

# Innovation in the University-Industry-Research Collaboration Paradigm: A Case Study of the Immunology Frontier Research Center of Osaka University

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**How to cite this paper:** Lyu, S. N. (2026). Innovation in the University-Industry-Research Collaboration Paradigm: A Case Study of the Immunology Frontier Research Center of Osaka University. *Advances in Applied Sociology*, 16, 302-320. <https://doi.org/10.4236/aasoci.2026.164019>

**Received:** February 26, 2026

**Accepted:** April 20, 2026

**Published:** April 23, 2026

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## Abstract

By systematically examining the practical dilemmas confronting the traditional Industry-University-Research (IUR) collaboration model in terms of contractual mechanisms, achievement commercialization, and benefit distribution, this study focuses on the new IUR collaborative innovation paradigm constructed by the Immunology Frontier Research Center (IFReC) of Osaka University, which is driven by the concept of “co-creation”. Through a multi-dimensional analysis of IFReC’s groundbreaking practices in the initial collaboration stage, funding models, and contractual mechanisms, this study aims to extract its successful experience, explore its enlightenment for Chinese universities to deepen IUR collaboration, and provide a reference with both theoretical depth and practical value for promoting the innovation of the IUR collaboration paradigm.

## Keywords

Industry-University-Research Collaboration, Basic Research, Immunology Frontier Research Center, World Premier International Research Center Initiative

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## 1. Introduction

Against the backdrop of China’s economic transition toward high-quality development, the driver of economic growth has shifted from extensive growth fueled by factor input to intensive growth driven by technological innovation. Advancing new quality productive forces is essential and a key priority for fostering high-

quality development. As a highly efficient collaborative mechanism, Industry-University-Research (IUR) collaboration is a critical measure to advance the development of new quality productive forces. Promoting the in-depth integration of education, science and technology, and talent, as well as accelerating the transformation and application of scientific and technological achievements can not only effectively enhance the innovation capacity and social service efficiency of universities, but also boost the optimization and upgrading of industrial structure and the transformation of economic development mode. Furthermore, it strengthens national core competitiveness, fosters the spirit of innovation and entrepreneurial capacity of the whole society, and provides solid support and strong impetus for the high-quality economic and social development. To better promote the innovation of China's IUR collaboration paradigm, this study takes IFReC at Osaka University as a case study, explores its innovative practices in IUR collaboration, and summarizes relevant enlightenment for China.

This study adopts a qualitative single case study design to conduct an in-depth investigation into the IUR collaboration model between the Immunology Frontier Research Center (IFReC) at Osaka University and Chugai Pharmaceutical Co., Ltd. Multiple credible documentary sources are employed to ensure the rigor and objectivity of the analysis, including official policy documents and strategic plans from Japanese government agencies (e.g., The Cabinet Office and the Ministry of Education, Culture, Sports, Science and Technology [MEXT]), institutional reports and public announcements from Osaka University and IFReC, corporate press releases and profile materials from Chugai Pharmaceutical, authoritative academic news and evaluations, peer-reviewed studies on university-industry collaboration, open innovation, and basic research commercialization, as well as official materials and annual reports related to the World Premier International Research Center (WPI) Initiative. These diversified sources enable a comprehensive and systematic interpretation of the formation process, operational mechanism, core advantages and practical implications of the targeted IUR collaboration model.

## **2. Dilemmas and Limitations of Traditional IUR Collaboration Models**

The traditional IUR collaboration model takes universities or research institutions as the core force in basic research, while enterprises assume the responsibility of applied research and industrialization. Under this model, enterprises usually carry out collaborative research based on the existing basic research achievements of universities to promote their industrial application. However, this linear collaboration path of “university R&D—enterprise transformation” has obvious drawbacks, with deficiencies in the collaboration stage, collaboration motives and goals, collaboration mechanisms, and achievement transformation. Therefore, solving the problems in traditional IUR collaboration is of great significance for China to realize high-quality development driven by scientific and technological

innovation.

### **2.1. Structural Disconnection between Basic Research and Industrial Demand**

Conventional IUR collaboration tends to overemphasize applied research, resulting in insufficient investment in basic research. Enterprises typically engage in applied research and commercialization only after universities or research institutes have produced basic research outcomes. Due to low early-stage corporate participation, basic research findings often are disconnected from real market needs. Empirical evidence indicates that basic research in Chinese universities has failed to effectively support enterprise innovation, creating a systematic “disconnection effect” between academic knowledge production and industrial application (Zhang & Bai, 2022). As a result, firms must invest considerable time and cost in reworking and adapting such outcomes, prolonging the technology transfer cycle.

Basic research is the source of technological innovation. Industrial formation and development generally follow a complete chain: basic research → technological innovation → product development → mass production → market validation, and breakthroughs in basic research acting as the cradle of new technologies. However, China’s basic research currently faces prominent challenges, including inadequate funding, low efficiency in the transfer of scientific and technological achievements, and weak support for industrial development. In 2019, basic research accounted for only 6.03% of China’s R&D expenditure, far below the 15% or higher share typical in developed countries. Many core links in China’s industrial chains still rely on foreign technologies; scientific and technological innovation fails to fully support urgent industrial transformation and upgrading, leading to low industrial chain controllability and an overall position in the mid-to-low end of the global value chain (Shi et al., 2021).

From a holistic policy perspective, this structural mismatch is further reinforced by inherent divergences between basic research—oriented toward exploratory novelty—and applied research required for technology transfer, which is mission-driven development. Within China’s current institutional context, academic incentive mechanisms remain incomplete, and technology transfer policies are characterized by “strong incentives yet weak constraints”. The substitution or crowding-out effect of technology transfer activities on university-based basic research is therefore particularly pronounced. Consequently, for universities to “return to their core mission” in the national innovation system, this realignment must precede efforts to connect with enterprises. This perspective suggests that without resolving underlying structural misalignment, merely expanding IUR collaboration may exacerbate rather than alleviate disconnection (He, 2023).

### **2.2. Misaligned Incentives and Institutional Barriers to Technology Transfer**

In IUR collaboration, there are significant differences in motives and goals be-

tween universities and enterprises: universities focus on academic output, while enterprises pursue commercial profit returns. Such divergences are prone to trigger opportunistic behaviors (Azoulay et al., 2009). University achievements may not match enterprises' technological needs and market applications, and enterprises' pursuit of short-term economic benefits tends to squeeze investment in basic research, hindering the sustainable development of IUR collaboration.

In addition, imperfect collaboration mechanisms are likely to cause collaboration conflicts. Ambiguities in Intellectual Property (IP) and benefit distribution clauses often result in disputes. If the agreement fails to clarify the rights and interests of all parties, once benefits are generated from achievement of transformation, disputes over benefit distribution and IP rights may result in prolonged negotiations or even litigation, delaying the transformation process. This uncertainty dampens collaboration enthusiasm, discourages the input of advantageous resources from all parties, makes it difficult to achieve in-depth collaboration and collaborative innovation, and ultimately limits the depth of innovation.

The aforementioned institutional obstacles are closely related to the problem of incentive misalignment. He (2023) points out that against the background of incomplete academic incentive mechanisms and technology transfer policies characterized by "strong incentives yet weak constraints" in China, scientific and technological achievement transformation activities have a significant substitution or inhibitory effect on the basic research function of universities, and this misalignment of incentive structure is a key factor restricting in-depth IUR collaboration. The low efficiency of patent commercialization in Chinese universities provides direct evidence for incentive misalignment. Based on an analysis of data from 65 universities directly under the Ministry of Education, Gu (2023) found that the proportion of associate professors, the scale of scientific and technological achievement transformation service teams, and the proportion of basic research funds are positively correlated with the patent conversion rate, and there is a spatial spillover effect of patent conversion among adjacent universities. This indicates that optimizing the faculty structure, building professional transformation service teams, and increasing investment in basic research are conducive to improving the efficiency of patent conversion, while institutional and regional factors have an important impact on the effectiveness of technology transfer. The above findings positively confirm that the lack of a professional support system and reasonable faculty incentives—both manifestations of incentive misalignment—restricts the efficiency of patent conversion.

Furthermore, China's current scientific research evaluation system still has a tendency to "valuing quantity over quality and transformation". Lei (2023) points out that universities have achieved remarkable results in the number of patent applications and academic papers published—the number of invention patents of Chinese universities is generally 5 to 10 times that of American universities, and universities contribute about 80% of SCI papers—but more than 96% of invention patents cannot be commercialized. A large number of scientific and technological

achievements have not been effectively transformed into real productivity, making it difficult to give full play to their role in promoting economic and social development. For the above reasons, scientific research work is to a certain extent disconnected from actual market needs, which in turn affects the implementation and application of scientific and technological achievements and the realization of economic and social benefits.

### **2.3. Theoretical Limitations: The Inadequacy of Western-Centric Open Innovation Frameworks for China's Context**

It should be noted that the mainstream open innovation theories guiding current IUR practices are mostly derived from the West. These frameworks, developed in advanced market economies, typically rest on prerequisites such as sound intellectual property protection, mature market mechanisms, and fair transactions between independent enterprises and research institutions. However, as China's economy has entered a stage of high-quality development, Chinese enterprises are confronted with a unique and complex innovation environment, creating an urgent need to construct innovation theories with Chinese characteristics (Qian & Chen, 2022). Through a systematic review of foreign open innovation research, Gao & Ma (2014) analyzed the research status and deficiencies in the Chinese context, pointing out that open innovation theories require re-examination and adaptation within China's institutional environment.

While open innovation emphasizes that enterprises open their organizational boundaries and leverage internal and external resources for innovation—with its core logic being cost and risk reduction—its direct application to China's institutional environment presents obvious problems. China differs fundamentally from the West in terms of institutional arrangements, government-led motivation for IUR collaboration, and the still-improving market mechanism for technology transfer. The state plays a central guiding role in IUR collaboration through strategic policies and top-down funding programs, a feature that is difficult to embed into Western open innovation models that emphasize voluntary, market-driven transactions. Through a fuzzy-set qualitative comparative analysis of 26 enterprises in China and the United States, Ma & Du (2022) found that differences in institutions and collaboration environments profoundly affect enterprises' choices of open innovation paths, with significant disparities in innovation models between the two countries. This further confirms that Western theories require cautious application in the Chinese context.

In addition, the problem context of strengthening technology transfer in China is significantly different from that in Europe and the United States (He, 2023). Against the background of incomplete academic incentive mechanisms and technology transfer policies characterized by “strong incentives yet weak constraints” in China, there is a particularly prominent risk that excessive or inappropriate incentives for applied research may undermine basic research. Empirical research by Ma & Gao (2016) further reveals that higher openness is not always better—

while the breadth of openness is positively correlated with innovation performance, there exists an optimal point for the depth of openness in relation to innovation performance. This finding reminds us that when drawing on Western open innovation theories, we cannot simply apply the linear logic of “openness equals effectiveness”; instead, we need to explore appropriate open models and governance mechanisms in light of China’s institutional environment and enterprises’ development stages. [Chen \(2025\)](#) also emphasizes that China’s technological innovation needs to further strengthen the capacity for original and disruptive innovation, and implement systematic measures such as enhancing macro coordination and reforming scientific research evaluation and incentive mechanisms. Therefore, directly applying Western-centric frameworks without contextual adaptation makes it difficult to fully diagnose China’s unique dilemmas. There is an urgent need to construct more context-sensitive theories that integrate China’s unique institutional, cultural, and policy realities ([Qian & Chen, 2022](#)).

#### **2.4. Lack of Interdisciplinary Integration Exacerbates Collaboration Barriers**

In addition to the structural, institutional, and theoretical limitations discussed above, the insufficient integration of interdisciplinary resources further constrains the effectiveness of traditional IUR collaboration in China. Addressing complex technological challenges and translating basic research into marketable products increasingly requires the convergence of multiple scientific and engineering disciplines. However, the absence of effective interdisciplinary integration mechanisms in China’s traditional IUR framework undermines the capacity of both universities and enterprises to achieve breakthrough innovation outcomes.

Empirical research on China’s specialized and sophisticated “little giant” firms has demonstrated that interdisciplinary scientific collaboration significantly enhances both exploratory (breakthrough) and exploitative (incremental) innovation, with knowledge substitutability serving as a partial mediating mechanism ([Peng et al., 2026](#)). Grounded in knowledge recombination theory and utilizing a dataset of 2542 “Little Giant” enterprises from 2000 to 2023 (including academic papers co-authored with universities), this study confirms that integrating heterogeneous knowledge elements across disciplines is a crucial pathway for firms to achieve high-level innovation performance. Consequently, it can be inferred that a lack of such interdisciplinary integration—specifically, the inability to recombine diverse knowledge inputs across domains—will directly impede the transformation of academic research outcomes into commercially viable products or processes.

Furthermore, the construction practices of China’s IUR innovation consortia further corroborate this assertion. [Zhang et al. \(2025\)](#) point out that the current development of IUR consortia faces prominent challenges, including ambiguous organizational models, outdated institutional mechanisms, and unclear construction pathways. However, integrating these findings with [Peng et al.’s \(2026\)](#) re-

search on the positive impact of interdisciplinary scientific collaboration on ambidextrous innovation reveals that these dilemmas reflect, by extension, a widespread deficiency in cross-institutional and cross-domain knowledge integration capabilities. In other words, insufficient interdisciplinary integration is the underlying cause exacerbating IUR collaboration barriers: when researchers, engineers, and industry experts from diverse disciplinary backgrounds fail to effectively integrate their respective knowledge systems, such consortia are prone to becoming loosely organized, conflicted in objectives, and inefficient in coordination. In contrast, a successful IUR innovation consortium serves as a platform where leading enterprises, upstream and downstream firms, universities, and research institutions collaborate under a unified framework. Its core advantage lies in its ability to “effectively break down innovation barriers, tackle complex innovation challenges, and achieve the deep integration of innovation subjects and elements along the industrial chain” (Zhang et al., 2025). In practice, such deep integration inherently demands interdisciplinary collaboration, as technical problems rarely adhere to traditional disciplinary boundaries.

The consequences of this interdisciplinary deficit are threefold. First, it reduces the potential for breakthrough innovations that naturally emerge at the intersections of different knowledge domains. Second, it slows down the translation of research findings into integrated technological solutions, as translation often requires synthesizing insights from multiple disciplines. Third, it limits the scope of knowledge spillover effects across fields, preventing firms from accessing the heterogeneous knowledge inputs that drive both exploratory and exploitative innovation.

### 3. Overview of the WPI and IFRcC

To better understand IFRcC’s innovative IUR collaboration model, this chapter first introduces the background of the World Premier International Research Center Initiative (WPI) and the basic situation of IFRcC, and then elaborates on the relationship between WPI’s core goals and IUR collaboration, laying a foundation for the subsequent analysis of IFRcC’s innovative practices.

#### 3.1. The World Premier International Research Center Initiative (WPI)

Against the backdrop of the shift in international scientific and technological competition toward frontier basic fields in the 21st century, Japan launched its third Science and Technology Basic Plan in 2006 to reverse the decline in its scientific and technological strength, thus officially initiating the World Premier International Research Center Initiative (WPI). The initiative aims to establish a number of world-class scientific research centers relying on first-class universities, and foster emerging scientific fields through interdisciplinary integration to enhance the level of basic scientific research (Council for Science and Technology Policy, Cabinet Office, Government of Japan, 2009). As of 2025, the WPI Initiative has established 18 research centers, each with a scale of 70 - 100 researchers, over

30% of whom are overseas researchers, and each equipped with more than 7 - 10 world-class Principal Investigators (PIs).

In terms of funding support, the WPI has built a multi-level system including basic funding, special grants, and research project funding. The government provides each research center with basic funding of up to 700 million Japanese Yen per year for a 10-year period; the research centers selected in 2007 and 2010 receive approximately 1.4 billion Japanese Yen per year (JSPS, n.d.). 1 - 2 years before the expiration of the funding period, research centers can apply for a 5-year extension of funding with a maximum of 300 million Japanese Yen per year, which is mainly used for daily operations, personnel salaries, equipment procurement, and travel expenses (MEXT, 2025).

### 3.2. The Immunology Frontier Research Center (IFReC)

As one of the five first batch of research centers established under the WPI Initiative in 2007, the Immunology Frontier Research Center (IFReC) is affiliated with Osaka University (JSPS, n.d.), focusing on the research of pathogen infection, autoimmune diseases, and the immune response and regulation of cancer cells. By attracting talents from various fields such as immunology, bioimaging, and bioinformatics, the center has built an interdisciplinary research platform to promote collaborative innovation among researchers and continuously produce high-quality achievements.

During the WPI funding period (2007-2017), IFReC published a total of 1270 papers (Digital Science & Research Solutions Ltd., 2021). According to Clarivate Analytics data, from 2008 to 2015, the average number of citations of its immunology papers ranked first among universities worldwide (Takagi, 2021); its Field Citation Ratio (FCR) reached 4.6 compared with papers in similar disciplines (Digital Science & Research Solutions Ltd., 2021), indicating a prominent relative citation rate. As of March 2021, the proportion of its top 1% and top 10% papers was 5.2% and 25.8% respectively (overall), and 7.8% and 33.3% in the field of immunology; its Field-Weighted Citation Impact (FWCI) was 2.37 (overall) and 2.76 in the field of immunology, far exceeding the average value of 1, indicating that IFReC has been conducting extremely high-level research since its establishment (Takagi, 2021). In 2016, IFReC passed the post-evaluation of the WPI project and was recognized as a “world-class level” due to its outstanding scientific research achievements, thus becoming a formal member of the WPI Initiative. It still operates in accordance with the initiative’s philosophy, accepting regular evaluations and submitting reports to it.

### 3.3. IUR Collaboration and Sustainable Development

The core goals of the WPI Initiative are to enhance the level of basic scientific research and promote the application and industrialization of scientific research achievements, committed to driving economic development and improving social well-being through cutting-edge research. Under this goal orientation, IUR col-

laboration has become an indispensable and important part of the WPI Initiative. As the main implementation body of the WPI Initiative, the construction and international development of research centers cannot be separated from the collaboration of multiple parties such as enterprises, universities, and research institutions. IUR collaboration can integrate the advantageous resources of all parties, accelerate the transformation of scientific research achievements from the laboratory to the market, and help achieve the strategic goals of the WPI Initiative.

The 10-year funding period of the WPI Initiative is a critical stage for the development of research centers, and the ability to operate stably and produce high-quality scientific research achievements after the expiration of funding is directly related to the long-term effectiveness of the initiative. Therefore, in the mid-term evaluation of the WPI Initiative, great emphasis is placed on examining each research center's ability to obtain sustainable funding independent of government financial support and establish stable collaboration relationships. The setting of this key evaluation criterion aims to predict the "self-sustaining" function and sustainable development potential of research centers in advance, ensuring that after the end of government funding, research centers can still obtain stable funding sources and resource support through IUR collaboration relationships established with enterprises and social institutions, thereby guaranteeing their continuous conduct of high-level scientific research and truly realizing the long-term value of the WPI Initiative in promoting scientific research innovation and industrial development.

IFReC was selected as the focal case for studying IUR collaborative innovation for two core reasons, which ensure its analytical representativeness and theoretical value. First, as one of the first batch of research centers under Japan's WPI Initiative, IFReC has long been committed to frontier basic research in immunology and has achieved world-class research results, which provides a solid foundation for exploring the deep integration of basic research and industrial needs—an important breakthrough that addresses the core dilemma of traditional IUR collaboration (i.e., the disconnection between basic research and market demand). Second, unlike conventional short-term, small-scale university-enterprise collaboration models, IFReC's collaborative practice with Chugai Pharmaceutical has formed a distinctive paradigm characterized by early enterprise involvement in basic research, long-term stable funding support, and a co-creation-based agreement mechanism. This paradigm not only solved the practical problem of IFReC's sustainable development after the expiration of WPI funding but also has been verified to have strong replicability and diffusion effects through subsequent collaboration with other enterprises such as Otsuka Pharmaceutical. Moreover, as a typical example recognized by the Japanese government (awarded the first Japan Open Innovation Prize), IFReC's model can provide targeted enlightenment for China to break through the bottlenecks of traditional IUR collaboration and promote the innovation of collaborative paradigms, making it an ideal case for this study. Building on this case-selection logic, the following section provides a de-

tailed analysis of IFReC's innovative breakthroughs in terms of collaboration stage, funding model, and agreement mechanism.

#### **4. Innovative Breakthroughs in IFReC's IUR Collaboration Model**

Faced with the pressure of WPI funding expiration, IFReC actively explored new IUR collaboration models and established in-depth collaboration with Chugai Pharmaceutical Co., Ltd. This chapter focuses on the innovative breakthroughs of IFReC in the collaboration stage, funding model, and agreement mechanism, and analyzes the initial achievements and paradigm diffusion of this innovative model.

In 2016, with the expiration of the WPI funding period, IFReC faced a critical turning point—it urgently needed to find new funding sources to maintain the normal operation of the research center and the progress of scientific research work. During the previous implementation of the WPI Initiative, IFReC focused on research in the frontier field of immunology, produced a large number of high-quality scientific research achievements, and received high recognition, demonstrating strong scientific research innovation capacity and development potential.

Chugai Pharmaceutical Co., Ltd., a top pharmaceutical enterprise headquartered in Japan, has profound attainments in the research of biological and antibody technologies and drug development, and has become a leader in the antibody technology industry with its continuous innovative R&D capabilities. It has carried out in-depth research in the treatment of major diseases such as cancer, kidney diseases, and bone and joint diseases, and occupies an important position in the international pharmaceutical industry with its extensive global market layout (Chugai Pharmaceutical Co., Ltd., n.d.).

With its advantages in drug R&D and market resources, Chugai Pharmaceutical keenly recognized IFReC's value in immunology research; meanwhile, IFReC urgently needed stable funding support and industrial resource alignment. Given their respective needs and complementary advantages, the two parties collaborated and signed a groundbreaking "Comprehensive Collaboration Agreement", opening a new chapter in IUR collaborative innovation.

##### **4.1. Innovation in the Collaboration Stage: Expansion to the Field of Basic Research**

IFReC's collaboration with enterprises breaks the traditional practice by extending the starting point of collaboration to the basic research stage. In the basic research stage, IFReC has full freedom to independently determine research topics and is required to disclose research achievements to the collaboration enterprise (Chugai Pharmaceutical) on a regular basis. Subsequently, the enterprise evaluates the achievements to decide whether to carry out joint research. For example, based on IFReC's research achievements in the field of immunology, Chugai Pharmaceutical has carried out targeted joint R&D of targeted drugs, shortening the cycle from theoretical breakthrough to clinical application.

This early involvement arrangement directly supports the claim that the model improves innovation efficiency: by enabling enterprises to screen and engage in research at an early stage, it avoids redundant development and repeated adjustments, and strengthens the alignment between basic research and clinical needs. This model breaks the traditional framework where enterprises only participate in applied research and opens up a new path for IUR collaboration.

As mentioned earlier, traditional IUR collaboration often follows the linear path of “university R&D—enterprise transformation”, where enterprises only act as end supporters of achievement transformation, leading to a disconnect between innovation demand and supply. By moving the starting point of collaboration forward to the basic research stage, this model essentially reconstructs the innovation value chain. The empirical basis for this claim lies in the institutional design that integrates market evaluation into the early stage of research, rather than waiting until the final stage. Endowing the research center with the right to independently determine research topics ensures that the research direction is in line with the trend of academic frontiers, and the phased achievement disclosure mechanism guides enterprises to intervene in evaluation in advance. This “demand advance—two-way selection” model breaks the barriers between enterprises and research centers, integrates market demand into scientific research design at an early stage, and improves the industrial adaptability of scientific research achievements from the source.

In addition, the core advantage of this collaboration model is the construction of a dynamic balance mechanism between academic autonomy and market demand. The research center retains the decision-making power of research topics to ensure the purity of academic exploration, while enterprises conduct selective collaboration based on disclosed achievements, introducing market value evaluation into the scientific research process. This “exploration first, verification later” model avoids the drawback of excessive intervention of enterprises in basic research due to short-term profit orientation in traditional collaboration.

From an economic perspective, this model effectively reduces the transaction costs of IUR collaboration. A clear indication of this can be found in the structured collaboration process: research centers do not need to adjust research directions repeatedly to cater to enterprise needs, thus lowering trial and error costs; at the same time, enterprises avoid inefficient investment by selecting projects based on periodic achievement disclosures, rather than committing to uncertain long-term plans upfront.

#### **4.2. Innovation in the Funding Model: Large-Scale, Long-Term and Stable Support**

Since 2017, IFRc and Chugai Pharmaceutical have signed a 10-year collaboration agreement, under which IFRc receives annual funding support of 1 billion Japanese Yen, totaling 10 billion Japanese Yen (Chugai Pharmaceutical Co., Ltd., 2016). This collaboration scale far exceeds that of conventional university-enter-

prise collaboration projects in Japan. According to MEXT (2018), in Fiscal Year 2016, large-scale projects (over 10 million yen per project) accounted for only 4.7% (1093 projects) of total university-industry collaborations, with a total funding amount of approximately 27.3 billion yen. This indicates that the vast majority of such partnerships are characterized by relatively small funding scales.

The long-term and large-scale funding commitment observed in this case clearly illustrates that the model overcomes the instability of traditional IUR funding. Unlike short-term project-based grants, the 10-year agreement provides predictable financial support, enabling IFRc to maintain continuous basic research without being restricted by annual funding fluctuations.

The sufficient funds provided by this agreement have enabled IFRc to get rid of its dependence on WPI funding, providing a solid guarantee for the long-term and stable development of the research center. The two parties have established a joint laboratory and dispatched personnel to carry out formal collaboration, which is committed to integrating IFRc's immunology research with Chugai Pharmaceutical's drug research expertise to conduct research on new cutting-edge drugs in immunology-related disease fields.

The above collaboration model of "long-term contract + large-scale investment" has effectively broken the funding constraints of traditional collaboration. This conclusion is corroborated by the fact that IFRc successfully maintained its research scale and international level after WPI funding expired, relying entirely on enterprise funding rather than government subsidies. This large-scale collaboration can not only provide a stable cash flow for the research center, but also build a "safety net" to resist external funding fluctuations.

From the perspective of transaction cost theory, this model reduces negotiation and supervision costs through long-term agreements. This is evident in the single overarching framework, which replaces repeated negotiations over multiple small projects; the long-term commitment also enhances mutual trust, reducing the risk of collaboration suspension due to short-term interest conflicts.

#### **4.3. Innovation in the Agreement Mechanism: A Comprehensive Collaboration Agreement Based on "Co-Creation"**

Based on the value concept of "co-creation" (Center for Co-Creation, Osaka University, n.d.), IFRc has signed a new type of industry-university collaboration agreement with collaboration enterprises. The agreement stipulates that IFRc shall regularly submit an annual research achievement report to the enterprise (excluding confidential achievements), based on which the enterprise obtains the latest research information and enjoys priority over other enterprises to propose collaboration research or intellectual property application proposals. For enterprise proposals, the two parties shall sign a separate joint research agreement through consultation and independently plan research funds.

This two-tier contractual structure serves as clear evidence that the mechanism reduces coordination costs and improves operational efficiency. The annual achieve-

ment report eliminates information asymmetry, while separate project agreements allow flexible responses to specific research needs without rewriting the entire collaboration contract. This mechanism not only guarantees enterprises' rights to obtain and transform cutting-edge research achievements, but also endows IFReC researchers with a relatively free research space, avoiding the problem that funding is limited to a single research topic.

Traditional IUR agreements are often based on a "principal-agent" relationship, with the risk of goal alienation: enterprises pursue short-term commercial returns, and scientific research institutions are restricted by contract clauses from carrying out independent innovation. However, this "value co-creation" mechanism breaks this framework and establishes a new relationship of "knowledge sharing—value co-creation—interest symbiosis".

The real-world operation of the agreement confirms this interpretation: enterprises gain priority access to frontier results, while researchers retain topic autonomy. This balanced structure avoids the opportunism and goal misalignment commonly seen in traditional contracts. At the same time, the agreement mechanism resolves institutional contradictions through a "two-tier contract" design: the annual reporting mechanism guarantees enterprises' right to obtain information, and the separate agreement mechanism ensures research flexibility.

From the perspective of transaction cost theory, this nested structure of "basic agreement + special agreement" reduces information costs for enterprises and avoids locking research teams into narrow topics. This inference is reinforced by the actual expansion of collaboration: after the initial agreement with Chugai Pharmaceutical, IFReC smoothly replicated similar models with Otsuka Pharmaceutical and other companies, demonstrating low additional coordination costs.

#### 4.4. Initial Achievements and Diffusion of the Innovative Model

As of March 2020, IFReC and Chugai Pharmaceutical have produced a number of basic research achievements such as research papers and patents, and signed 5 - 10 joint research agreements based on these achievements (Kuwashima, 2020). Since new drug development takes at least 10 years, the collaboration has not yet yielded new products, and no data on commercialization is currently available. However, it has made remarkable progress in basic research and collaboration expansion, with existing evidence limited to research achievements, collaboration agreements, awards, and model promotion.

Notably, the partnership has continued to yield landmark scientific breakthroughs in recent years, further validating its long-term translational value. On March 26, 2025, a key collaborative achievement was formally published in *Nature*: a genome-wide CRISPR screen in human T cells that identified a novel regulatory mechanism of the FOXP3 protein in regulatory T cells (Tregs) (Chen et al., 2025). As a master switch governing the immunosuppressive function of Tregs, FOXP3 critically determines whether Tregs can properly suppress excessive immune responses. The joint team systematically mapped the regulatory network of

FOXP3 expression, demonstrating that precise modulation of FOXP3 enables control over the development and function of Tregs. This breakthrough provides new therapeutic possibilities for autoimmune and inflammatory diseases such as rheumatoid arthritis, by enhancing Treg activity or expanding Treg populations to restrain aberrant immune reactions (Chugai Pharmaceutical, 2025).

Shortly after this landmark mechanistic breakthrough, foundational research on regulatory T cells received international recognition through the highest academic honor. In October 2025, the Karolinska Institute in Sweden announced that Professor Shimon Sakaguchi, a core researcher at IFRcC and a key contributor to this collaboration, was awarded the Nobel Prize in Physiology or Medicine. His core contribution is the discovery of regulatory T cells that can act as the “immune brake”, which has been highly recognized worldwide as an outstanding achievement, bringing important turning points in medicine not only in the field of immunology but also in multiple other fields (Mixonline, 2025). In addition, to support Professor Shimon Sakaguchi’s subsequent research activities and promote continuous breakthroughs in the field of immunology, Chugai Pharmaceutical decided to donate 100 million Japanese Yen to the “Shimon Sakaguchi Research Support Fund” of the Osaka University Future Fund, fulfilling the mission of pharmaceutical enterprises to support scientific research and benefit patients (Chugai Pharmaceutical, 2025).

These outputs provide tangible evidence that the model has improved collaborative efficiency and promoted knowledge transformation: multiple joint research projects were launched within just a few years, showing that the early involvement and co-creation mechanism effectively accelerated the translation of basic research into applied development. The output of a number of research achievements has not only consolidated its theoretical foundation, but also realized the step-by-step transformation of knowledge through joint research agreements, forming a technological R&D matrix that enables a single scientific research discovery to derive multiple application directions.

In addition, IFRcC’s innovative collaboration model has shown strong vitality and demonstration effect. In February 2017, IFRcC signed a similar “Comprehensive Collaboration Agreement” with Otsuka Pharmaceutical Co., Ltd. (Immunology Frontier Research Center, Osaka University, 2017). In the same year, Daikin Industries, Ltd. also reached a 10-year collaboration with Osaka University for artificial intelligence application research, with an annual investment of 500 million Japanese Yen (Ichiko, 2018).

This subsequent replication and diffusion attests to the model’s institutional sustainability and broad applicability, rather than a one-off success. It can be seen that IFRcC’s innovative collaboration model has realized paradigm diffusion through a “benchmark effect”, forming a replicable IUR ecological system.

The successful practice of this collaboration model has also been recognized by the Japanese government. In 2019, the Japanese Cabinet Office awarded the first Japan Open Innovation Prize (JOIP) to IFRcC, Osaka University, Chugai Phar-

maceutical, Otsuka Pharmaceutical and Daikin Industries (Cabinet Office, Government of Japan, 2019). This official recognition provides external validation that the model delivers measurable social and industrial value, further supporting the paper's evaluation of its innovative significance.

## **5. Enlightenments from IFRc's New IUR Collaboration Model**

Based on the dilemmas of China's traditional IUR collaboration analyzed in Section 2—namely, the structural disconnection between basic research and industrial demand (2.1), misaligned incentives and institutional barriers to technology transfer (2.2), the inadequacy of Western-centric theoretical frameworks (2.3), and the lack of interdisciplinary integration (2.4)—this chapter draws on IFRc's innovative experience to propose targeted enlightenments for China. These recommendations aim to promote innovation in China's IUR collaboration paradigm and advance the development of new quality productive forces.

### **5.1. Promoting the Extension of the Collaboration Stage to Basic Research**

Encourage universities and enterprises to establish a full-chain collaboration mechanism covering basic research, applied development, and industrial transformation. Based on enterprises' technological needs, universities can jointly establish basic research projects in frontier fields such as artificial intelligence and biomedicine, with enterprises providing early guidance on research directions and partial funding support to jointly explore key scientific issues and lay a theoretical foundation for subsequent technological innovation.

### **5.2. Building a Diversified Long-Term Funding Support System**

Drawing on the 10-year large-scale funding collaboration model between IFRc and Chugai Pharmaceutical, the government can introduce policies to guide enterprises and universities to sign long-term IUR collaboration agreements—for example, providing tax reductions or financial subsidies for projects with continuous collaboration of more than 5 years. At the same time, a special fund for IUR collaboration can be established, with the participation of government guidance, enterprise investment and social capital, to provide stable operational and scientific research funds for universities or research institutions.

### **5.3. Improving Agreement Mechanisms Based on Value Co-Creation**

Drawing on the concept of "co-creation", the rights and obligations of all parties should be clearly defined in IUR collaboration agreements. Universities can submit research progress reports to enterprises on a regular basis, enabling enterprises to enjoy priority in collaboration in the development of scientific research achievements; for joint research projects, separate agreements can be signed and

funds can be independently accounted for to ensure clear ownership of intellectual property rights and reasonable benefit distribution, forming a long-term collaboration mechanism for universities and enterprises to share risks and benefits.

#### **5.4. Strengthening Interdisciplinary Collaboration Platforms**

Addressing the lack of interdisciplinary integration identified in Section 2.4, support universities to integrate interdisciplinary resources and establish joint interdisciplinary research centers with enterprises to attract talents from different fields such as computer science, materials science, and clinical medicine to conduct collaborative research. Interdisciplinary integration can be promoted by holding regular IUR docking meetings and setting up interdisciplinary innovation projects. This will not only help cultivate compound innovative talents and accelerate technological R&D and breakthroughs, but also promote the transformation and application of technological achievements; at the same time, it is more conducive to creating new economic growth points, enhancing industrial competitiveness, and promoting high-quality economic development.

#### **5.5. Research Limitations**

It should be noted that this study has certain limitations that need to be clarified to ensure the objectivity and comprehensiveness of the research conclusions and policy recommendations. First, this study adopts a single case study design, focusing only on the innovative IUR collaboration model between IFReC at Osaka University and Chugai Pharmaceutical in Japan. The research conclusions and experience summarized are based on the specific institutional environment, policy background and industrial context of Japan, which may not fully cover the diversity of IUR collaboration models in different countries and regions. Second, there are significant differences in institutional systems, policy orientations, market environments and the development level of industry-university-research collaboration between China and Japan. The innovative model formed by IFReC under Japan's WPI Initiative and market mechanism may face adaptability challenges when applied to China's specific context, such as differences in government management systems for scientific research institutions, enterprise R&D investment concepts, and the protection mechanism of intellectual property rights. These differences may affect the direct applicability of the model and related insights in China. Therefore, the policy recommendations proposed in this study need to be flexibly adjusted and optimized in light of China's actual national conditions and should not be simply copied. Future research can expand the scope of case studies, select typical cases from different countries and regions for comparative analysis, and further improve the universality and applicability of the research conclusions.

### **6. Conclusion**

Industry-university-research collaboration is a key engine driving scientific and technological innovation and promoting industrial upgrading. Drawing on the

practical experience of IFReC and Chugai Pharmaceutical, China's IUR collaboration urgently needs to break free from the constraints of the traditional model. It should take basic research as the source, diversified funding as support, improved agreements as guarantees, and interdisciplinary integration as the path to build a collaborative innovation ecosystem. Through the joint efforts of the government, universities and enterprises, theoretical research and industrial demand are deeply integrated, which can not only stimulate the scientific research vitality of universities, but also enhance the core competitiveness of enterprises, realize the efficient flow and sharing of innovation factors. In conclusion, the innovative paradigm of IFReC provides a valuable reference for China to deepen IUR collaboration, and the joint efforts of all parties will help promote the high-quality development of China's science and technology and economy.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

### References

- Azoulay, P., Ding, W., & Stuart, T. (2009). The Impact of Academic Patenting on the Rate, Quality and Direction of (Public) Research Output. *The Journal of Industrial Economics*, 57, 637-676. <https://doi.org/10.1111/j.1467-6451.2009.00395.x>
- Cabinet Office, Government of Japan (2019). *The 1st Japan Open Innovation Prize*. (In Japanese) <https://www8.cao.go.jp/cstp/openinnovation/prize/joipichiran.pdf>
- Center for Co-Creation, Osaka University (n.d.). *A Quick Guide to Collaboration Types*. (In Japanese) <https://www.ccb.osaka-u.ac.jp/service/hitome/>
- Chen, J. (2025). Accelerating the Development of New Quality Productive Forces Requires Strengthening Capabilities for Original Innovation and Disruptive Innovation. *People's Tribune*, 24, 6-9.
- Chen, K. Y., Kibayashi, T., Giguelay, A., Hata, M., Nakajima, S., Mikami, N. et al. (2025). Genome-Wide CRISPR Screen in Human T Cells Reveals Regulators of FOXP3. *Nature*, 642, 191-200. <https://doi.org/10.1038/s41586-025-08795-5>
- Chugai Pharmaceutical (2025). *Chugai and IFReC: Pioneering Next-Generation Immunology Therapies through Open Innovation*. (In Japanese) [https://www.chugai-pharm.co.jp/english/story/detail/20251007000000\\_90.html](https://www.chugai-pharm.co.jp/english/story/detail/20251007000000_90.html)
- Chugai Pharmaceutical Co., Ltd (2016). *Announcement on Conclusion of Comprehensive Collaboration Agreement between Osaka University and Chugai Pharmaceutical*. (In Japanese) [https://www.chugai-pharm.co.jp/news/detail/20160519150000\\_180.html](https://www.chugai-pharm.co.jp/news/detail/20160519150000_180.html)
- Chugai Pharmaceutical Co., Ltd (n.d.). *What Kind of Company Is Chugai?* <https://www.chugai-pharm.co.jp/english/profile/overview/whatkind/>
- Council for Science and Technology Policy, Cabinet Office, Government of Japan (2009). *Third Science and Technology Basic Plan Follow-Up*. Council for Science and Technology Policy, Government of Japan.
- Digital Science & Research Solutions Ltd. (2021). *Scientific and Social Impact of the World Premier International Research Center Initiative*. Digital Science & Research Solutions Ltd.
- Gao, L. M., & Ma, W. J. (2014). Open Innovation: Connotation, Framework and Chinese

- Context. *Management World*, 6, 157-169. (in Chinese)  
<https://doi.org/10.19744/j.cnki.11-1235/f.2014.06.013>
- Gu, J. F. (2023). Commercialization of Academic Patents in Chinese Universities: Antecedents and Spatial Spillovers. *Heliyon*, 9, e14601.  
<https://doi.org/10.1016/j.heliyon.2023.e14601>
- He, J. (2023). “Repositioning” Is More Important Than “Connecting”: Reflections on the Policy of Science and Technology Achievement Transformation from a Holistic Perspective. *Journal of Renmin University of China*, 37, 118-130.  
[https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gckmKfYQK5MfRfafCc02cyzDyx2vubbgEMOama0O0\\_k7BKo82YVjzfFGR-aOlggHpIXpnmfLXvRS\\_TxdP7a3qPujt-5B2Ufoq39VYTzyVe5wk9WzLyZPBB7BPjugl6kYqrR2VTu-uVFIqLTh5rPxJgUcIu3SaYNFBvGgdFq1bROGjO==&uniplatform=NZKPT&language=CHS](https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gckmKfYQK5MfRfafCc02cyzDyx2vubbgEMOama0O0_k7BKo82YVjzfFGR-aOlggHpIXpnmfLXvRS_TxdP7a3qPujt-5B2Ufoq39VYTzyVe5wk9WzLyZPBB7BPjugl6kYqrR2VTu-uVFIqLTh5rPxJgUcIu3SaYNFBvGgdFq1bROGjO==&uniplatform=NZKPT&language=CHS)
- Ichiko, F. (2018). Osaka Hastens Industry Partnerships. *Nature Index*.  
<https://www.nature.com/nature-index/news/osaka-hastens-industry-partnerships>
- Immunology Frontier Research Center, Osaka University (2017). *Announcement on Conclusion of Comprehensive Collaboration Agreement between Osaka University and Otsuka Pharmaceutical*. (In Japanese)  
<https://www.ifrec.osaka-u.ac.jp/jpn/topics/20170216-0200.htm>
- Japan Society for the Promotion of Science (JSPS) (n.d.). *World Premier International Research Center Initiative (WPI): Program Overview*.  
[https://www.jsps.go.jp/english/e-toplevel/11\\_gaiyo.html](https://www.jsps.go.jp/english/e-toplevel/11_gaiyo.html)
- Japan Society for the Promotion of Science (JSPS) (n.d.). *World Premier International Research Center Initiative (WPI): Selected Projects*.  
[https://www.jsps.go.jp/english/e-toplevel/04\\_centers.html](https://www.jsps.go.jp/english/e-toplevel/04_centers.html)
- Kuwashima, K. (2020). A Role Model of Large-Scale University-Industry Collaboration in Japan: The Case of Chugai Pharmaceutical and Osaka University. *Annals of Business Administrative Science*, 19, 81-96. <https://doi.org/10.7880/abas.0200422a>
- Lei, C. Z. (2023). Strengthening the Enterprise-Led Deep Integration of Industry-University-Research to Promote High-Quality Development of University Scientific and Technological Innovation. *Journal of National Academy of Education Administration*, 6, 3-5. [https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcmGxrwIoN6cWRxGBm-WbmEKRS8jTgOvNveAvjzs71hfBYh23J4tDNWZImRG1VMzVeAOFQx9fAUXMB-WqLqFFISjyJmpvgO7kY3uLxaD-dkK1IbFrn-rHsUsreKV1o\\_apZ92ChgMPI2VQvE0GGGLTOPqOjiOc1Gzp0O7XFGm7vKPHPwsA==&uniplatform=NZKPT&language=CHS](https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcmGxrwIoN6cWRxGBm-WbmEKRS8jTgOvNveAvjzs71hfBYh23J4tDNWZImRG1VMzVeAOFQx9fAUXMB-WqLqFFISjyJmpvgO7kY3uLxaD-dkK1IbFrn-rHsUsreKV1o_apZ92ChgMPI2VQvE0GGGLTOPqOjiOc1Gzp0O7XFGm7vKPHPwsA==&uniplatform=NZKPT&language=CHS)
- Ma, W. J., & Gao, L. M. (2016). Research on the Relationship between Openness and Innovation Performance: The Moderating Role of Dynamic Capabilities. *Science Research Management*, 37, 47-54. (in Chinese)  
<https://doi.org/10.19571/j.cnki.1000-2995.2016.02.006>
- Ma, X. F., & Du, Z. W. (2022). The Impact of Institutional and Cooperative Environments on Enterprise Open Innovation Paths: A Fuzzy-Set Qualitative Comparative Analysis of 26 Enterprises from China and the United States. *Science & Technology Progress and Policy*, 39, 71-80.  
[https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gckzGU8oXZA-kOpOkOvgvdRsH9nit\\_1QaKcb6UfdAG3J4kxfy7NAusTHRTnDYQF\\_1cR4ROIUov4z\\_aDancgK-2tqn2Wb5p3VRaVPdjVthRTfnc-bZieTBm9yTg8giOsVptWy8v0ZTCcGUjtKzVZpctmkLcaXs7ra-](https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gckzGU8oXZA-kOpOkOvgvdRsH9nit_1QaKcb6UfdAG3J4kxfy7NAusTHRTnDYQF_1cR4ROIUov4z_aDancgK-2tqn2Wb5p3VRaVPdjVthRTfnc-bZieTBm9yTg8giOsVptWy8v0ZTCcGUjtKzVZpctmkLcaXs7ra-)

- [zouFP67rTMVpLhA==&uniplatform=NZKPT&language=CHS](https://www.mext.go.jp/a_menu/shinkou/sangaku/1397873.htm)
- Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2018). *Status of Industry-University Collaboration at Universities, Etc., Fiscal 2016*.  
[https://www.mext.go.jp/a\\_menu/shinkou/sangaku/1397873.htm](https://www.mext.go.jp/a_menu/shinkou/sangaku/1397873.htm)
- Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2025). *FY 2025 Follow-Up of WPI Program*.  
[https://www.jsps.go.jp/file/storage/e-toplevel\\_08\\_followup/report/FY2025\\_FU\\_Report\\_E.pdf](https://www.jsps.go.jp/file/storage/e-toplevel_08_followup/report/FY2025_FU_Report_E.pdf)
- Mixonline (2025). *Osamu Okuda, CEO of Chugai Pharmaceutical, Comments on Comprehensive Collaboration with IFRcC*. Mixonline.  
<https://www.mixonline.jp/tabid55.html?artid=79083>
- Peng, D., Li, J., Qiu, Z. Y., & Liu, H. Y. (2026). The Impact of Interdisciplinary Scientific Collaboration on the Ambidextrous Innovation of Specialized and Sophisticated “Little Giant” Enterprises. *Science & Technology Progress and Policy*, 43, 90-99.  
[https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcmvtXUemfMDmp3D3Eliz-MYOx0i68erOV0laMUu6s8hrK75sYfnFjMZXD2-7\\_py6-CpKeNKCEH5xqQELuAY-WNFZQ6Qqs10ZAHQ8b9g2K6lcbAOn09sWbaLOiy8xPfZ0xelmrX1jpZYdr\\_jGSCo-FxTazVK12bqIkxOmd6oA9CkRfmO==&uniplatform=NZKPT&language=CHS](https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcmvtXUemfMDmp3D3Eliz-MYOx0i68erOV0laMUu6s8hrK75sYfnFjMZXD2-7_py6-CpKeNKCEH5xqQELuAY-WNFZQ6Qqs10ZAHQ8b9g2K6lcbAOn09sWbaLOiy8xPfZ0xelmrX1jpZYdr_jGSCo-FxTazVK12bqIkxOmd6oA9CkRfmO==&uniplatform=NZKPT&language=CHS)
- Qian, L. X., & Chen, J. (2022). A Review of Open Innovation Research: Theoretical Framework, Research Directions and Chinese Context. *Review of Evolutionary Economics and Economics of Innovation*, 1, 82-99.  
[https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcliD5zj-PqPflq\\_wDrfvY6QZ0uo-sIOgyMioSaZK4y8yhTZg3B0Cu74i9ab6Xw1aiHtmW4Cag-EjCUyzMgb4-UeoRWkc-fkeIpMpDUs8X\\_KOjj0hzPY8xfO-RilVjPzq9H58HPswlyZh66d9OstTXTHpCoIuBWmBZKBZH5aq5AeGSA==&uniplatform=NZKPT&language=CHS](https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcliD5zj-PqPflq_wDrfvY6QZ0uo-sIOgyMioSaZK4y8yhTZg3B0Cu74i9ab6Xw1aiHtmW4Cag-EjCUyzMgb4-UeoRWkc-fkeIpMpDUs8X_KOjj0hzPY8xfO-RilVjPzq9H58HPswlyZh66d9OstTXTHpCoIuBWmBZKBZH5aq5AeGSA==&uniplatform=NZKPT&language=CHS)
- Shi, Y., Li, J. Y. H., Wang, G. S., Bai, S. R., Bian, G. B., & Li, B. Q. (2021). Constructing a Basic Research Funding Navigation System Platform to Promote Technological Innovation and Support the Development of a Modern Industrial System. *Bulletin of Chinese Academy of Sciences*, 36, 573-579. (in Chinese)  
<https://doi.org/10.16418/j.issn.1000-3045.20210407007>
- Takagi, A. (2021). Promotion of New Industry-Academia Collaboration and Human Immunology Research at the Immunology Frontier Research Center, Osaka University. *MedChem News*, 31, 111-115.
- Zhang, J., & Bai, K. R. (2022). Basic Research in Chinese Universities and Enterprise Innovation. *Economic Research Journal*, 57, 124-142.  
[https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcnF7Mcg6oRRBdITB9ibVroVq8jeQU0JC-f8D1nUES4Jwy8rcZRmVcK-dLdbfqNHtQu5tBgbP58iUaEtpIO6pGvV8W5kqdz\\_A08Ad0VXA6k-w0LlzoX-TWQzQHDKxo39arXeL\\_e4rttHTbexLpJXDwLvavQOwgihRW-gro8KUUuPkT7oGw==&uniplatform=NZKPT&language=CHS](https://kns.cnki.net/kcms2/article/abstract?v=A2Z-m-A1gcnF7Mcg6oRRBdITB9ibVroVq8jeQU0JC-f8D1nUES4Jwy8rcZRmVcK-dLdbfqNHtQu5tBgbP58iUaEtpIO6pGvV8W5kqdz_A08Ad0VXA6k-w0LlzoX-TWQzQHDKxo39arXeL_e4rttHTbexLpJXDwLvavQOwgihRW-gro8KUUuPkT7oGw==&uniplatform=NZKPT&language=CHS)
- Zhang, Y. F., Liu, B., Yuan, C. H., & Zhang, S. M. (2025). Research on the Construction Path of Industry-University-Research Innovation Consortia under the Scenario of Chinese Modernization. *Science Research Management*, 46, 73-85. (in Chinese)  
<https://doi.org/10.19571/j.cnki.1000-2995.2025.02.008>