests Determine whether the policy involves the principal incentives Determine whether the policy involves platform construction Determine whether the policy involves title evaluation Determine whether the policy involves publicity and guidance Determine whether the policy involves legal protection	Wang et al., 2025
Policy evaluation (X_5)	Well founded ($X_{5,1}$) Clear objectives ($X_{5,2}$) Scientific program ($X_{5,3}$) Detailed planning ($X_{5,4}$) Clear authority and responsibility ($X_{5,5}$)	Determine whether the policy is well founded Determine whether the policy has clear objectives Determine whether the policy has a scientific program Determine whether the policy has detailed planning Determine whether the policy has clear authority and responsibility	Zhang et al., 2025a
Policy implementation agency (X_6)	Research staff ($X_{6,1}$) Management ($X_{6,2}$) University-run enterprises ($X_{6,3}$) Science and technology parks ($X_{6,4}$) Intermediary organizations ($X_{6,5}$)	Determine whether the policy involves research staff Determine whether the policy involves management Determine whether the policy involves university-run enterprises Determine whether the policy involves science and technology parks Determine whether the policy involves intermediary organizations	Zhu et al., 2025
Policy function (X_7)	Scientific and technological innovation ($X_{7,1}$) Promoting industry-university research cooperation ($X_{7,2}$) Normative guidance ($X_{7,3}$) Institutional constraints ($X_{7,4}$)	Determine whether the policy promotes scientific and technological innovation Determine whether the policy promotes industry-university-research cooperation Determine whether the policy provides normative guidance Determine whether the policy imposes institutional constraints	Zhu et al., 2025
Policy implication (X_8)	Research and development ($X_{8,1}$) Academic exchange ($X_{8,2}$) Talent cultivation ($X_{8,3}$) Innovation and entrepreneurship ($X_{8,4}$) Commercialization and industrialization ($X_{8,5}$)	Determine whether the policy promotes research and development Determine whether the policy promotes academic exchange Determine whether the policy promotes talent cultivation Determine whether the policy promotes innovation and entrepreneurship Determine whether the policy is used for commercialization and industrialization	Li et al., 2024
Policy safeguard (X_9)	Strengthened organizational leadership ($X_{9,1}$) Establish long-term mechanism ($X_{9,2}$) Provide financial support ($X_{9,3}$) Establish recognition and reward mechanism ($X_{9,4}$) Penalize according to regulations ($X_{9,5}$)	Determine whether the policy has strengthened organizational leadership Determine whether the policy establishes a long-term mechanism Determine whether the policy provides financial support Determine whether the policy establishes recognition and reward mechanism Determine whether the policy has penalized according to regulations	Yu et al., 2025
Policy disclosure (X_{10})	Current ($X_{10,1}$) Repealed ($X_{10,2}$)	Determine whether the policy is current Determine whether the policy is repealed	Kuang et al., 2020

evaluation of university scientific and technological achievements transformation policies. Among them, the Perfect grade ranges from 8 to 9, which means that the policy formulation process is comprehensive, complete, clear, capable of realizing the policy objectives, and the effectiveness of measures is evident. An Excellent grade ranges from 6 to 7.99, which means that the policy implementation process is more effective, the policy directionality and purposefulness are obvious, and the policy effect is more

satisfactory and basically meets the policy expectations. The Acceptable grade ranges from 4 to 5.99, the main meaning of which means that the policy content and policy implementation have certain limitations, the PMC index is general, and the scores of each index are unstable. In general, the score of each index is unstable, and the effect of policy implementation is poor. A low grade is less than 4, which means that it cannot achieve the expected policy objectives, and the feasibility, pertinence, and applicability

TABLE 3 Multi-input-output tables for the quantitative evaluation of scientific and technological achievements transformation policy.

Primary variable	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀
Secondary variable	X _{1,1}	X _{2,1}	X _{3,1}	X _{4,1}	X _{5,1}	X _{6,1}	X _{7,1}	X _{8,1}	X _{9,1}	X _{10,1}
	X _{1,2}	X _{2,2}	X _{3,2}	X _{4,2}	X _{5,2}	X _{6,2}	X _{7,2}	X _{8,2}	X _{9,2}	X _{10,2}
		X _{2,3}	X _{3,3}	X _{4,3}	X _{5,3}	X _{6,3}	X _{7,3}	X _{8,3}	X _{9,3}	
			X _{3,4}	X _{4,4}	X _{5,4}	X _{6,4}	X _{7,4}	X _{8,4}	X _{9,4}	
			X _{3,5}	X _{4,5}	X _{5,5}	X _{6,5}		X _{8,5}	X _{9,5}	
			X _{3,6}	X _{4,6}						
			X _{3,7}							

TABLE 4 PMC-index model score results and corresponding consistency levels.

PMC-index model score	0–3.99	4–5.99	6–7.99	8–9
Consistency level	Low	Acceptable	Excellent	Perfect

of the policy are insufficient. The larger the PMC index model score, the more comprehensive the policy text content and the more practicable the policy in the implementation process. The larger the PMC-index model result score, the more comprehensive and operational the policy text is in the process of implementation.

2.2.4 Construction of PMC-surface diagram

Relying on the numerical results of the PMC index model calculation to establish the PMC-surface three-dimensional image, it can intuitively and graphically respond to the advantages and disadvantages of the sample of scientific and technological achievement transformation policies. In this study, according to X₁–X₉, a matrix of three rows and three columns is established, which does not include X₁₀, satisfying the symmetry and balance of the matrix itself. This was calculated using Equation 5.

$$\text{PMC-Surface} = \begin{bmatrix} X_1 & X_4 & X_7 \\ X_2 & X_5 & X_8 \\ X_3 & X_6 & X_9 \end{bmatrix} \tag{5}$$

3 Results and analysis

3.1 Analysis of results based on PMC-index model

3.1.1 Analysis of overall effectiveness of the policy samples

The consistency level is determined through the PMC-index model results, and the specific results are as follows in Table 5: the PMC-index model scores of the selected 10 policy samples increase from 3.85 to 7.99, and the average PMC-index model score of the 10 policy samples is 6.21, with an average level at an excellent level. In terms of the 10 policy samples, the score of P8 is 7.99, ranking first, at the level of Excellent grade, reflecting the strong effectiveness of the scientific and technological achievements transformation

policy in universities. P10, P6, P9, and P7 were rated as excellent. P5, P4, P2, and P3 were at the acceptable grade level. P1 is the lowest at 3.85, which is at the “Low” grade level. According to the release time of the policy samples, China has gradually improved the rationality, innovativeness, and completeness of policies in the process of formulating policies on the transformation of scientific and technological achievements in universities (Liang, 2024), which also indicates that its policies have a better role in promoting the transformation of scientific and technological achievements. However, each policy has certain flaws and deficiencies.

3.1.2 Analysis of overall primary variables of policy samples

First, in terms of the mean value of each level of the variables of the PMC-index model, the advantage of China’s university scientific and technological achievements transformation policy is more obvious in the four aspects of policy content, policy evaluation, policy implementation agency, and policy function, which indicates that the policy content is clear and explicit, the policy function is accurately positioned, and the policy evaluation effect is excellent. Second, it also performs well in terms of policy nature and policy timeliness, indicating that the policy performs better in terms of guiding, predicting, describing, and regulating, while the medium-term balance of the policy is also better. Third, there is an urgent need to adjust and optimize policy implications and safeguard levels, indicating that there is still a gap between the policy implication in promoting scientific and technological research and development, talent cultivation, innovation, and entrepreneurship in the process of promoting the transformation of scientific and technological achievements. In addition, at the policy safeguard level, it is urgent to establish a more complete reward and punishment mechanism and a long-term supervision mechanism.

3.2 Analysis of PMC-surface results for the policy samples

3.2.1 Analysis of the results of the PMC-matrix

Based on the calculation results of the PMC index model, the PMC matrices corresponding to the 10 policies are presented in Table 6. The row and column values are the horizontal coordinate values of the matrix, and the sequence values are the vertical coordinate values of the matrix, which are used to judge the advantages and disadvantages of each policy sample based on the concavity index and the degree of concavity of the image surface.

TABLE 5 PMC-index model for policy samples and evaluation results.

Primary variable	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
X ₁	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
X ₂	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
X ₃	0.29	0.29	0.14	0.29	0.14	0.14	0.14	0.86	0.43	0.86
X ₄	0.33	0.5	0.33	0.67	0.67	1	1	1	1	0.83
X ₅	0.4	0.8	0.8	0.8	1	1	1	1	1	1
X ₆	0.4	0.6	0.8	0.6	0.8	1	0.6	1	0.8	0.8
X ₇	0.5	0.5	0.75	0.75	1	1	1	1	1	1
X ₈	0.4	0.6	0.4	0.4	0.6	0.8	0.8	0.8	0.8	0.8
X ₉	0.2	0.6	0.4	0.6	0.4	1	1	1	0.8	0.8
X ₁₀	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Index score	3.85	5.22	4.95	5.44	5.94	7.27	6.87	7.99	7.16	7.42
Ranking	10	8	9	7	6	3	5	1	4	2
Consistency level	Low	Acceptable	Acceptable	Acceptable	Acceptable	Excellent	Excellent	Excellent	Excellent	Excellent

The more the surface map as a whole is located in the upper-middle space, the smaller the depression of the coordinate surface, which represents the more comprehensive coverage of each element of the policy and the higher the evaluation grade of the policy.

3.2.2 Analysis of PMC-surface results of the policy samples

The depression index refers to the difference between the values of the primary variables of the policy to be evaluated and those of the perfect policy in the PMC-index model. As shown in [Figures 2, 3](#), taking the perfect policy as the benchmark, the PMC surface diagram is analyzed in the order of the depression index from the lowest to the highest by comparing the degree of depression as follows:

Among them, P8 has the lowest concavity index, indicating that P8 has performed relatively well in the 10 primary variables and has recently come close to having a perfect policy. Compared with the first-ranked P8, there is still a gap between P10 in terms of policy content and policy protection. In terms of policy content, P10 fails to mention the initiative of advocating the transformation of scientific and technological achievements to incentivize talents, and only proposes financial incentives; the incentives for the evaluation of titles are also not involved. In terms of policy protection, there is a lack of regulatory mechanisms for the transformation of scientific and technological achievements, and there is a lack of punishment mechanisms for the inaction of the relevant departments and personnel P6 There is a gap in terms of policy-issuing agencies. This indicates that the policy effectiveness (policy strength) of P6 is low, and the administrative level of the policy issuing organization represents the difference in policy effectiveness (policy strength). To achieve the goal of transforming scientific and technological achievements, the coordination and assistance of other departments are often needed in the policy implementation process. P6 was issued only by the Ministry of Education, which lacks interdepartmental coordination and

TABLE 6 PMC matrix of the policy samples.

Policy	P1	P2
PMC-matrix	$\begin{bmatrix} 0.5 & 0.33 & 0.5 \\ 0.33 & 0.4 & 0.4 \\ 0.29 & 0.4 & 0.2 \end{bmatrix}$	$\begin{bmatrix} 0.5 & 0.5 & 0.5 \\ 0.33 & 0.8 & 0.6 \\ 0.29 & 0.6 & 0.6 \end{bmatrix}$
Policy	P3	P4
PMC-matrix	$\begin{bmatrix} 0.5 & 0.33 & 0.75 \\ 0.33 & 0.8 & 0.4 \\ 0.14 & 0.8 & 0.4 \end{bmatrix}$	$\begin{bmatrix} 0.5 & 0.67 & 0.75 \\ 0.33 & 0.8 & 0.4 \\ 0.29 & 0.6 & 0.6 \end{bmatrix}$
Policy	P5	P6
PMC-matrix	$\begin{bmatrix} 0.5 & 0.67 & 1 \\ 0.33 & 1 & 0.6 \\ 0.14 & 0.8 & 0.4 \end{bmatrix}$	$\begin{bmatrix} 0.5 & 1 & 1 \\ 0.33 & 1 & 0.8 \\ 0.14 & 1 & 1 \end{bmatrix}$
Policy	P7	P8
PMC-matrix	$\begin{bmatrix} 0.5 & 1 & 1 \\ 0.33 & 1 & 0.8 \\ 0.14 & 0.6 & 1 \end{bmatrix}$	$\begin{bmatrix} 0.5 & 1 & 1 \\ 0.33 & 1 & 0.8 \\ 0.86 & 1 & 1 \end{bmatrix}$
Policy	P9	P10
PMC-matrix	$\begin{bmatrix} 0.5 & 1 & 1 \\ 0.33 & 1 & 0.8 \\ 0.43 & 0.8 & 0.8 \end{bmatrix}$	$\begin{bmatrix} 0.5 & 0.83 & 1 \\ 0.33 & 1 & 0.8 \\ 0.86 & 0.8 & 0.8 \end{bmatrix}$

association. There are gaps between P9 and P7 in terms of the policy issuing agency and the policy implementing agency, but P9 is better than P7, which indicates that the policy implementation of P9 and P7 is ineffective, and that the policy implementing agency mainly refers to the agency that adopts measures and behaviors under the influence of the policy, and that the administrative level and the scope of the management of the policy implementing

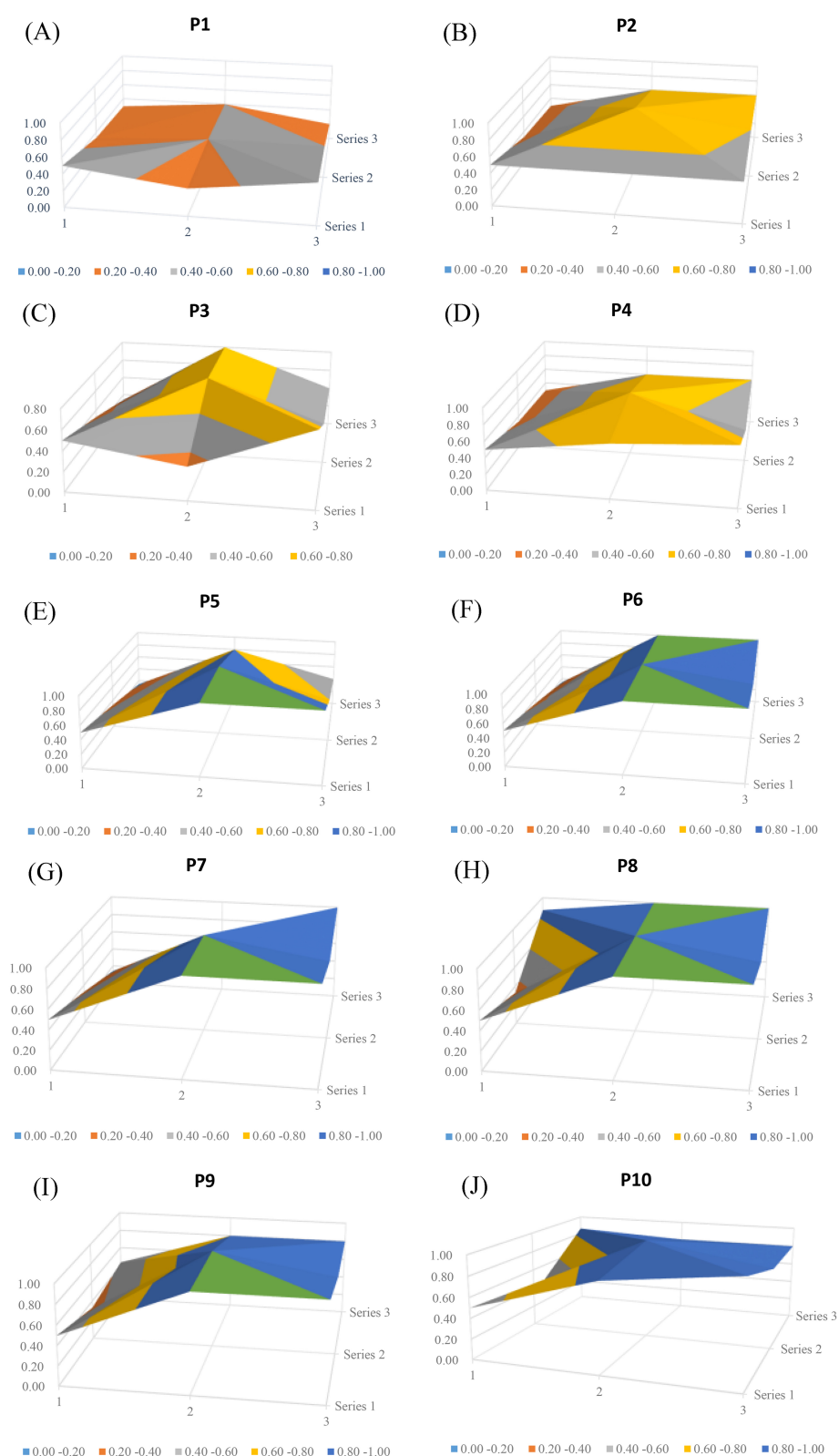


FIGURE 2

PMC-surface of the digital economic policy. (A) PMC surface diagram at P1. (B) PMC surface diagram at P2. (C) PMC surface diagram at P3. (D) PMC surface diagram at P4. (E) PMC surface diagram at P5. (F) PMC surface diagram at P6. (G) PMC surface diagram at P7. (H) PMC surface diagram at P8. (I) PMC surface diagram at P9. (J) PMC surface diagram at P10.

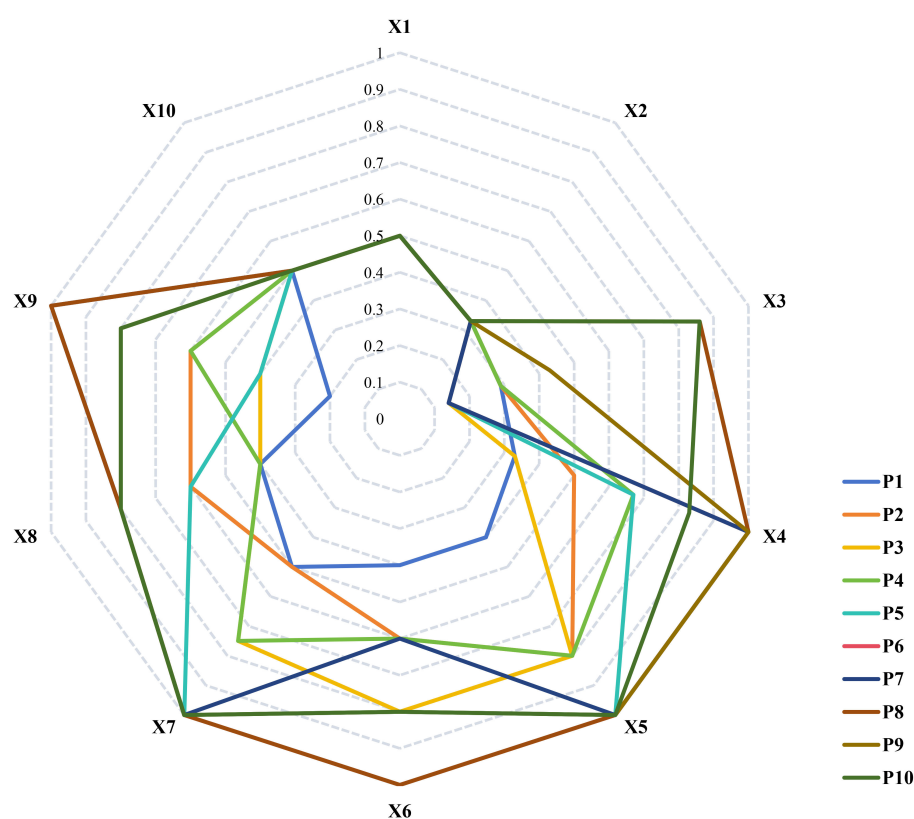


FIGURE 3
Debra diagram of the degree of concavity of the first-order variables.

agency are important factors affecting the policy implementation. P9 and P7 both lack intersectoral coordination and coalition in the process of policy implementation; at the same time, there are fewer policy-implementing departments, and the policy implementation is not effective. P5 has gaps in terms of the policy issuing agency, policy content, policy implementing agency, policy implication, and policy safeguard. P4, P2, P3, and P1 have gaps in terms of the policy issuing agency, policy content, policy evaluation, policy implementation agency, policy functions, policy implications, and policy safeguards are very weak. This means that the above five policies fail to collaborate with other departments to issue policies regarding policy-issuing institutions. In terms of policy content, they fail to mention the advocacy of forming an informatized platform for the transfer and transformation of scientific and technological achievements.

Simultaneously, there is a lack of initiatives for the attribution of rights and interests and the establishment of platforms, which may be due to the fact that it pays more attention to academic originality and not enough to the transformation of scientific and technological achievements. In terms of policy evaluation, the basis for policy formulation is insufficient, the degree of clarity of responsibilities and rights is not clear enough, and insufficient attention is paid to the transformation of scientific and technological achievements. In terms of policy implementation, these policies not only emphasize the importance of researchers and management personnel, but also cover the level of university-run enterprises, science and technology parks, and

intermediary organizations. In terms of policy implementation, the policy only emphasizes the importance of scientific researchers and management departments, and the implementation of the policy for science and technology parks and intermediary institutions is not strong, which indicates that the policy has not planned for the future development of science and technology parks and has not introduced corresponding support and incentive policies for science and technology parks. In terms of policy function, the policy only focuses on the promotion of scientific and technological research and development, with no layout for the commercialization and industrialization stages in the chain of transformation of scientific and technological achievements, and no mention of the pilot stage and the technology research and development stage, which indicates that the commercialization and industrialization of the transformation of scientific and technological achievements do not have a high level of energy efficiency. These gaps have hindered the effectiveness of policy implementation.

4 Discussion and recommendations

The consistency and completeness of policy texts are important factors affecting the degree of achievement of policy objectives. Then, it is undoubtedly true that there is a difference between the consistency of policy texts and the consistency of policy implementation. Whether the policy is effectively implemented

is a direct influencing factor for the policy's effectiveness. For policies with high consistency in their texts, only when the policy implementation is good will the policy effectiveness be good.

With the continuous deepening of awareness of technological transformation and the continuous advancement of the innovation and reform process in universities, the transformation of scientific and technological achievements in Chinese universities is constantly improving. Any policy arrangement related to scientific and technological innovation has played an important role in guaranteeing this within a certain period. However, due to the differences in the status of the transformation of scientific and technological achievements in universities and the external development environment in different periods, the consistency of policies for the transformation of scientific and technological achievements also varies. On the one hand, the transformation of scientific and technological achievements in universities is a complex systematic project, involving aspects such as economy, politics and society. The specific issues that policies for the transformation of scientific and technological achievements in colleges and universities aim to address are different. For instance, some policies focus on increasing incentives in key universities in China (such as 985 and 211 Project universities), while others focus on the management level of scientific research departments in universities. Some policies specifically stipulate how to implement them at the micro level, while others provide guidance at the macro level. Therefore, there are differences in policy themes, priorities, innovations, and measures. However, with the development of the social economy, the concepts, technologies, and methods of the transformation of scientific and technological achievements in colleges and universities will continue to progress and change. In practice, the transformation of scientific and technological achievements in some Chinese universities will be piloted in some universities and implemented nationwide. This will undoubtedly affect the formulation and implementation of policies for the transformation of scientific and technological achievements in higher education institutions. For example, on the one hand, it can be targeted at cities with a large number of universities such as Beijing and Changchun; On the other hand, incentive policies for relevant scientific and technological achievements can be formulated for institutions such as science and engineering, and agriculture and forestry. Furthermore, the aim is to promote the formation of healthy competition among universities within the same region or of the same type of university. Furthermore, the aim is to foster the formation of a healthy competitive environment within the same region or among universities of the same type. For instance, in this study, the policy sample P8 has the optimal policy consistency. Although the level of policy consistency is good, it does not mean that it can completely promote the technological transformation of all universities across the country. This is because the implementation of the policy has a certain lag, and the implementation intensity varies among different universities, resulting in inconsistent effects. Even if the implementation effect of this policy is very good, compared to the overall effect after the policy combination, it is still extremely limited. Therefore, it is necessary to consider the joint efforts of universities, enterprises, research institutions and other departments.

Combining the PMC-index model scores of this study and the current development status of China's university scientific and technological achievements transformation policies, the following three recommendations are proposed.

Firstly, it is necessary to enhance multi-departmental collaboration and joint policy issuance, which will help break down administrative barriers and create a policy synergy. The transformation of scientific and technological achievements involves multiple fields such as intellectual property rights, taxation, finance, education, and science and technology. Policies of a single department often fail to comprehensively cover all aspects. Joint policies can establish a collaborative supervision mechanism. Both the policy-issuing and implementing agencies are important components that affect the effectiveness of policy implementation. In China, the Ministry of Education, the Ministry of Science and Technology, governments at all levels, and education management departments play important roles in the transformation of scientific and technological achievements in universities. Currently, China's policies on the transformation of scientific and technological achievements are mostly issued by the Ministry of Education, the Ministry of Science and Technology, and other main departments. Direct links with the National Development and Reform Commission, Ministry of Finance, Ministry of Human Resources and Social Security, and Intellectual Property Office should be strengthened to create an atmosphere of joint multi-departmental issuance and implementation by multi-major agencies (Jiang et al., 2023). Nations and regions are increasingly focusing on the transformation of scientific and technological achievements to promote economic development. To accomplish this, the government seeks reasonable paths for policy optimization and improves the efficiency of transformation. Therefore, it is necessary to tailor the policy-mix pattern to suit local conditions (Li et al., 2022).

Second, a platform for the transformation of science and technology should be built, and the commercialization and industrialization of science and technology should be promoted. Colleges and universities should actively build a platform for the transformation of scientific and technological achievements, set up special departments for the key nodes in the process of transformation of scientific and technological achievements, and optimize the whole chain of service systems, such as the construction of scientific and technological achievements transformation centers and other bases, to enhance the value of scientific and technological achievements in the early stage of transformation, reduce the risk of transformation of the achievements, and provide professional guidance for the transformation of scientific and technological achievements. Simultaneously, only through extensive cooperation between universities and enterprises can we realize the effective docking of scientific research results and market demand, and then promote the scientific and technological achievements of universities to play a practical role in boosting social and economic development. Through the effective promotion of scientific research, academic exchanges, and the commercialization and industrialization of university scientific and technological achievements, the efficiency of the transformation of university scientific and technological achievements should be improved, and commercialization and industrialization should be promoted (Zhang and Zhao, 2025).

Third, a transformation incentive mechanism should be established to promote the transformation of scientific and technological achievements. Strengthening the importance of the transformation of scientific and technological achievements in universities, implementing differentiated classification management and incentives, improving and optimizing the support policies for the transformation of scientific and technological achievements, further emphasizing the performance benefits of the transformation of scientific and technological achievements, and forming a multi-level incentive mechanism from the incubation, confirmation, and maintenance of scientific and technological achievements to their application and transformation are all necessary. Given the heterogeneity of the demand for resources in the process of transforming scientific and technological achievements by universities, it is necessary to implement precise policies, and the supply of policies should be fully integrated with the development status of universities to categorize and implement policies for universities at different stages of development, technological levels, and capital requirements, and to continuously improve the pertinence, suitability, and efficiency of the incentive policies.

5 Conclusion

This study selects 10 policies on transferring and transforming the scientific and technological achievements of Chinese universities as research objects, constructs an evaluation system for transforming the scientific and technological achievements of universities that contains 10 primary variables and 44 secondary variables, and evaluates the system quantitatively using text mining and the PMC-index model. The following conclusions were drawn:

The average PMC index value of the 10 policies is 6.21, which is excellent. The consistency of five policies, including P8, P10, P6, P9, and P7, was “Excellent.” The consistency of P5, P4, P2, and P3 was “Acceptable.” The consistency of the P1 policy is “Low.” This indicates that the overall formulation of the transformation of scientific and technological achievements in China’s universities is at a high level, and it can play a better guiding effect. The policies on the transformation of scientific and technological achievements in Chinese universities are excellent in four aspects: policy content, evaluation, implementation agency, and function. However, common problems remain, such as policy issuing agencies, policy implications, and policy safeguards. The overall synergy, scientific, and effectiveness of the policies are better. Finally, there is still much room for optimization in China’s university scientific and technological achievements transformation policy, which can still be adjusted and optimized in terms of the policy issuing agency, policy implication, and policy safeguard.

6 Limitations of the study

The selection of policy samples and the setting of variables are limitations of this study. With the gradual intersection and expansion of policy goals and functions, further research and optimization are needed to explore and expand the dimensions and scope of the first- and second-order variables of the policy on

the transformation of scientific and technological achievements in Chinese universities. In addition, the effectiveness of the policies on the transformation of scientific and technological achievements in colleges and universities formulated by the Ministry of Education and the education authorities of various regions can also be evaluated and compared, and studies on the effectiveness of policy simulations and combinations can be conducted. For example, the simulation of the effectiveness of policies for the transformation of scientific and technological achievements in colleges and universities and the formulation of multi-objective coordinated policies should be strengthened.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

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