Research on Industry-University-Research Related Policies from the Perspective of Policy Tools and Innovation Value Chain: A Case Study of Gansu Province

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Abstract
This study examines the industry-university-research (IUR) policies in Gansu Province using policy instruments and a two-dimensional analytical framework grounded in the innovation value chain. The results reveal that the existing policies positively influence the collaborative innovation among industry, academia, and research sectors. Nevertheless, there is a need to reinforce policies during the industrialization stage and to enhance those supporting informatization. This paper suggests policy recommendations aimed at bolstering IUR-related policies in Gansu Province and promoting collaborative innovation. The findings aspire to contribute to the development of a more robust and dynamic policy ecosystem. They provide theoretical support and practical guidance for Gansu and similar regions to achieve innovation-driven sustainable development. Furthermore, this study offers valuable insights for policy stakeholders, including businesses, academic institutions, and government decision-makers, on how to effectively stimulate and harness the region's innovation potential through policy measures.
Keywords: Industry-University-Research, Policy Texts, Policy Tools, Innovation Value Chain

Introduction
Governments worldwide place significant importance on Industry-University-Research (IUR) Collaborative Innovation. To seize the commanding heights of scientific and technological innovation, countries prioritize enhancing the innovation capacity of the university system and constructing an innovation synergy mechanism between universities and enterprises. This is a crucial policy for improving a country's innovation capacity (Yusuf & Nabeshima, 2007). According to some scholars, IUR collaborative innovation involves collaborative innovation activities among enterprises, universities, and research institutes. These entities

invest their respective resources and capabilities to carry out technological development with the support of the government, scientific and technological service intermediaries, financial institutions, and other related subjects (Zhang, 2011). Collaborative innovation between industry and universities is a crucial aspect of China's innovation strategy, which aims to drive the country's economic growth. To achieve this, Chinese governments at all levels have implemented policies to promote University-Industry collaborative innovation, resulting in improved innovation performance and positive outcomes. Gansu Province, located in western China, holds a significant position in the national economic development pattern. Research on Gansu Province's collaborative innovation policy is of great significance to the national economy and can serve as a reference for policy formulation in other regions of the country. This paper presents a quantitative study of Gansu IUR related policies from the perspectives of policy tools and innovation value chain theory. It analyzes the current situation and issues of the policy and provides policy recommendations for the development of IUR collaborative innovation in Gansu Province.

Literature Review

Governments worldwide are introducing policies to promote IUR collaborative innovation. Developed countries such as the United States, the United Kingdom, Germany, and Japan have accumulated significant experience in formulating IUR related policies and legislation. The policy frameworks and systems to promote IUR collaboration have achieved great success (Song & Chen, 2008). Sa and Litwin (2011) examined the policy tools used by the Canadian federal government to promote IUR linkages and summarised the main features and impacts of Canadian policy approaches. Bstieler et al (2015) investigated 105 collaborations between industry, universities, and research institutions in the biotechnology sector in the United States. They discovered that university intellectual property rights policies played a crucial role in establishing a trusting relationship between the university and the firm, which in turn contributed to the success of the collaborations. Sohn et al (2009) empirically analysed the structure of innovation networks in four industrial clusters in South Korea using social network analysis and textual analysis, and concluded that government policy is a major determinant of the role of Korean universities as knowledge providers in industrial innovation, and that this policy also brings about regional differences in the involvement of universities in innovation activities in the capital region and outside the capital. Kitagawa and Woolgar (2008) analysed the development of science, technology and innovation governance in Japan, with a particular focus on the 'regionalisation' of innovation policy and policy support for new IUR linkages. The authors discussed the nature and constraints of the multi-level structure of science and innovation policy in Japan. Scholars in China have also paid extensive attention to foreign IUR related policies and have put forward policy suggestions in light of China's actual situation. For instance, Cheng et al (2005) introduced the main policies for promoting the transformation of scientific and technological achievements in the UK and analysed their policy effects. Wu (2017) analysed the policy tools used by the US government to promote collaborative innovation among industries, universities, and research institutes. Shi et al (2010) conducted a comparative analysis of the formulation, development process, form, institutions, and policies of IUR integration between China and Japan.

Since the reform and opening up, the Chinese government has implemented several policies related to IUR, which have significantly contributed to economic development and scientific and technological progress. Chinese scholars not only learn from foreign IUR related policies but also summarise the Chinese experience and conduct qualitative research.

According to Zhang (2011), promoting collaborative innovation requires a deep integration of IUR resources with the rest of society, achieving a balance between guiding external demand and stimulating endogenous impetus, and continuously creating a policy environment and social atmosphere conducive to the healthy development of collaborative innovation. Wang (2018) analysed the evolution of IUR integration and university-enterprise cooperation policies in China's colleges and universities from the perspective of the 'triple helix' theory. The author also examined China's IUR related policies through the case of Liaoning and provided policy suggestions. According to Zhang (2010) tax relief policies are not the primary benefit pursued by enterprises in IUR Cooperation. Instead, relevant policies should guide universities to take the initiative to cooperate with enterprises through project and financial support.

Chinese researchers have conducted quantitative studies on IUR related policies. For example, Wu and Chen (2011) investigated the impact of government subsidies on IUR cooperation and innovation. They concluded that government subsidies are essential to promote IUR cooperation and innovation. Zhu and Cheng (2014) analysed 651 policies on the transformation of achievements of IUR enacted in China from 1985 to 2013. Liu et al (2016) conducted an in-depth analysis of the cooperation network of the main body of policies on the transformation of achievements of IUR, using social network analysis. The authors analysed 1,521 IUR collaborative innovation policies that were promulgated individually or jointly by the State Council and various ministries and commissions from 1978 to 2015. The authors employed the social network analysis method to identify the subject keywords of the policy texts and map their evolution. They conducted in-depth analyses of the focus themes at different stages. Wu and Xu (2018) performed a quantitative analysis of the publicly released policies on IUR collaborative innovation of the central government ministries and commissions from 2006 to 2016. Based on their findings, they provided policy suggestions.

In summary, current research mainly concentrates on national-level policies, with limited in-depth analysis of regional-level policies. The 2015-2018 Gansu Province Science and Technology Innovation Evaluation Comprehensive Level Index ranks Gansu Province 18th in the country, indicating a certain level of strength in science and technology innovation (Du & Li, 2021). This suggests that Gansu Province has the potential to further enhance its scientific and technological innovation capacity. The 'Outline of the 14th Five-Year Plan and 2035 Vision for National Economic and Social Development of Gansu Province' prioritises innovation as the primary driving force for development. The plan aims to accelerate the construction of innovative provinces and establish Gansu as a new hub for innovation-driven development in the western region. The development and execution of innovation policy are crucial tools for the government to establish a province that fosters innovation. A comprehensive analysis of the IUR related policies in Gansu Province can improve the policy system that facilitates collaborative innovation among industry, universities, and research institutions, and promote the development of the regional innovation system.

Research Design
Policy Text Selection
The policy texts analysed in this paper were obtained from the 'PKULAW Law Database' (https://www.pkulaw.com/). The search was specifically for local laws and regulations related to 'industry-university-research'. This paper only includes policy texts issued at the provincial level, namely by the People's Congress of Gansu Province (including the Standing Committee), the Communist Party of China Gansu Provincial Party Committee, Gansu Provincial People's

Government, and the departments of the provincial government. To ensure the representativeness of the selected policy texts, the following criteria are applied: (1) Exclude invalid policies and policies that have not yet come into effect. (2) Select policy content that is related to the current effective policy documents that are substantially related to the IUR related policies. (3) Policy types should be selected from official documents such as plans, opinions, notices, measures, laws, and regulations. Informal decision-making documents such as replies and approvals should be excluded. (4) The selected policy texts must be issued by the Gansu Provincial People's Congress (including the Standing Committee), the Gansu Provincial People's Government, or provincial government departments. The chosen policy texts do not have a specified time span. A total of 102 policy texts were selected, as shown in Table 1.

Table 1
Gansu IUR Related Policies Text (Part)

No.	TITLE	DATE OF PUBLICATION
1	Regulations on Promoting the Transformation of Scientific and Technological Achievements in Gansu Province (Revised in 2016)	2016.04.01
2	Regulations on Promoting the Development of Small and Medium Enterprises in Gansu Province (Revised in 2021)	2021.09.29
3	Notice on Accelerating the Construction of Research and Development Institutions in Private Enterprises issued by the Development and Reform Commission of Gansu Province and the Department of Science and Technology of Gansu Province	2012.08.27
4	Notice on Issuing the "Eleventh Five Year Plan for Science and Technology Innovation and Development in Gansu Province" by the Development and Reform Commission of Gansu Province and the Department of Science and Technology of Gansu Province	2006.11.17
5	Opinions of the Development and Reform Commission of Gansu Province on Strengthening the Construction of Independent Innovation Capacity in Strategic Emerging Industries	2013.04.16
6	Notice on Issuing the Implementation Plan for the Construction of Gansu Province Manufacturing Innovation Center by Gansu Provincial Commission of Industry and Information Technology, Gansu Provincial Development and Reform Commission, Gansu Provincial Department of Science and Technology, and Gansu Provincial Department of Finance	2016.12.20
...	...	...
99	Opinions of the General Office of the Communist Party of China Gansu Provincial Committee and the General Office	2013.05.31

	of the People's Government of Gansu Province on Promoting the Engineering Work of the "3341" Project	
100	Notice of the General Office of the Communist Party of China Gansu Provincial Committee and the General Office of the People's Government of Gansu Province on Issuing the "Eleventh Five Year Plan for the Construction of Talent Teams in Gansu Province"	2006.07.21
101	Notice of the General Office of the Communist Party of China Gansu Provincial Committee and the General Office of the People's Government of Gansu Province on Issuing the "Several Measures to Support Scientific and Technological Innovation in Gansu Province"	2016.10.01
102	Notice on Issuing the Guiding Opinions on Deepening Reform and Innovation Mechanisms in Development Zones throughout the Province by the General Office of the Communist Party of China Gansu Provincial Committee and the General Office of the People's Government of Gansu Province	2016.01.14

Research Methodology

This paper employs quantitative analysis methods for policy documents and content analysis methods to study the IUR related policies in Gansu Province. The quantitative analysis methods for policy documents focuses on the policy subject, policy tools, and policy-associated network. Drawing on and introducing the knowledge and methods of statistics, policy econometrics and other disciplines, through empirical analyses of the content and external attributes of policy literature, combined with the history, institutional environment and policy practice in which it is situated, in order to reveal the selection and application of policy tools, the distribution of interests and the gaming process of the policy process, and the internal logic and historical laws of policy transmutation (Huang, 2016). The content analysis method draws conclusions through a series of operations, such as coding and statistical analysis of the text content. This method offers the advantages of objectivity, neutrality, rich data, and low research costs (Liu, 2014).

Analysis Framework

Collaborative innovation involves cooperation among IUR. In this process, the government should formulate policies and regulations to enhance the enthusiasm of all parties involved, reduce the cost of cooperation, and allocate resources and benefits reasonably. Policy tools can help the government implement macro-control and achieve policy objectives. Industrial policy refers to public policy aimed at promoting cooperation between IUR (Hong & An, 2015). According to Roderick (2009), a sound industrial policy should involve strategic collaboration between the private sector and the government to identify the primary obstacles to economic restructuring and take measures to overcome them. In order to improve competitiveness, it is necessary to implement rational policies that coordinate the involvement of industry, academia, and research parties at different stages of the innovation value chain. This paper presents a two-dimensional analytical framework of policy tools and the innovation value chain to analyze the policy texts of IUR in Gansu.

Dimension X: Policy Tool Dimension

This paper utilises the research of Wu and Xu (2018), employing the categorisation of policy tools by Roy Rothwell and Walter Zegveld, which is now widely recognised in academia. Rothwell and Zegveld classify innovation policy tools into three types: supply-type, environment-type, and demand-type policy tools, based on their varying levels of impact on technology. Supply-type policy tools promote innovation efforts, while demand-type policy tools stimulate them. Figure 1 shows that environment-focused policy tools indirectly affect cooperation and innovation in IUR.
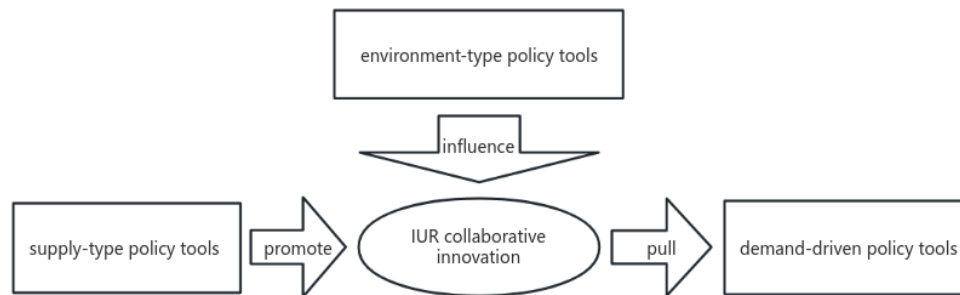

Figure 1 Policy Tools for IUR Collaborative Innovation

Supply-type policy tools mainly refer to the government's direct support for IUR co-operation and innovation through funds, talents and technologies, so as to promote efficient co-operation and innovation among IUR, and the sub-tools of supply-type policy tools are classified into: financial input, infrastructure construction, information support, talent training and public services; Environmental policy tools mainly refer to the government's indirect influence on the cooperation between industry, academia and research through the tax system, regulations and controls, and financial and financial means, so as to create a favourable environment for the cooperation and innovation between industry, academia and research, and the sub-tools of environmental policy tools are divided into the following categories: financial support, tax incentives, regulations and controls, target planning, and strategic measures; Demand-based policy tools mainly refer to the government's initiative to stabilise the market by using the means of purchasing and trade control in order to reduce the market's uncertainty, so as to stimulate the development of the collaboration between the industry, academia and research. The sub-tools of demand-based policy tools are divided into: government procurement, trade control, overseas institutions, as shown in Table 2.

Table 2

Policy Tools for IUR Collaborative Innovation

Tool Types	Tool Names	Meanings
supply-type	capital inputs	Direct government funding for IUR collaborative innovation activities
	Infrastructure construction	Government-established R&D laboratories, platforms and other projects
	Information support	Various public science and technology support and information services provided by the Government for IUR collaborative innovation projects
	talent cultivation	The government educates and cultivates talents according to the needs of the development of IUR collaborative innovation
	public service	Supporting services provided by the government, including the establishment of responsible organisations, improvement of policies and regulations
environment-type	financial support	Government support through financial channels, including financing, loans
	tax incentives	Policies involving tax relief and tax incentives
	regulatory control	Regulate the behavior of participants in IUR, and maintain market order, such as formulating standards, industrial policies
	target planning	Based on the needs of IUR collaborative innovation, provide an overall description and outline of the goals and vision to be achieved
	strategic measures	Measures taken by the government to encourage the establishment of joint organizations, reward and remunerate personnel
demand-driven	government procurement	The government's policy on using fiscal funds to purchase IUR collaborative innovative products and services
	trade control	Government control measures on import and export trade, such as trade agreements, tariffs
	Overseas organisations	Government policy to encourage co-operation between IUR parties within the scope of management and foreign IUR organisations

Dimension Y: Innovation Value Chain
Porter introduced the concept of the value chain in 1985 in his book Competitive Advantage, which examines value from a strategic perspective (Liang, 2016). The concept of the innovation value chain is generally attributed to a paper entitled 'The Innovation Value Chain' published by Morten T Hansen and Julian Birkinshaw in the June 2007 issue of Harvard Business Review (Wang et al., 2019). In the innovation value chain, universities and research institutes conduct research and development(R&D), while enterprises transform scientific

research results into revenue by using their own capital and production advantages and bringing the products to market. This division of labour utilises the advantages of all parties in the IUR and accelerates the realisation of the entire innovation value chain. According to the collaborative innovation policy of IUR in Gansu Province, combined with the implementation process and characteristics of innovation, this paper proposes a research-based framework for the collaborative innovation policy of IUR in Gansu Province. The innovation value chain is divided into three stages: R&D, results transformation, and industrialisation. The Y dimension of the analysis framework for the IUR related policies is based on the work of (Tang et al., 2019).

Combining the two dimensions culminates in the two-dimensional analytical framework of this paper, as shown in Figure 2.
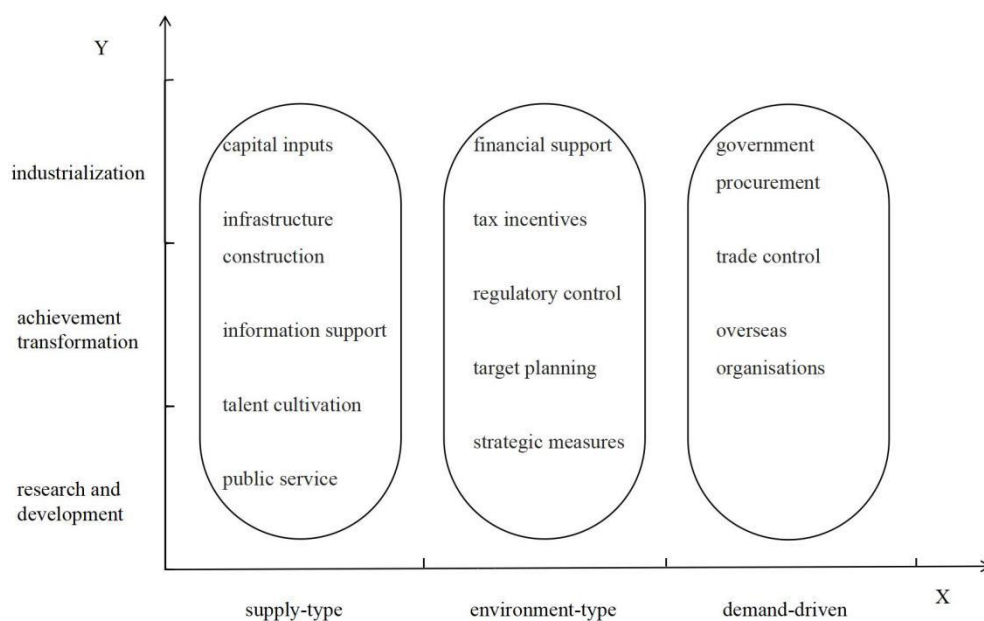

Figure 2 Two-dimensional Analysis Framework of IUR Related Policies

The study conducted content analysis using paragraphs as the unit of analysis. 102 policy texts related to IUR in Gansu Province were coded based on the two-dimensional analysis framework for IUR related policies in Figure 2 using Nvivo software. During the coding process, paragraphs involving multiple policy tools and innovation value chains were identified and counted according to the coding. The related policy tools and innovation value chains are shown in Table 3 as coding examples.

Table 3

Coding Examples of IUR Related Policies

Tool Types	Tool Names	Example Sentences	Innovation Value Chain
supply-type	capital inputs	Various types of government-led venture capital funds give priority to projects that support the industrialisation of scientific and technological achievements of research institutions. For enterprises and units undertaking major national scientific and technological special projects, local financial support will be given in the form of matching funds. Financial institutions will be given interest rate subsidies for carrying out patent pledge loans.	industrialization
	infrastructure construction	It has actively promoted the implementation of the "13th Five-Year Plan" project on the integration of industry and education, supporting 56 middle and higher vocational schools to strengthen school-enterprise co-operation and to build and share practical training facilities for technical skills. Three applied undergraduate colleges and universities will be supported to strengthen the construction of practical training environment, platforms and carriers for the integration of industry and education. Supporting 4 provincial general undergraduate colleges and universities to focus on strengthening the construction of practical teaching links in the light of industrial demands. Support provincial high-level universities and first-class discipline construction colleges and universities to strengthen the interaction between disciplines, talents, scientific research and industries, and promote cooperative education, collaborative innovation and transformation of achievements.	achievement transformation

	information support	Encourage the use of cloud computing, big data and other information technologies to build a market-oriented, professional, open and shared information service platform for the integration of education and industry. Relying on the platform, it aggregates regional and industrial supply and demand of talents, school-enterprise cooperation, project R&D, technical services and other types of supply and demand information, and provides various types of main bodies with precise information release, retrieval, recommendation and related value-added services on the integration of production and education. Encourage Lanzhou New District Vocational Education Park to establish a Silk Road vocational school and school-enterprise cooperation information platform to provide services for the exchange and cooperation between vocational schools and enterprises.	R&D 、 achievement transformation
	talent cultivation	Give full play to the important role of institutions of higher education in independent innovation. Deepen the reform of higher education, adjust the structure of higher education, and strengthen the construction of key disciplines. It will further optimise the layout of disciplines and specialties in higher education institutions and urgently train talents in short supply for the economic and social development of the province. Steadily push forward the construction of high-level universities, and build 1-2 influential research universities in China by 2020. The scale of postgraduate training will be expanded, and research institutes and business units with the necessary conditions will be encouraged to establish postgraduate training bases jointly with higher education institutions.	R&D

	public service	Provide public services for manufacturing innovation. Provide small and microenterprises with services such as the use of high-end equipment, prototype design and development, production process counselling and industry chain support. Actively carry out public services such as technology R&D, standard development and test verification, collaborative use of intellectual property rights, inspection and testing, business incubation, personnel training, market information services.	R&D 、 achievement transformation 、 industrialization
environment-type	financial support	Promote the integration of science and technology and finance, and, under the principle of controllable risk and within the scope of business permitted by the State, encourage policy banks to increase their support for enterprises in transforming scientific and technological achievements and importing and exporting key technological equipment. For projects with good market prospects, independent intellectual property rights and commercial loans, interest subsidies will be provided at the benchmark interest rate for one-year bank loans.	achievement transformation
	tax incentives	Recognised high-tech enterprises, within five years from the date of industrial and commercial registration, the business tax, enterprise income tax, value-added tax paid by the local share of the form of "first levy and then award", by the same level of the financial award to the full amount of the enterprise for the R&D of new products or the expansion of reproduction.	R&D
	regulatory control	Revising the Regulations on Promoting the Transformation of Scientific and Technological Achievements in Gansu Province. Strengthen the distribution orientation of respecting knowledge and innovation and fully reflecting the value of intellectual labour, so that scientific and technological personnel	achievement transformation

		can receive reasonable rewards for their innovative activities, reflect the value of innovation through the application of results, and create wealth through the transformation of results.	
	target planning	By 2020, an institutional environment and a system of policies and regulations adapted to the requirements of innovation-driven development in the province will be basically formed, with the proportion of R&D expenditure in society as a whole to the GDP striving to reach 2 per cent, the added value of strategic emerging industries accounting for more than 20 per cent of the GDP, and the number of invention patents per 10,000 people exceeding 3 pieces. Talents, capital, technology and knowledge will flow freely, enterprises, scientific research institutes and higher education institutions will collaborate in innovation, innovation vitality will burst forth competitively, innovation achievements will be fully protected, innovation value will be better reflected, the efficiency of innovation resource allocation will be greatly improved, and innovation talents will reasonably share the benefits of innovation, so as to make the strategy of innovation-driven development really come to fruition, and to initially build an innovative Gansu, and then to create a new engine for promoting economic growth and employment and entrepreneurship. It will provide important support for building a moderately prosperous society in an all-round way and promote the formation of a new pattern of sustainable development.	R&D 、 achievement transformation 、 industrialization
	strategic measures	Encourage the proceeds from the results of job-related inventions in universities, research institutes and state-owned institutions and enterprises in Gan to be allocated at least 60 per cent and at most 95 per cent of the proceeds to the scientific and	R&D

		technological personnel involved in the R&D and their teams.	
demand-driven	government procurement	A government first-purchase system will be implemented for trial products that meet the requirements for the development of advanced technologies and for independent innovative products that are put on the market for the first time; and a government subscription system will be implemented for major independent innovative products and services.	achievement transformation
	overseas organisations	Encourage R&D institutes, institutions of higher learning and technology transfer services to make use of their international scientific and technological cooperation resources to promote IUR cooperation with foreign R&D institutes, institutions of higher learning and enterprises.	R&D 、 achievement transformation

Statistical Analysis
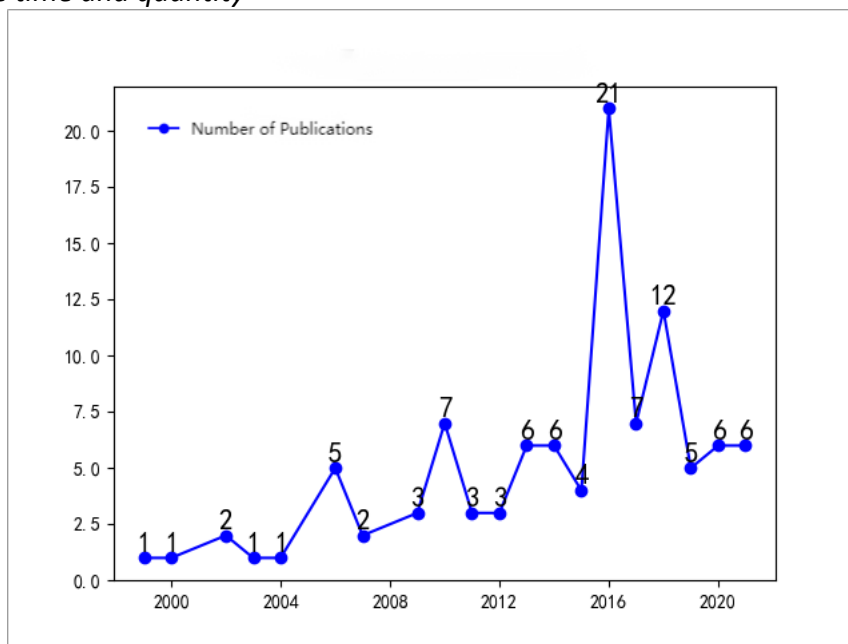*Policy release time and quantity*

Figure 3 Number of Publications on IUR Related Policies

The study compiled data on the annual number and timing of policy issuances for the 102 selected policies. Figure 3 presents the findings. In 1992, the State Council launched the 'Industry-University-Research Joint Development Project' to establish a stable and close system of exchange and cooperation between state-run large and medium-sized industrial enterprises, higher education institutions, and research institutes. This marked the formal

involvement of the government in the integration of IUR. The first policy document regarding IUR collaboration in Gansu Province, collected in this study, is the 'Decision of the CPC Gansu Provincial Committee and the Gansu Provincial People's Government on Promoting the Integration of Science and Technology into the Economy and Developing High-tech Industries' (Provincial Party Committee Document No. 36), which was issued in 1999. The number of policies increased gradually until it reached its first small peak in 2006. This was when the Gansu Provincial People's Government published the 'Outline of the Medium- and Long-Term Science and Technology Development Plan of Gansu Province (2006-2020)' and 'Some Policy Measures of the Outline of the Medium- and Long-Term Science and Technology Development Plan of Gansu Province (2006-2020)'. The integration of IUR has been promoted due to various policy documents, including the 'Decision on the Implementation of the Outline of the Medium- and Long-Term Science and Technology Development Plan and Enhancement of the Capacity for Autonomous Innovation' published by the Communist Party of China (CPC) and the People's Government of Gansu province. These documents have created a favourable environment for this integration. In 2010, the General Office of the People's Government of Gansu Province forwarded the Circular of Gansu Science and Technology Department and other departments on the Implementation Opinions on Promoting Enterprises to Increase Investment in R&D and Improve Independent Innovation Ability. In 2016, the People's Government of Gansu Province proposed specific opinions on IUR collaborative innovation in emerging industries, Chinese medicine business, software service industry, and enterprise quality and efficiency. These opinions pointed the way for the development of Gansu. The number of IUR-related policies in Gansu peaked in 2016 with the release of the Outline of the National Innovation-Driven Development Strategy by the CPC Central Committee and State Council. The General Office of the People's Government of Gansu Province has issued two circulars: one on the Action Programme for Promoting the Transfer and Transformation of Scientific and Technological Achievements in Gansu Province, and the other on the Implementation Programme for Accelerating the Development of Crowd Creative Space to Serve the Transformation and Upgrading of the Entity Economy in Gansu Province. The General Offices of the CPC Gansu Provincial Party Committee and the People's Government of Gansu Province have issued the Guiding Opinions on the Mechanisms of the Province's Development Zones for Deepening Reforms and Innovation, as well as Circulars on Supporting Scientific and Technological Innovation in Gansu Province and other related circulars. These measures are aimed at enhancing the capability of independent innovation and building an innovative country. Policy issuance has been on a downward trend since 2017, with a brief rebound in 2018.

Analysis of IUR Related Policies in Gansu Province
Frequency counts were conducted on the 102 policies selected from both policy tools and innovation value chain perspectives. A total of 387 policy tool uses were identified, and the statistical analyses are presented in Table 4.

Table 4
Coding Results of IUR Related Policies (Unit: Times)

Tool Types	Tool Names	R&D	achievement transformation	industrialization	Subtotal	Total	Percentage
supply-type	public service	14	15	8	37	223	(57.6%)
	Infrastructure construction	40	31	13	84		
	talent cultivation	32	7	0	39		
	Information support	3	5	0	8		
	capital inputs	30	17	8	55		
environment-type	strategic measures	49	35	8	92	154	(39.8%)
	regulatory control	13	8	4	25		
	financial support	4	8	2	14		
	target planning	10	3	3	16		
	tax incentives	6	1	0	7		
demand-driven	overseas organisations	1	1	0	2	10	(2.6%)
	government procurement	2	5	1	8		
Total		204	136	47	387		
Percentage		(53%)	(35%)	(12%)			

The analysis examines Gansu's IUR related policies at various levels and stages. A frequency count of 102 selected policies, totalling 387 occurrences, was conducted using the perspectives of policy tools and innovation value chain. The analysis fully considers the use of policy tools and policy intervention at various stages of the innovation value chain. This provides a comprehensive perspective for understanding Gansu's IUR related policies in depth.

(a) Policy Tools Dimension
In terms of policy tools, supply-type, environment-type, and demand-type policy tools were used 57.6%, 39.8%, and 2.6% of the time, respectively. This statistical analysis provides initial insights into the IUR related policies in Gansu Province. The importance of supply-side policy tools in attracting research institutions and enterprises to engage in IUR collaboration is highlighted. Therefore, the government proactively provides various forms of support and resources to foster IUR cooperation and innovation activities. These measures aim to support scientific and technological research, as well as industrial progress, to encourage the enthusiasm and innovative capacity of stakeholders.

Secondly, the data reveals that the government prioritises the implementation of regulatory, financial, and taxation policy tools to foster an environment conducive to IUR collaboration and innovation. This approach provides comprehensive policy support for all three parties, promoting the sound development of innovative activities from compliance and financial standpoints. To improve the effectiveness and quality of innovation activities, and to facilitate the transformation and commercialization of scientific and technological achievements, it is essential to create a stable and sustainable environment that fosters innovation.

Finally, policy tools based on market demand, although they make up a relatively small proportion, still play a crucial role. They demonstrate the government's responsiveness to market demands, promote collaboration between IUR, and emphasize the market applicability of technological innovations. However, the policy framework shows a bias towards the supply side due to a limited focus on addressing market demands and emphasizing demand-driven innovation. This approach fails to fully utilise market demand to guide innovation, which could hinder the development of IUR cooperation and the application of innovative outcomes in the market. The government's policy tools primarily focus on the supply-side, emphasising direct guidance over core technologies and innovations. While the presence of environment-oriented policy tools demonstrates a commitment to sustainability and social responsibility, it is important to balance these with economic growth pursuits. However, there may be a need to adjust policies to more effectively stimulate market demand, given the relative deficiency of demand-oriented policy tools.

(b) Innovation Value Chain Dimension

Gansu's IUR related policies covers the entire innovation value chain, intervening at all stages, including R&D (53%), results transformation (35%), and industrialisation (12%). The objective of Gansu's IUR related policies is to comprehensively promote industrial innovation, with policy support spanning from R&D to the final stage of industrialisation. This holistic policy intervention enhances the efficacy of innovation activities as well as the quality of industrial development. The R&D phase receives the highest proportion of policy intervention, at 53%. This highlights the government's emphasis on scientific research and technological innovation, providing significant support and resources during the R&D phase. The government is also committed to establishing a strong foundation for IUR collaboration, with the aim of enhancing the innovation capacity and research capabilities of institutions and universities within the scientific research sector. R&D are crucial for fostering innovative talent and advancing scientific and technological frontiers. Gansu's investment in this phase aims to attract and cultivate research talents, foster cooperation between research institutions and industry, and hasten the development and application of emerging technologies. Policy intervention in the transformation stage accounts for 35% of outcomes, making it a crucial factor in the region's competitiveness in science and technology. The policies aim to translate scientific research into practical applications and support the commercialisation and marketisation of innovative results through corresponding measures.

The effectiveness of the transformation process at this stage directly affects the integrity and continuity of the innovation value chain. The government provides necessary support and guidance for the transformation of achievements through relevant policy tools. This facilitates the acceleration from laboratory to market and expedites the realization of innovation value. Finally, the industrialization stage accounts for a 12% share of policy intervention. Relevant policies support the market introduction of science and technology (S&T) innovations and their subsequent industrialisation. Policy attention during the industrialisation stage ensures that innovation results can be practically applied in the industrial domain and fosters collaborative development of intellectual property rights towards tangible industrial outcomes. Industrialisation represents the terminal phase of the innovation value chain and is crucial for introducing innovative products to the marketplace. At this point, government support can reduce market risks and increase the competitiveness and market share of new products. In Gansu, it is necessary to strengthen policy support for industrialization, especially in promoting the widespread adoption of innovative products.

The industrialization phase is crucial for translating research findings into practical market applications. Bolstering policy support can enhance the ability of innovative results to be transformed into marketable products.

In summary, the IUR related policies in Gansu Province have effectively intervened at all stages of the innovation value chain, including R&D, results transformation, and industrialization. However, there is a discernible variation in the inclination and strength of these policies across different stages, which reflects the government's approach to fostering industrial innovation. However, to promote the commercialisation and industrialisation of innovative advancements, and to ensure a mutually beneficial relationship between scientific and technological innovation and economic development, it is essential that policy support is directed towards the industrialisation phase. This strategic emphasis will ensure the coherence and effectiveness of the entire value chain. Further research is needed to address potential vulnerabilities arising from the rapid advancement of science, technology, and industry in response to changing market dynamics and industrial demands.

Analysis of Policy Tools in IUR Related Policies in Gansu Province
Analysing the segmentation dimension of policy tools and the innovation value chain of Gansu IUR related policies can provide a comprehensive understanding of their implementation effects and existing problems in Gansu Province. This analysis can offer valuable insights for the further development of UIR cooperation in the province.

(a) Policy tools dimension

Supply-based policy tools. The R&D stage is mentioned 14 times, the results transformation stage 15 times, and the industrialisation stage 8 times. The frequency of R&D and results transformation stages is equal, but it declines in the industrialisation stage. The government's policy tools for innovation are focused on the entire process of the innovation value chain in terms of public services. Although the industry-university-research sector benefits from policy support throughout the R&D, result transformation, and industrialisation stages, the text suggests that infrastructure plays a crucial role in the innovation value chain. Therefore, it is important to pay attention to both R&D and infrastructure development. The policy tools for infrastructure development mention the R&D stage 40 times, the results transformation stage 31 times, and the industrialisation stage 13 times. This suggests that stronger infrastructure support is provided in the early stages of innovation, with support gradually reduced in later stages. The government's support for infrastructure development appears to be more balanced, with greater attention paid to the R&D and achievement transformation stages. The policy tools for talent cultivation primarily concentrate on the R&D (32 occurrences) and result transformation (7 occurrences) stages of the innovation value chain. However, the entrepreneurialisation stage is not mentioned. Government policies on talent cultivation mainly focus on the R&D and result transformation stages, which is in line with the need to cultivate innovative talents. However, less attention is paid to the industrialisation stage, which hinders the transformation of innovation results into the market. Therefore, more policy support is needed to strengthen attention to talent cultivation in the industrialisation stage. The information support category of policy tools mentions the R&D stage of the innovation value chain three times and the transformation stage five times, but does not mention the industrialisation stage at all. This indicates that the policies primarily target the R&D and achievement transformation stages of the innovation value chain in terms of information support. However, there is still insufficient policy support in the

industrialisation stage, and the lack of information support during this stage can hinder the advancement of industrialisation. Therefore, it is necessary to further strengthen information support during the industrialisation stage. Financial input policy tools are mentioned most frequently in the R&D stage (30 times), followed by the results transformation stage (17 times) and the industrialisation stage (8 times). These tools support the entire innovation value chain in a more balanced manner, although they still tend to favour the R&D stage.

Environment-based tools. In Gansu Province's policies related to IUR, five environment-based tools have influenced the various links of the innovation value chain to varying degrees. In Gansu Province's policies related to industry-university-research, five environment-based tools have influenced the various links of the innovation value chain to varying degrees. These tools include strategic measures, regulatory control, financial support, target planning, and tax incentives. The data shows that the R&D stage was mentioned 49 times among the strategic measures policy tools, followed by the results transformation stage mentioned 35 times, and the industrialisation stage mentioned only 8 times. The text highlights the importance of strategic measures in the R&D, results transformation, and industrialisation phases of the innovation value chain. The frequency of mentions suggests that the government places significant emphasis on guiding innovation activities at a strategic level. The regulatory control policy tools mention the R&D stage 13 times, the result transformation stage 8 times, and the industrialisation stage 4 times. Regulatory control primarily focuses on the R&D and achievement transformation stages, with relatively little impact on industrialization. Financial support policy tools were mentioned four times in the R&D stage, eight times in the result transformation stage, and twice in the entrepreneurialization stage. The financial support policy tools had a greater impact on the results transformation and industrialisation stages, indicating that the government regulated the financial environment to a certain extent in order to promote the marketisation of innovation results. While the results transformation and entrepreneurialisation stages received some attention in terms of financial support, the R&D stage received more limited support. Among the target planning policy tools, the R&D stage was mentioned 10 times, the results transformation stage was mentioned 3 times, and the industrialisation stage was mentioned 3 times. Targeted planning is mentioned more often in the R&D stage and has less impact in the result transformation and industrialisation stages. Tax incentive policy tools were mentioned six times in the R&D stage, once in the result transformation stage, and not in the industrialisation stage. Tax incentive tools are primarily concentrated in the R&D stage and have less impact on the transformation of results and industrialisation stages.

Demand-based tools. Among the policy tools for overseas institutions, the R&D stage was mentioned once, the results transformation stage was mentioned once, and the industrialisation stage was not mentioned. It is evident that the government focuses on both the R&D and results transformation stages when it comes to overseas institutions, but provides less support for the industrialisation stage. The government procurement policy tools mention the R&D stage twice, the result transformation stage five times, and the industrialisation stage only once. It is evident that the government's support for R&D and results transformation stages in government procurement is relatively balanced. However, less attention is given to the industrialisation stage. This suggests that the government promotes innovative products through its procurement practices, thereby stimulating the demand for innovation.

Taken as a whole, policy tools have impacted, to varying degrees, on various segments of the innovation value chain. Through the combined use of these tools, governments aim to

create an environment conducive to innovation and to promote the deeper integration of industry, academia and research.

    (b) Dimension of the innovation value chain

Table 3 shows that infrastructure development is the most frequently used policy tool in the R&D phase of the innovation value chain, accounting for 35.7% of the total number of times. This suggests that the Gansu Provincial Government places great importance on improving the R&D environment and infrastructure construction. The use of this policy tool may enhance R&D capability and innovation efficiency. Good infrastructure is essential for the smooth conduct of scientific and technological research, and it is the cornerstone for innovation activities. The talent cultivation policy tool was used 32 times, accounting for 28.6% of the total usage. This indicates that Gansu Province prioritises the cultivation and attraction of high-level talents during the R&D stage, providing human resources for industrial R&D and enhancing the professionalism and innovation capability of the research team. The use of this policy tool provides talent protection during the R&D stage. This helps to optimise the talent structure of the R&D team and improve the quality of scientific research results. It is crucial for maintaining the vitality of scientific research and improving the level of innovation. The financial input policy tool was used 30 times, accounting for 26.8% of the total usage. This suggests that the government's funding of R&D projects is balanced, which facilitates the smooth progress of research projects, encourages the development of innovative projects, and promotes the output of scientific research results. Financial support is a crucial factor in R&D activities, and the government's financial inputs provide the necessary economic support for R&D. The public service policy tool was used 14 times, accounting for 12.5% of the total usage. This indicates that the government provides necessary public services for research institutions and universities, promoting cooperation and exchanges between them. This creates a favourable research environment and enhances the capability of researchers. The tool for information support policy was used only three times, accounting for 2.7% of the total usage. This indicates that Gansu Province needs to improve its information support for industrial R&D. Information support is crucial in the R&D stage as it promotes knowledge sharing, cooperation, and access to innovation resources. Information technology support is expected to accelerate the transfer of information and cooperation in the R&D process.

In summary, Gansu Province has implemented various policy tools to intervene in the R&D stage of its IUR related policies. By focusing on supporting infrastructure construction, talent training, capital investment, and public services, the conditions and effects of R&D activities can be improved. However, the frequency of policy tool usage in information support is relatively low. Therefore, additional policy adjustments and measures are necessary to enhance the support system during the R&D stage, thereby promoting innovation and technological development.

Conclusions and Policy Recommendations
Conclusion
(a) To strengthen policy attention during the industrialization stage is necessary.
The data indicates that the government has implemented various measures to promote innovation in public services, infrastructure construction, talent training, and other areas. This is particularly evident in the R&D and achievement transformation stages, demonstrating the positive impact of relevant policies on scientific research. The government's attitude towards

supporting technological innovation is positive. The government has provided significant support and resources during the R&D stage to enhance the innovation capabilities and scientific research levels of institutions and universities. This demonstrates the government's commitment to scientific research and its desire to foster and accumulate innovative results. However, policy attention has declined during the industrialization stage, as reflected in the relative paucity of mentions of this stage in policy tools. The industrialization stage is crucial to the integrity of the innovation value chain and represents a key node in transforming scientific research results into practical market applications. However, the current policy framework appears to provide insufficient support and measures for the entrepreneurial stage. This limitation may hinder the ability to transform innovative results into the market.

(b) The government's policy of directly supporting IUR collaborative innovation provides a driving force for the innovation process. However, there are certain deficiencies in information transfer, sharing, and application. Information support is crucial for promoting the industry to understand and utilize innovative results. To address this issue, the 'Notice of the General Office of the People's Government of Gansu Province on Issuing the Special Action Plan for the Development of Data Information Industry in Gansu Province' (Ganzhengbanfa [2018] No. 88) suggests using the 'Gansu Keju Network' information service of the Provincial Department of Science and Technology. This platform regularly shares information on scientific and technological achievements with society, promotes the sharing of information resources, and provides resources for enterprises, governments, and management agencies, thereby fostering win-win cooperation among all parties. Gansu Keju Network is a public service platform for scientific and technological innovation in Gansu. It includes scientific tools and facilities, scientific and technological documents, inspection and testing, R&D, technology transfer, entrepreneurial incubation, scientific and technological consulting, intellectual property, technology finance and other sectors. The platform is sponsored by the Gansu Provincial Department of Science and Technology and constructed by the Provincial Science and Technology Information Institute. The platform was initially built in 2015, and a new version of Gansu Keju Network was launched in 2020, which improved its ability to serve customers. However, similar platforms still have some shortcomings, particularly in their lack of attention to collaborative innovation between industry, academia, and research institutes. To enhance information sharing, a complete information transmission platform should be established, along with an open innovation network. Collaborative cooperation between scientific research institutions and industry should also be promoted.

Policy Recommendations
(a) Strengthen support for industrialization to promote the marketization of innovation results.Clear policies that are oriented towards industrialization should be implemented to ensure that policy tools comprehensively cover the needs of the industrialization stage, thereby increasing the marketization rate of innovation results. To alleviate financing problems faced by start-up enterprises in the industrialization process, it is recommended to increase entrepreneurial capital support for projects in the industrialization stage. This can be achieved by setting up special industrialization funds and providing loan guarantees. Additionally, it is important to establish a closer collaboration mechanism between industry and scientific research institutions to promote better integration between the two parties. The introduction of innovative products to the market can be encouraged by motivating scientific research institutions to sign cooperation agreements with industry and providing

technical support from the government. To encourage more companies to actively participate in innovation activities during the industrialization stage, an incentive mechanism should be established. This could include policy rewards such as tax incentives and scientific research fund rewards for companies that have achieved remarkable results. Additionally, a performance evaluation indicator system should be established to monitor and evaluate the implementation effects of policies. By evaluating the stages of industrialization, the government can adjust policies in a more targeted manner to ensure that its support for industrialization is more effective.

(b) Strengthen information support to promote IUR collaborative innovation. The government should enhance information support by increasing promotion and publicity of innovation achievements and science and technology policies. By organizing exhibitions of scientific and technological achievements, technical exchange meetings, and media publicity, we will disseminate information on innovative achievements to the public and relevant stakeholders. This will increase society's awareness and attention to the collaborative innovation of industry, academia, and research. Simultaneously, the establishment of a network platform for IUR collaboration and innovation will promote communication and cooperation among all parties. The platform will provide online communication and collaboration tools, such as forums and collaborative workspaces, to facilitate communication and cooperation between industry, academia, and research, and promote the exchange and sharing of information. To enhance the open sharing of data element resources, it is necessary to improve the data governance system, establish standards for open data sharing, and create legal systems for data security and privacy protection. This will facilitate the orderly circulation of various types of data from governments, enterprises, and society, and stimulate the value of data, promoting data-driven innovative development.

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