Mechanism of Regional Sci-Tech Innovation in Driving the Development of Strategic Emerging Industry – Perspective of Modern Service Industry and Marketization Level

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Abstract

A theoretical model of regional Sci-Tech innovation-driven strategic emerging industry development is constructed with the modern service industry as the mediating variable and regional marketization level as the moderating variable. Based on Chinese provincial panel data from 2010-2020, a multiple regression model is used to empirically analyze the mechanism of the role of regional Sci-Tech innovation driving the development of the strategic emerging industry. The research results show that: regional Sci-Tech innovation significantly drives the development of the strategic emerging industry; the modern service industry plays a partly intermediary role in the process of regional Sci-Tech innovation driving the growth of the strategic emerging industry; the level of marketization plays a positive moderating role in the relationship between regional Sci-Tech innovation and modern service industry development, and modern service industry and strategic emerging industry development; the level of marketization has a positive effect on the relationship between regional Sci-Tech innovation and The marketization level plays a positive regulating role in the relationship between regional Sci-Tech innovation and the development of modern service industry and the development of modern service industry and strategic new industry.

Keywords: innovation-driven, regional Sci-Tech innovation, strategic emerging industry, modern service industry, marketization level

Introduction

The rapid development of Sci-Tech in today's world and the increasingly fierce international competition in Sci-Tech have made the global economy enter a profound adjustment. Sci-Tech innovation has become a solid driving force to lead industrial change and promote economic and social development. As a critical subject in the regional Sci-Tech innovation system and a new driving force to promote industrial structure upgrading and economic development, strategic emerging industry, which represent the integration

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of new technologies and new industries in each country, have been developing rapidly under the guidance of the innovation-driven strategy. Innovation-driven originates from Michael Porter's national competitive advantage theory emphasizes that Sci-Tech innovation is the core of innovation-driven development. Germany put forward the national development strategy of "Industry 4.0" in "High Technology Strategy 2020", aiming to achieve a significant increase in industrial energy efficiency through Sci-Tech innovation [1], and the "Made in China 2025" also aims to drive a new round of manufacturing development with the help of advanced science and information technology [2]. The strong momentum of Sci-Tech innovation in industrial growth has triggered a series of thoughts from relevant scholars and focused on two main aspects.

First, research on the influencing factors of industrial Sci-Tech innovation. The influencing factors of industrial Sci-Tech innovation capability can be divided into internal and external factors. Internal influencing factors refer to the industry's innovation factor input intensity and human capital level, etc., which can significantly affect the industry's Sci-Tech innovation capability. For example, Song et al. [3] studied the energy-intensive industry in the Korean manufacturing industry. They pointed out that the ratio of R&D personnel in the industry and the intensity of R&D investment are the two most important factors affecting process and product innovation. Emodi et al. [4], using the Chinese manufacturing industry as a study, similarly concluded that R&D personnel and expenditure significantly affect the product innovation capability of firms. External influencing factors affect industrial innovation in the regional Sci-Tech innovation system in which the industry is located, mainly including other innovation subjects, the constructed innovation network, and the innovation environment.

In the study of external influences, Fernández et al. [5] verified that network cooperation between firms and alliance partners is the main influencing factor for their Sci-Tech innovation progress, using developing countries as an example. Tudor et al. [6] studied the Romanian manufacturing industry. They found that the lack of awareness of Sci-Tech innovation and the neglect of the importance of universities and research institutions were the main reasons for the low output rate of firms' innovations. Corrocher et al. [7], using firms inside and outside Italian industrial parks, verified that the intensity of firms' innovation activity depends on the strength of the regional Sci-Tech innovation network and has a positive impact only on firms that already can innovate. Kim et al. [8] used a multiple regression model to verify that establishing regional Sci-Tech alliances and knowledge practice activities are essential influences on the performance of open industrial innovation. Li et al. [9] used structural equations to empirically analyze the factors influencing Sci-Tech innovation in an emerging strategic industry, and the results showed that the practical cooperation among innovation subjects

and the willingness of each organizational unit within the sector to engage with each other are the main influencing factors of Sci-Tech innovation. Su et al. [10] emphasized that inter-industry knowledge spillover through the absorption of external Sci-Tech innovation achievements is an important driving force for scientific and technological innovations to guide the upward development of the strategic emerging industry.

Second, research on the driving force of industrial Sci-Tech innovation. Since Sci-Tech innovation is the key driver of industrial development, what factors can drive the industry to innovate in Sci-Tech? To address this issue, McMahon et al. [11], exploring innovation in emerging areas in developing countries, found that market demand is the primary driver stimulating Sci-Tech innovation. Liu et al. [12] also considered market demand as a direct trigger for industrial innovation activities and constructed a quadratic helix model of industrial innovation drive with market demand as the initiator. Fu et al. [13] finally found through an empirical study that Sci-Tech innovation plays a mediating role in the growing market demand driving the development of strategic emerging industry, following the path of "market demand → Sci-Tech innovation → industrial development." Yang [14], on the other hand, starts from the essence of a strategic emerging industry and believes that the synergistic drive of Sci-Tech innovation and market demand is the key to the development of a strategic emerging industry.

In summary, the conclusions of the research on industrial Sci-Tech innovation can be roughly summarized as follows: First, the intensity of the enterprises' internal innovation investment and the effective connection with the innovation subjects in the regional Sci-Tech innovation system are essential factors affecting the enterprises' Sci-Tech innovation capability; Second, market demand is a crucial driving force for the enterprises' Sci-Tech innovation. As a critical subject and new driving force of the regional Sci-Tech innovation system, most of China's strategic emerging industries are transformed and upgraded from traditional industries, with weak innovation capacity and still imperfect technology and industrial chains [15]. Therefore, as a carrier of long-term strategic cooperation for the industry to achieve significant goals such as core Sci-Tech breakthroughs, the regional Sci-Tech innovation system in which strategic emerging industries are rooted becomes a binding force for the industry itself to achieve innovation-driven development [16]. However, there is a disconnection between regional Sci-Tech innovation and strategic emerging industry development in China. The development of strategic emerging industries in each region generally needs to catch up to regional Sci-Tech innovation [17]. Are the imbalances and inconsistencies between the two related to the above factors? More standardized research results are still needed to explore this field's development pattern and promote the synergy between the two.

The modern service industry is based on and gradually separated from the manufacturing industry and eventually becomes an independent knowledge, technology and information-intensive industry that promotes the rapid growth of the manufacturing industry. It mainly includes finance, business and government, network information technology, comprehensive scientific and technological services and some traditional service sectors that have been transformed and upgraded. It mainly plays the function of knowledge, technology and human capital in the development of the manufacturing industry and economic growth through the intermediate input in the production process of goods and services [18]. In recent years, the modern service industry has played a significant role in promoting and radiating the upgrading of industrial structures. They have become the commanding heights of emerging economies actively seized by developed and developing countries. Similarly, as an essential subject and new driving force in the regional Sci-Tech innovation system, the modern service industry should be a necessary support for further promoting the high-end development of strategic emerging industry under the dual advantages of helping the manufacturing industry integrate into the Sci-Tech innovation network and building differentiated market competition [19]. Pei et al. [19] pointed out that developing strategic emerging industries needs to follow the law of equal emphasis on advanced manufacturing and the modern service industry. Jin [20] also believed that the development of strategic emerging industries needed the extra support of the modern service industry. Therefore, can regional Sci-Tech innovation drive the growth of the strategic emerging industry by promoting the development of the modern service industry? Can the differences in marketization in different regions impact the driving process? Based on this, this paper takes the pharmaceutical manufacturing industry, one of the eight strategic emerging industries in China, as the research object, introduces the modern service industry as the intermediary variable and the marketization level as the regulating variable, discusses the driving mechanism of regional Sci-Tech innovation on strategic emerging industry, and studies the ambitious path based on data analysis. To support and guarantee precise policy formulation and implementation in regional Sci-Tech innovation-guided industrial planning.

Theory and Hypotheses

Regional Sci-Tech Innovation and the Development of Strategic Emerging Industry

The industrial development environment can be divided into global, national, and regional environments according to the region. Regional innovation environment is the sum of interrelated innovation subjects (industry, universities and research institutions, etc.), innovation factors, and innovation environment in a specific region [21]. Regional Sci-Tech innovation can be summarized as a process in which all innovation-related subjects in the area cooperate and closely connect to the network so that the innovation resources in the region can be used efficiently in the process of flow and diffusion and finally realize the regional economic development and improve the competitiveness. Its core purpose is to effectively organize innovation elements to gather in enterprises and establish and improve the support service system to promote enterprise Sci-Tech innovation. In the impact of regional Sci-Tech innovation on the development of strategic emerging industry, from the perspective of supporting strategic emerging industry, Song [17] constructed the PSR framework of regional Sci-Tech innovation and the development of strategic emerging industry, indicating that the regional Sci-Tech innovation system realizes the resource optimization, integration and structural upgrading of the strategic emerging industry through Sci-Tech progress and innovation factor diffusion. Lv et al. [22] also believed that when the coupling system of regional Sci-Tech innovation and strategic emerging industry was in the growth stage, the regional Sci-Tech innovation system would provide essential support for the strategic emerging industry in terms of the supply of industrial Sci-Tech innovation elements. Regions with sci-tech solid innovation capability have high-quality development factors of the strategic emerging industry, including high-quality technical personnel, favorable industrial development environment, perfect industrial supporting facilities, advanced Sci-Tech research and development and achievement transformation capabilities, etc., creating good conditions for the development of strategic emerging industry [23].

From the perspective of the growing needs of the strategic emerging industry, as the Sci-Tech innovation in today's world gradually presents the characteristics of integration, high-end, and complexity, clustering has become the driving force for the development strategy and location choice of the strategic emerging industry. Instead of relying on the internal R&D of a single enterprise, more regional Sci-Tech innovation resources and a rational division of labor and cooperation between industry, university, and research are utilized [24, 25]. In addition, China's strategic emerging industry is transitioning from Sci-Tech introduction and imitative innovation to breakthrough independent innovation. The generation of breakthrough innovation also depends on the coordination and cooperation of the main body, resources, environment, and functions in the regional Sci-Tech innovation system, which is the premise and guarantee for cultivating the independent innovation ability of strategic emerging industry [26]. Hence, the following hypotheses are proposed:

Hypothesis 1. Regional Sci-Tech innovation positively affects the development of the strategic emerging industry.

Regional Sci-Tech Innovation and Development of the Modern Service Industry

Regional Sci-Tech innovation systems can directly affect the development scale and structure of the modern service industry [27]. First of all, in the new era of the implementation of innovation-driven development strategy, the pattern of enterprise innovation activities has changed significantly. Juan et al. [28] found through empirical research that the innovation mode of enterprises will vary with the change in the regional innovation environment. Bullinger et al. [29] explained this change. He believed that with the gradual complexity of Sci-Tech innovation, only some individual participants could have all the capabilities required for creation, and the traditional linear innovation model has been transformed into nonlinear innovation with extensive resource integration. The demand for nonlinear innovation mode can provide colossal development space for the modern service industry. At the same time, as the organic combination of the Sci-Tech system, economic system, and innovation resources, the regional Sci-Tech innovation system can also provide a suitable environment for developing the modern service industry.

Secondly, regional Sci-Tech innovation contributes to the aggregation of the modern service industry. Wang et al. [30] conducted an empirical analysis of the factors influencing the spatial aggregation of the modern service industry in western China and found that infrastructure construction and urbanization processes had a significant positive impact on the aggregation of the modern service industry. Regions with Sci-Tech solid innovation capacity have developed infrastructure construction and a high level of urbanization, which can create high-quality conditions for the aggregation of the modern service industry.

Finally, the high level of human capital in the regional Sci-Tech innovation system is conducive to promoting the transformation of a low-end labor-intensive traditional service industry into a high-end knowledge-intensive modern service industry. With the continuous productivity development brought by regional Sci-Tech progress and knowledge capital accumulation, the focus of regional consumption demand structure will gradually shift to a higher level. It can guide the industrial system to upgrade to the advanced form of the modern service industry [31]. Hence, the following hypotheses are proposed:

Hypothesis 2. Regional Sci-Tech innovation positively affects the development of the modern service industry.

The Modern Service Industry and Development of the Strategic Emerging Industry

The role of the modern service industry in promoting the development of the strategic emerging industry is as follows. Firstly, the modern service industry can help

strategic emerging industries construct competitive advantages and achieve high-end growth. Michael Porter believes that the value chain of the manufacturing industry changes from manufacturing to service is a crucial way to gain a competitive advantage in the market. Promoting the integrated development of strategic emerging industries and the modern service industry is conducive to obtaining long-term differential competitive advantages for strategic emerging industries [19]. The "smile curve" theory also proves that the added value of industrial R&D, marketing, and other service links is significantly higher than that of manufacturing links. The development of strategic emerging industries may even achieve rapid growth and improvement due to the expansion of the market scale of existing technologies through "business model innovation" or "innovation and improvement of applicability" [32].

Second, the modern service industry is conducive to improving the innovation ability of an emerging strategic industry. The knowledge-intensive modern service industry is regarded as the main driving force of industrial innovation and economic progress in the current industrial system. The development of strategic emerging industries must rely on industrial innovation. Therefore, in the process of development, strategic emerging industries need extensive cooperation with all kinds of related modern service industries such as finance and insurance, modern logistics, Sci-Tech information services, etc., to realize network innovation with complementary capabilities, jointly carry out a series of activities such as scientific and technological research and development, product production and business expansion, and make full use of their respective advantages to improve the innovation ability of the strategic emerging industry. Hence, the following hypotheses are proposed:

Hypothesis 3. The modern service industry positively affects the development of strategic emerging industries.

The Mediating Role of the Modern Service Industry in the Relationship between Regional Sci-Tech Innovation and the Strategic Emerging Industry Development

This paper holds that the modern service industry plays a vital role in developing a strategic emerging industry driven by regional Sci-Tech innovation. By analyzing the previous research, it can be concluded that responding to market demand and building an innovation network are the two keys to realizing innovation-driven development of the strategic emerging industry. On the one hand, regional Sci-Tech innovation provides essential support for the strategic emerging industry by stimulating Sci-Tech progress [17]. In contrast, the modern service industry is the medium to transform the Sci-Tech progress of strategic emerging industry into market benefits and competitiveness. The stability and differentiated competition of large-scale production in the strategic emerging industry

are the key factors to overcome the "Valley of Death" in the Sci-Tech transition to products and even commodities. The modern service industry is undoubtedly an essential guarantee for the stable development of large-scale production in a strategic emerging industry and the construction of differentiated competition [32]. On the one hand, the modern service industry can closely connect strategic emerging industries with other innovation subjects in the region, optimize resource allocation of spillover diffusion of regional Sci-Tech innovation system to the strategic emerging industry, and ensure the most efficient use of innovation resources [33]. Hence, the following hypotheses are proposed:

Hypothesis 4. The modern service industry mediates the relationship between regional Sci-Tech innovation and the development of the strategic emerging industry.

The Regulating Effect of Marketization Level

Marketization level refers to the story that the market plays a role in resource allocation. As an important factor affecting the operation of the regional Sci-Tech innovation system, the marketization level can significantly improve regional Sci-Tech innovation ability [34]. On the one hand, regions with high marketization levels have strong Sci-Tech innovation ability, high market demand intensity, and large capacity for the modern service industry, which can accelerate the spatial aggregation of the modern service industry. On the other hand, the regional government with high marketization level intervenes accurately and appropriately, and the market competition environment is relatively fair, contributing to the rapid development of the modern service industry [35]. Hence, the following hypotheses are proposed:

Hypothesis 5. Marketization level plays a significant positive regulating role in the relationship between regional Sci-Tech innovation and modern service industry development.

Shen et al. [36] and Yang et al. [37] both pointed out that a developed marketization level can significantly improve the efficiency of Sci-Tech innovation and resource allocation in the regional Sci-Tech innovation system. Sci-Tech innovation and the improvement of resource allocation efficiency are conducive to

Sci-Tech progress, which in turn helps to accelerate the integration of the modern service industry and strategic emerging industry. In addition, a high level of marketization also helps to improve the openness of the modern service industry, thus indirectly affecting the degree of integration with strategic emerging industries [38]. Hence, the following hypotheses are proposed:

Hypothesis 6. Marketization level plays a significant positive regulating role in the relationship between the modern service industry and strategic emerging industry.

Furthermore, this paper proposes a moderated mediation effect model. The process of regional Sci-Tech innovation driving the development of the strategic emerging industry through expanding the modern service industry is regulated by the marketization level. As mentioned above, the marketization level dramatically influences the development of the modern service industry. When the regional marketization level is high, on the one hand, it can accelerate the spatial aggregation and growth of the modern service industry in the regional Sci-Tech innovation system. On the other hand, a high level of marketization helps improve the efficiency of Sci-Tech progress and the openness of the modern service industry, to realize the integration with strategic emerging industries better and promote the development of the strategic emerging industry. Hence, the following hypotheses are proposed, and the conceptual framework is shown in Fig. 1.

Hypothesis 7. Marketization level positively regulates the relationship between "regional Sci-Tech innovation → development of modern service industry → development of the strategic emerging industry."

Method

Measures

Strategic Emerging Industry Development Comprehensive Evaluation Index (SEI)

Considering that a single index cannot measure the development status of a strategic emerging industry, this paper constructs an evaluation index system for the development of a strategic emerging industry
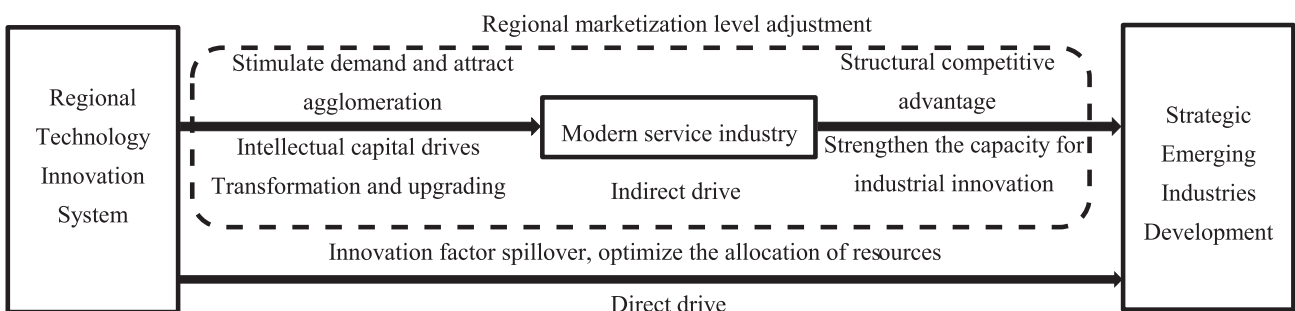

Fig. 1. Conceptual framework.

Table 1. Strategic emerging industry development evaluation index system.

First-level indicator	Second-level indicator	Third-level indicator	Method of measurement	Unit
Development of strategic emerging industry	Scientific and technological innovation	Innovative personnel input	R & D personnel equivalent full time	Person-year
		Investment intensity of innovation funds	Internal investment in R&D expenditure as a proportion of main business income	%
	Development potential	Innovation Scale	The number of enterprises with R&D activities as a proportion of the total number of enterprises	%
		Market Accommodation	The proportion of new product sales revenue to primary business revenue	%
	Development environment	Regional technology mobility capabilities	Regional Technology Market Turnover as a Share of GDP	%
		Government Support	The proportion of government funds in the internal investment of industrial R&D funds	%

based on three dimensions of scientific and technological innovation, development potential, and development environment, and considers the scientificity, simplicity, and collectibility of evaluation indexes, and uses entropy weight method to calculate the comprehensive evaluation index. The specific evaluation index system is shown in Table 1.

Regional Sci-Tech Innovation Capacity (RTI)

Under the nonlinear innovation mode, it is necessary to realize scientific and technological innovation. As an index to measure the output of practical scientific and technical inventions, the number of patent grants can effectively reflect each innovation subject's suitable connection degree and scientific and technological innovation ability in the regional scientific and technological innovation system. This paper represents the variable by the number of patent applications granted in each region.

Comprehensive Evaluation Index of Modern Service Industry Development (MSI)

The modern service industry is a comprehensive industrial system. Referring to the research of Lu et al.

[39], this paper constructs an evaluation index system for the development of the modern service industry to measure the development status of the modern service industry from three dimensions, such as industrial scale, industrial potential, and industrial structure, and considers the scientificity, simplicity, and collectibility of evaluation indexes, and uses entropy weight method to calculate the comprehensive evaluation index. The specific evaluation index system is shown in Table 2.

Marketization Level (Market)

Based on the research of Xu et al. [40] and Cui et al. [41], the regional marketization index of Wang et al. [42] is adopted. The marketization index is composed of five indexes, including the relationship between the government and the market, the development of a non-state-owned economy, the development degree of the product market, the development degree of the factor market, the development of the intermediary market organization and the legal system environment, as well as several sub-indexes under its jurisdiction, to effectively measure the relative progress of marketization in each region of China.

Table 2. Modern service industry development evaluation index system.

First-level indicator	Second-level indicator	Third-level indicator	Unit
Development of modern service industry	Industry Scale	Modern service industry employment	Person
		Modern service industry GDP	Billion
	Industry Potential	Growth rate of employment in the modern service industry	%
		The modern service industry value added growth rate	%
	Industry Structure	The proportion of the added value of the modern service industry to regional GDP	%
		The proportion of employment in the modern service industry to employment in the three types of industry	%

Controls

Starting from the medium and macro factors affecting the development of strategic emerging industry, this paper intends to select the following three control variables: 1. Foreign Direct Investment (FDI), expressed by the amount of foreign direct investment in each region; 2. The per capita GDP of each area represents Regional Economic Level (GDP per capita). 3. Government Investment in Sci-Tech Innovation (Finance_tech) is represented by financial expenditure on Sci-Tech.

Models

Based on Hypothesis 1 to 4, models 1 to 4 were established:

$$SEI_{it} = \alpha_0 + \alpha_1 RTI_{it} + \Sigma\alpha_k Controls_{it} + \varepsilon_1 \quad (1)$$

$$MSI_{it} = \beta_0 + \beta_1 RTI_{it} + \Sigma\beta_k Controls_{it} + \varepsilon_1 \quad (2)$$

$$SEI_{it} = \gamma_0 + \gamma_1 MSI_{it} + \Sigma\gamma_k Controls_{it} + \varepsilon_1 \quad (3)$$

$$SEI_{it} = c_0 + c_1 RTI_{it} + c_2 MSI_{it} + \Sigma c_k Controls_{it} + \varepsilon_1 \quad (4)$$

In models 1 to 4, SEI_{it} represents the comprehensive evaluation index of strategic emerging industry development in year t of region i. MSI_{it} represents the Integrated Assessment Index of Development of the modern services industry in the t year of region i. RTI_{it} represents the regional Sci-Tech innovation capability in year t of region i. According to model 4, the mediation effect test was conducted strictly concerning the test method proposed by Wen et al. [43].

Based on Hypothesis 5 to 7, models 5 to 7 were established:

$$MSI_{it} = \mu_0 + \mu_1 RTI_{it} + + \mu_2 Market_{it}$$
$$+ \mu_3 Market_{it} * RTI_{it} + \Sigma\mu_k Controls_{it} + \varepsilon_1 \quad (5)$$

$$SEI_{it} = \beta_0 + \beta_1 MSI_{it} + \beta_2 Market_{it} + \beta_3 Market_{it}$$
$$* MSI_{it} + \Sigma\beta_k Controls_{it} + \varepsilon_1 \quad (6)$$

$$SEI_{it} = l_0 + l_1 RTI_{it} + + l_2 Market_{it} + l_3 MSI_{it}$$
$$+ l_4 Market_{it} * MSI_{it} + \Sigma l_k Controls_{it} + \varepsilon_1 \quad (7)$$

In models 5 to 7, Market$_{it}$ represents the marketization level in year t of region i. μ_3 in model 5 is the critical coefficient, indicating whether the marketization level will strengthen or weaken the influence of regional Sci-Tech innovation on

the development of the modern service industry. According to Hypothesis 6, β3 in model 6 is the critical coefficient, indicating whether the marketization level will strengthen or weaken the influence of the modern service industry on the development of an emerging strategic industry. Model 7 belongs to the moderated mediation effect model. According to Hypothesis 7, the test was conducted strictly concerning the mediation effect test method proposed by Wen et al. [44].

Sample Selection, Data Sources and Descriptive Statistics

This paper chooses the pharmaceutical manufacturing industry as the representative industry of an emerging strategic industry. Since 2020, the novel coronavirus has spread worldwide, affecting all countries to varying degrees. In this context, the pharmaceutical manufacturing industry stands out among China's primary strategic emerging industries. So far, China has provided more foreign aid and exported COVID-19 vaccines than other countries combined, contributing significantly to China's international reputation and competitiveness. The pharmaceutical manufacturing industry is high-tech, with highly integrated advanced technology and means involving national health, social stability, and economic development. Innovation in pharmaceutical manufacturing takes longer, costs more, and is riskier than in other industries. It will undoubtedly become the focus of competition between developed and developing countries in the period after that.

This paper selected panel data from 28 Chinese provinces, municipalities, and autonomous regions from 2010 to 2020 as samples (Tibet Autonomous Region, Qinghai Province, and Hainan Province were not selected as samples due to severe data missing). The data comes from the China Sci-Tech Statistical Yearbook, China High Technology Statistical Yearbook, China Tertiary Industry Statistical Yearbook, Guotai 'a Database, and the National Bureau of Statistics of the corresponding years. The interpolation method completes the missing data in the statistical yearbook. According to the marketization index in 2020 in China, the average growth rate method is used to supplement the forecast. All variables are processed logarithmically. The descriptive statistics of each variable are shown in Table 3.

Results

The Relationship between Regional Sci-Tech Innovation, the Modern Service Industry, and Strategic Emerging Industry Development

Model 1 in Table 4 shows the total impact of regional Sci-Tech innovation on the strategic emerging industry development. The coefficient of regional

Table 3. Descriptive statistics.

Variable Name	Observations	Minimum	Maximum	Average value	Standard error
GDP per capita	308	9.464	12.009	10.759	0.471
FDI	308	3.433	9.984	6.710	1.339
Finance_tech	308	10.997	16.274	13.564	0.974
SEI	308	-3.927	-0.373	-1.490	0.557
MSI	308	-2.284	-0.318	-1.279	0.401
Market	308	1.212	2.479	2.056	0.249
RTI	308	4.111	11.166	8.255	1.316

Sci-Tech innovation is significantly positive at the 1% level, indicating that regional Sci-Tech innovation promotes strategic emerging industry development. Hypothesis 1 is verified. Model 2 in Table 4 shows the influence of regional Sci-Tech innovation on the development of the modern service industry. The coefficient of regional Sci-Tech innovation is significantly positive at the 1% level, indicating that regional Sci-Tech innovation has dramatically promoted the development of the modern service industry. Hypothesis 2 is verified. Model 3 in Table 4 shows the influence of the modern service industry on the development of an emerging strategic industry. The coefficient of the modern service industry is significantly positive at the 1% level, indicating that the modern service industry substantially promotes the development of strategic emerging industries, and Hypothesis 3 is verified.

The Mediate Effect Test of the Modern Service Industry

Model 4 in Table 4 shows the combined influence of regional Sci-Tech innovation and intermediate variable modern service industry on developing strategic emerging industry. According to model 1 and Model 3, regional Sci-Tech innovation is significantly positively correlated with the development of the modern service industry and strategic emerging industry at the 1% level. In Model 4, when both regional Sci-Tech innovation and modern service industry regression to the development of an emerging strategic industry, the results show that the influence of regional Sci-Tech innovation and modern service industry on the development of the strategic emerging industry is still significantly positive at 1% level, and the effect of regional Sci-Tech innovation on the development of strategic emerging

Table 4. Results of baseline regression and mediation effects analysis.

Variable Type	Variable Name	Model 1	Model 2	Model 3	Model 4
Dependent variables		SEI	MSI	SEI	SEI
Control variables	GDP per capita	0.489*** (10.103)	-0.132*** (-2.144)	0.527*** (5.886)	0.526*** (5.998)
	FDI	-0.140*** (-3.031)	0.059* (1.832)	-0.049*** (-2.190)	-0.156*** (-3.437)
	Finance_tech	0.060 (0.891)	0.131*** (2.783)	0.159*** (2.811)	0.023 (0.341)
Independent variables	RTI	0.208*** (4.089)	0.094*** (2.651)		0.181*** (3.588)
Intermediate variables	MSI			0.329*** (4.020)	0.285*** (3.512)
	_cons	-8.344*** (-9.503)	-2.801*** (-4.586)	-8.265*** (-9.333)	-7.546*** (-8.465)
	Year	Control	Control	Control	Control
	N	308	308	308	308
	Adj R²	0.414	0.452	0.413	0.435
	F Value	55.188***	64.318***	54.963***	48.268***

Notes:*p<0.1, **p<0.05, ***p<0.01

industry decreases from 0.208 to 0.181. According to the stepwise test method, the modern service industry partially mediates the relationship between regional Sci-Tech innovation and the development of strategic emerging industry, and the mediating effect size is 0.027 (0.094*0.285). Hypothesis 4 is verified.

The Regulating Effect of Marketization Level

Model 5 in Table 5 examines the regulating effect of marketization level on the relationship between regional Sci-Tech innovation and modern service industry development. In Model 5, the interaction term of marketization level and regional Sci-Tech innovation has a significant positive correlation with the development of the modern service industry at the 1% level. It shows that the marketization level significantly positively regulates the relationship between regional Sci-Tech innovation and the development of the modern service industry. Hypothesis 5 is verified, that is, the higher the marketization level of the region, the more significant the role of regional Sci-Tech innovation in promoting the development of the modern service industry.

Model 6 in Table 5 examines the regulating effect of marketization level on the relationship between the modern service industry and strategic emerging industry development. In Model 6, the interaction term

of marketization level and modern service industry is positively correlated with the development of strategic emerging industry at the 1% level. It shows that the marketization level significantly positively regulates the relationship between the modern service industry and strategic emerging industry development. Hypothesis 6 is verified, that is, the higher the marketization level of the region, the more significant the role of the modern service industry in promoting the development of the strategic emerging industry.

Model 7 in Table 5 is a regulating mediation effect test. Model 5 and model 7 are combined for analysis. In Model 7, regional Sci-Tech innovation, modern service industry, marketization level, and the interaction term between modern service industry and marketization level were added into the regression model. The results show that the interaction between the modern service industry and marketization level is significantly positively correlated with the development of strategic emerging industry at the 1% level. In Model 5, a significant positive correlation exists between regional Sci-Tech innovation and modern service industry development at the 1% level. According to Wen et al. [43] moderated mediating effect test method, in three sets of coefficients ($\mu 1$, $l4$), ($\mu 3$, $l3$) and ($\mu 3$, $l4$), as long as a set of test coefficients is significant, the mediating effect will be regulated. Therefore, the latter half of

Table 5. Regression results of the moderating effect of the level of marketization.

Variable Type	Variable Name	Model 5	Model 6	Model 7
Dependent variables		SMI	SEI	SEI
Control variables	GDP per capita	-0.220*** (-3.594)	0.451*** (5.173)	0.451*** (5.266)
	FDI	0.048 (1.296)	-0.216*** (-4.081)	-0.257*** (-4.823)
	Finance_tech	0.038 (0.781)	0.148*** (2.712)	0.016 (0.251)
Independent variables	RTI	0.140*** (3.987)		0.173*** (3.509)
Intermediate variables	MSI		0.292*** (3.702)	0.249*** (3.168)
Adjustment variables	Market	0.424** (2.527)	0.897*** (4.166)	0.784*** (3.668)
Interaction items	Market*RTI	0.327*** (5.595)		
	Market*MSI		1.244*** (4.355)	1.297*** (4.618)
	_cons	0.164 (0.200)	-6.971*** (-7.799)	-6.345*** (-7.086)
	Year	Control	Control	Control
	N	308	308	308
	Adj R²	0.501	0.458	0.477
	F Value	31.302***	44.188***	41.058***
Notes: *p<0.1, **p<0.05, ***p<0.01				

the mediating impact of regional Sci-Tech innovation driving the development of the strategic emerging industry by promoting the development of the modern service industry will be regulated by the marketization level, and Hypothesis 7 is verified.

Robustness Test

Endogeneity Test

It should be noted that regional Sci-Tech innovation and development of the modern service industry, regional Sci-Tech innovation, and development of the strategic emerging industry are likely to influence each other. That is, the higher the development level of the modern service industry, the stronger the regional Sci-Tech innovation ability, or the better the development of strategic emerging industry, the stronger the regional Sci-Tech innovation ability. Therefore, to avoid the endogeneity problem caused by reverse causation, this paper refers to the study of Xue et al. [45], selects the one-stage lag variable of regional Sci-Tech innovation as the instrumental variable, and uses the two-stage least square method (2SLS) to test the robustness of models 1 and 2. The specific results are shown in Table 6. The results show that regional Sci-Tech innovation has a significant positive correlation with the development of the modern service industry and strategic emerging industry at 5% and 1%. The conclusions of this paper are robust.

Table 6. Estimation results of 2SLS using instrumental variables method.

Variable Type	Variable Name	Model 1	Model 2
Dependent variables		SEI	MSI
Control variables	GDP per capita	0.487*** (5.531)	-0.134** (-2.181)
	FDI	-0.123*** (-2.662)	0.079** (2.457)
	Finance_tech	0.096 (1.396)	0.176*** (3.662)
Independent variables	RTI	0.163*** (3.029)	0.038** (1.004)
	_cons	-8.556*** (-9.762)	-3.067*** (-5.016)
	Year	Control	Control
	N	308	308
	Adj R ²	0.412	0.448
	Waldχ2	216.048***	253.293***

Notes:*p<0.1, **p<0.05, ***p<0.01

Further Examination of the Mediating Effect

This paper uses the Bootstrap method to examine further the mediating effect of the modern service industry in the relationship between regional Sci-Tech innovation and strategic emerging industry. Since the sample size of this paper is less than 500, 5000 times Bootstrap sampling is selected. According to Bootstrap's deviation correction confidence interval, after adding the intermediary variable modern service industry into the regression model, the 95% confidence interval [0.009, 0.143] of the modern service industry did not contain 0, indicating that the intermediary effect of the modern service industry was significant. The 95% confidence interval [0.082, 0.280] of the direct impact of regional Sci-Tech innovation on the development of strategic emerging industry also excludes 0. Therefore, the modern service industry plays an intermediary role in the influence of regional Sci-Tech innovation on the development of strategic emerging industries, and it is a partial intermediary. The core Hypothesis 4 is verified.

Conclusions and Recommendations

Based on China's provincial panel data from 2010 to 2020, this paper systematically discusses the relationships among regional Sci-Tech innovation, the modern service industry, and strategic emerging industry development. It considers the influence of regional marketization levels on these relationships. The main research conclusions are as follows.

First, regional Sci-Tech innovation plays a significant positive role in promoting the development of the modern service industry and strategic emerging industry. Regional Sci-Tech innovation can attract modern service industry agglomeration and encourage growth by creating the demand for non-linear innovation mode and advanced urbanization process. Establish a Sci-Tech innovation network to carry out integrated innovation and make innovation elements flow and diffusion to promote the strategic emerging industry to achieve Sci-Tech progress.

Second, the modern service industry, has a partial intermediary effect in the relationship between regional Sci-Tech innovation and strategic emerging industry development. The modern service industry is a key "weapon" to help the strategic emerging industry establish an innovation network, build differentiated competitive advantages, and realize the benefits of Sci-Tech progress.

Third, the marketization level has a positive moderating effect on the relationship between regional Sci-Tech innovation and the development of modern service industry and the development of modern service industry and the development of strategic emerging industry, and the latter half of the mediating effect of regional Sci-Tech innovation driving the growth of the strategic emerging industry by promoting

the development of modern service industry is positively moderated by the marketization level.

According to the above research, the following suggestions are put forward:

First, attach great importance to the critical role of developing modern service industries. As a knowledge-intensive industry, the modern service industry has become the pillar industry and core competitiveness of some Western developed countries. Promoting the development of the modern service industry, like developing strategic emerging industries, is an essential means to upgrade our industrial structure. Service-oriented manufacturing has become the main direction of transforming and upgrading the traditional manufacturing industry in China. In the non-linear innovation mode, the modern service industry is essential for strategic emerging industries to achieve better high-quality development driven by regional scientific and technological innovation.

Second, the government should create a favourable environment for the integration of modern service industries and strategic emerging industries. In recent years, the pace of integrating the modern service industry and strategic emerging industry has been accelerating, but the "two industries" derailment occurs from time to time. On the one hand, the government should create a green channel for the primary interaction between strategic emerging and modern service industries, improve the fluency of the regional Sci-Tech innovation network, and make the communication between the "two industries" more convenient. On the other hand, the carrier of a "two industries" integrated development platform can be established to fully activate the interaction and integration between strategic emerging industries and the modern service industry so that the modern service industry can run through the whole process and every link of the innovation and development of strategic emerging industries, and accelerate the penetration of modern service industry to strategic emerging industries.

Third, they are combined with the characteristics of strategic emerging industries to develop a matching modern service industry. Designing the modern service industry in unison and without regard to primary and secondary development in the context of limited resources in each region is not desirable. In developing the modern manufacturing industry, all areas should pay attention to the critical weak links in the innovation and development of strategic emerging industries and prioritise the development of a modern service industry which can achieve dynamic matching. Only in this way can the strategic emerging industries give full play to their competitive advantages under limited resources.

Acknowledgments

Conflict of Interest

The authors declare no conflict of interest.

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Supplementary Matrerial

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