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RESEARCH ON THE INNOVATION RESOURCE ALLOCATION STRATEGY OF CHINA'S REGIONAL HIGH-TECH MANUFACTURING INDUSTRY BASED ON INDIVIDUAL ADVANTAGE CHARACTERISTICS

The development of the high-tech manufacturing industry is closely related to the deep implementation of the innovation-driven development strategy in China. This research constructs an evaluation index system for innovation input and output in China's regional high-tech manufacturing industry. Based on the jingyou theory framework, an individual advantage characteristics identification model is developed. The individual advantage characteristics of innovation input and output in various regions of China in 2021 are identified from the perspective of input-output. Subsequently, cluster analysis is applied to categorize the individual advantage characteristics of each region. The study finds that the innovation resource allocation strategies in China's regional high-tech manufacturing industry can be summarized into three modes: (1) Technology-driven innovation resource allocation strategy. (2) Comprehensive balanced innovation resource allocation strategy. (3) Market-oriented innovation resource allocation strategy. This research provides valuable insights and references for the study of innovation resource allocation strategies in China's high-tech manufacturing industry .

Keywords: Jingyou;Individual Advantage Characteristics;Innovation Resource Allocation Strategy

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СТРАТЕГИЯ РАСПРЕДЕЛЕНИЯ ИННОВАЦИОННЫХ РЕСУРСОВ РЕГИОНАЛЬНОГО ВЫСОКОТЕХНОЛОГИЧНОГО ПРОМЫШЛЕННОГО ПРОИЗВОДСТВА КИТАЯ НА ОСНОВЕ ИНДИВИДУАЛЬНЫХ ПРЕИМУЩЕСТВ

Развитие высокотехнологичного промышленного производства тесно связано с реализацией китайской стратегии развития, основанной на инновациях. В статье представлена система индексов оценки для инновационного ввода и вывода в региональном высокотехнологичном промышленном производстве. На основе теории Цзинъю разрабатывается модель идентификации индивидуальных преимуществ, которые определялись в различных регионах Китая в 2021 году с точки зрения ввода-вывода, и применяется кластерный анализ для классификации индивидуальных преимуществ характеристик каждого региона. Эта стратегия делится на три режима: 1) Стратегия распределения инновационных ресурсов, основанная на технологиях; 2) Комплексная сбалансированная стратегия распределения инновационных ресурсов; 3) Стратегия распределения инновационных ресурсов, ориентированная на рынок. Данное исследование дает ценную информацию и ссылки для изучения стратегий распределения инновационных ресурсов в высокотехнологичном промышленном производстве Китая.

Ключевые слова: Цзинъю; индивидуальные преимущества; стратегия распределения инновационных ресурсов.

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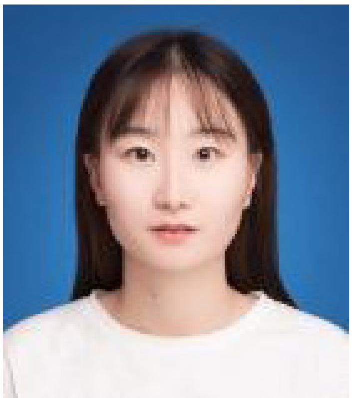

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1. Introduction

The development of the high-tech manufacturing industry is closely related to the deep implementation of the innovation-driven development strategy in China. Innovation has increasingly become a key driving force for sustainable and healthy economic development, particularly in the economic development sector. The high-tech sector is the core engine of innovation for Chinese enterprises, playing a crucial role in China's process of building a modern technological powerhouse. Meanwhile, innovation in the high-tech manufacturing industry exhibits distinct individual characteristics in different regions. Due to differences in the innovation resource endowments across regions, each region shows unique innovation resource allocation strategies. However, in practice, there is often an excessive emphasis on uniform evaluation standards, neglecting the individual elements in innovation exploration, resulting in the failure to highlight the individual achievements of high-tech manufacturing. Therefore, it is imperative to delve into the individual characteristics of innovation resource allocation in the high-tech manufacturing industry in different regions, fully highlight their individual advantages, and explore the commonalities in innovation resource allocation across regions to guide the allocation of innovation resources in China's regional high-tech manufacturing industry. This study aims to explore the individual characteristics of innovation resource allocation in the high-tech manufacturing industry, revealing the individual characteristics of the high-tech manufacturing industry in each province. By summarizing the innovation resource allocation strategies of different provinces, this research provides useful references for future regional high-tech manufacturing innovation resource allocation strategies to promote continuous innovation and development in the industry.

In the relevant research on jingyou theory, Zhao et al. (2019) used the main melody analysis method to study strategic groups, demonstrating how to combine jingyou theory with modern strategic management practices to optimize the structure and function of strategic groups. This study provides new perspectives and methods for understanding how companies maintain their advantages in a highly competitive market [1]. Additionally, Xin et al. (2020) applied the jingyou evaluation method to analyze the performance of companies in the Chinese steel industry. This method not only revealed the competitive structure within the industry but also assessed the jingyous of each company in the market, significantly influencing strategy formulation and resource allocation within the industry [2]. Huang et al. (2017) explored how to design a new type of university research team structure based on jingyou theory. This study highlighted the importance of optimizing individual advantages to enhance overall team performance [3]. In the field of enterprise growth, Enfu and Xinan (2012) proposed an enterprise growth evaluation method based on jingyou thinking, emphasizing the role of advantageous resources in driving continuous enterprise growth [4]. In research on individual advantage characteristics, Liu and Xinan (2018) explored how to identify and evaluate individual advantages in a mixed information environment. They proposed a new evaluation method that not only enhanced the accuracy of identifying individual advantages but also contributed to more effective human resource allocation and development within organizations [5]. Another study by Shi-tong et al. (2021) combined the particle swarm optimization algorithm with jingyou theory to develop a new decision model for evaluating and guiding the application of the TOPSIS model. This model significantly improved decision efficiency and effectiveness, especially in complex and dynamic decision-making environments [6]. In optimizing governance structures, Kai et al. (2022) proposed a multi-advantage evaluation method for independent director governance based on hierarchical structure, using jingyou theory to analyze and evaluate the effectiveness of independent director governance, thereby enhancing the effectiveness of corporate governance structures [7].

Existing literature provides extensive research on innovation resources. Some scholars define innovation resources from the perspective of innovation. Meadows et al. (1972) noted that with the development of human society and the depletion of Earth's resources, new resources will always be found to sustain societal development, providing the earliest explanation of innovation resources [8]. Samuelson (1983) from the perspective of "environmental economics" and "resource economics," proposed that innovation resources are new resources that can replace "natural resources" [9]. Bessarabov (2012) argued that innovation resources refer to all resources involved in innovation activities and are the foundation of innovation activities [10]. Some scholars have explained innovation resources from the perspective of classification. Hall and Walsh (2014) pointed out that innovation capital, human capital, innovation policies, and innovation infrastructure together constitute innovation resources, which are important drivers of regional innovation [11]. Some scholars have researched the role of innovation-driven development. Vares and Parvandi (2011) used global competitiveness index evaluations to study the intrinsic connection between efficiency-driven and innovation-driven factors and proposed that their intrinsic connection positively affects economic transformation [12]. In terms of human and knowledge resources for innovation, many scholars have shown that human and knowledge resources have positive effects on regional development. Ale et al. (2009) indicated that the key to regional innovation success is actively acquiring knowledge and information resources [13]. Blažek et al. (2012) showed that the differences in regional innovation capabilities mainly depend on regional knowledge creativity, human capital, and regional policies [14]. Youtie and Shapira (2008) revealed that universities have become places where human and knowledge resources are concentrated and centers of regional innovation, playing a positive role in regional innovation [15]. Faggian and McCann (2009) established a performance evaluation system for regional innovation systems, demonstrating that the performance evaluation of regional innovation systems is influenced by the number of university graduates in the region [16]. Casper (2013) pointed out that the network connections between universities and research institutions and industries make universities more commercialized. The knowledge spillover from universities positively impacts regional industrial development, and university research outcomes can enhance regional innovation capabilities [17]. Benneworth et al. (2009) noted that institutions like universities play a positive role in regional innovation systems through mutual learning among organizations [18]. In terms of financial and material resources for innovation, scholars have focused on R&D investment size and efficiency in regional innovation research. For example, Cooke (2003) analyzed the innovation strategy and performance of Northern Ireland and found a positive correlation between increased R&D investment and innovation performance [19]. Fritsch (2002) compared the innovation performance of 11 regions in Europe using R&D expenditure as an indicator of innovation input and knowledge production function analysis [20]. Tavassoli and Carbonara (2014) indicated that improving regional innovation performance and development levels requires enhancing R&D expenditure efficiency [21]. Gracia and Voigt (2005) used R&D expenditure, personnel, and patent applications as indicators to evaluate regional innovation performance [22]. Fromhold-Eisebith (2004) explored the different characteristics of the innovation environment and social capital in the Aachen region of Germany, finding a close relationship between the innovation environment and social capital [23]. Furman and Hayes (2004) highlighted that economic development plays an important role in promoting innovation, and this relationship is reflected in the input of human and capital resources and the continuous improvement of innovation infrastructure, significantly promoting innovation-driven development [24]. Research on the relationship between innovation resource allocation efficiency and regional innovation-driven development is mainly reflected in two aspects. First, from the perspective of innovation-driven theory, Gebreeyesus and Mohnen (2013) emphasized that innovation-driven development is a complex system with repeated and long-term interactions among various innovation resources, forming the driving force of innovation-driven development [25]. Sleuwaegen and Boiardi (2014) found that for long-term regional development, relying solely on concentrated innovation resources is far from sufficient, and differences in regional innovation performance and economic development levels cannot be attributed simply to differences in innovation resource stock. The capability and efficiency of innovation resource allocation significantly influence and even determine regional innovation performance [26]. Klingebiel and Rammer (2014) also pointed out that innovation resource allocation strategies affect regional innovation performance, thus influencing regional innovation-driven development [27]. Nilsson and Moodysson (2014) revealed that common problems in regional innovation-driven development include a shortage of innovation human resources, a lack of innovation financial resources, and severe separation between innovation entities and innovation activities in many industries [28]. Second, from the perspective of innovation-driven development evaluation, scholars have constructed evaluation index systems from an input-output perspective to study innovation-driven development. Broekel et al. (2010) conducted regression analysis on factors influencing regional innovation in 97 regions in Germany, identifying 12 main factors, including the number of corporate R&D personnel, universities and technical colleges, public research institutions, potential human capital, quality of human capital, degree of urbanization, economic structure, and financial status [29]. In addition, the substitution elasticity between the innovation efficiency of the enterprise itself and various R&D investment resources can lead to the mismatch of innovation resources [30].

Through combing the existing literature, it is found that there are a lot of research results on individual advantage characteristics, innovation resources and their allocation. In general, scholars lack research on the resource allocation of innovation, and there is little research on applying the relevant content of jingyou theory to the innovative resource allocation strategy of high-tech manufacturing industry. They lack innovation in the methods of studying the innovative resource allocation strategy, and there are disadvantages such as subjective research results. Therefore, this study adopts the jingyou evaluation method to analyze the innovation resource allocation of regional high-tech manufacturing industry in China from the perspective of best reflecting the advantages of high-tech manufacturing industry, aiming to improve the objectivity and recognition of the evaluation results. At the same time, several mainstream innovative resource allocation strategies are summarized by means of cluster analysis, pointing out the direction for promoting regional innovation development.

On the basis of exploring the individual advantage characteristics of innovative resource allocation, this study further explores the main innovative resource allocation strategies. In terms of exploring individual advantages, the jingyou theory and its evaluation framework have unique advantages. Based on the jingyou analysis framework, this research constructs the identification model of innovative resource allocation of high-tech manufacturing industry, and thus obtains the individual advantages of innovative resource allocation of high-tech manufacturing industry. Then, through the cluster analysis of individual advantage characteristics, the subject classification of the current innovation resource allocation strategy of high-tech manufacturing industry is obtained, and the strategy selection is provided for the subsequent innovation resource allocation of each individual. This research will integrate the basic framework of jingyou analysis and cluster analysis according to the idea of the following figure

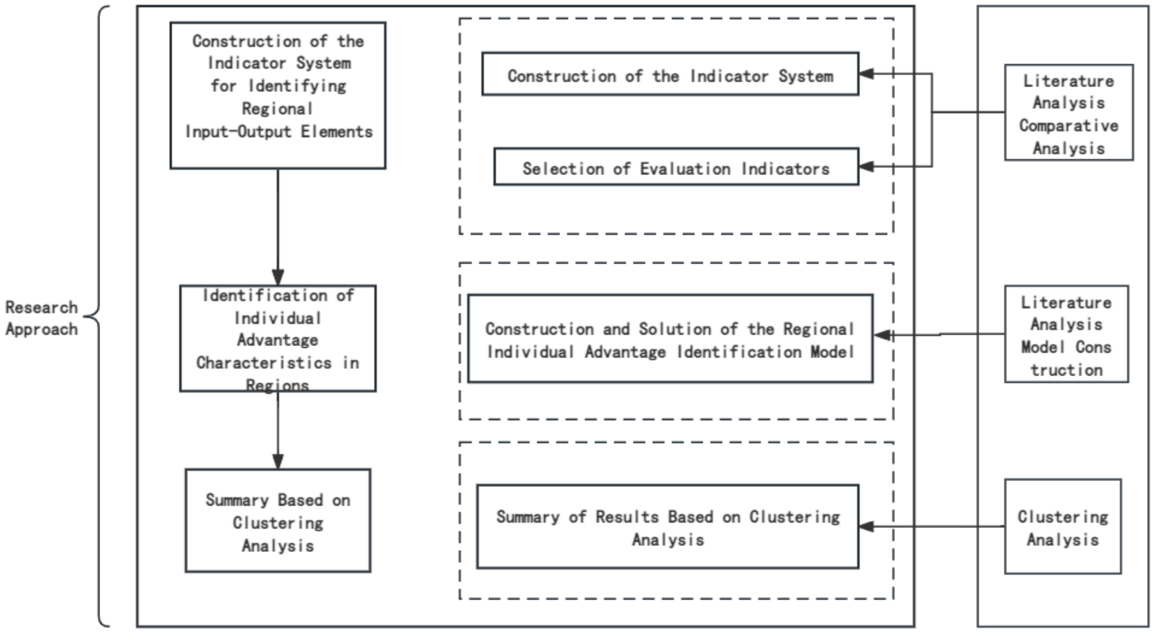

Fig. The research approach of this article.

2. Methods and Data

2.1. Constructing the Identification equation for Individual Advantage Characteristics of High-Tech Manufacturing Innovation Resource Allocation

For the first time, Zhao Xinan's team put forward the jingyou theory and its corresponding theoretical framework from the perspective of promoting individual advantages. On the basis of theoretical research, Professor Zhao Xinan's team has developed the method of individual advantage feature identification, which has been applied in some fields. At present, these methods have been widely used in human resource management, enterprise strategy adjustment, the performance evaluation of R&D personnel and other employees, as well as the competence evaluation of senior management personnel and other aspects.

Compared with other evaluation methods, the jingyou evaluation method based on the idea of jingyou focuses more on the individual analysis of the evaluation objects on the premise of ensuring the objectivity, and has more advantages in exploring the individual advantages of individuals. In order to improve the efficiency of innovation resource allocation in high-tech manufacturing industry and summarize the innovation resource allocation strategy, it should first base on the innovation input resources and innovation output resources, construct the algorithm model of individual advantage identification, and realize the identification of individual advantage characteristics under the guidance of the jingyou theory.

Assume there are n regions, denoted as $D = \{(x_1, y_1), (x_2, y_2), ..., (x_n, y_n)\}$, which is the set of all regions. Each region has m types of inputs and s types of outputs. Let $x_j = (x_{ij}, x_{2j}, ..., xmj)^\tau$, $j = 1, 2, ..., n.$ represent the input variables of region j, where $x_{ij}(x_{ij} \geq 0)$ is the i th input quantity of region j $(1 \leq i \leq m)$; $y_j = (y_{1j}, y_{2j}, ..., y_{sj})^\tau$, $j = 1, 2,..., n.$ represents the output variables of region j. Where y_η $(y_{ij} \geq 0)$ is the rth output quantity of region j $(1 \leq r \leq s)$; $v = v_1, v_2, ..., v_s)^\tau$ is the weight vector for the m types of inputs, and $u = (u_1, u_2, ..., u_r)^t$ is the weight vector for the s types of outputs. Under the input-output criteria, the formula for identifying individual advantage characteristics is as follows:

$$z(k) = \max\{\frac{u^\tau y_k}{v^\tau x_k}\}$$

$$sub.to: \quad \frac{u^\tau y_j}{v^\tau x_j} \leq c_j, \quad j = 1, 2, \cdots, n.$$

$$\sum_{r=1}^{s} \mathsf{U}_r = 1$$

$$\sum_{i=1}^{m} v_i = 1$$

$$u \geq 0, v \geq 0 \qquad (1)$$

Where c_j is a specific constant determined by equation 2. It serves as a bounded constraint on the output-to-input ratio of the group, demonstrating the characteristics of data envelopment; it also defines the maximum relative efficiency level of region j.

$$c_j = \frac{\max_r\{y_{rj}\}}{\min\{x_{ij}\}}, x_{ij} > 0.l \leq r \leq s.l \leq i \leq m.l \leq j \leq n \qquad (2)$$

The optimal solution of equation 1 can also be interpreted as how an individual within a group determines the best value matching standards for their input-output resources under a given input-output index system to maximize their output-to-input ratio, thereby highlighting their achievements.

Based on the data standardization method, assume that x_j, y_j, $j = 1, 2, ..., n$ are all non-negative vectors; according to the "rational man" behavioral assumption in organizational behavior, each real individual acknowledges that "output is indeed based on input", i. e., where the input is greater than 0, it ensures that $v^\tau x_j \geq \varepsilon$, $j = 1, 2, ..., n$.

Perform the variable substitution:

Let

$$v^\tau x_k = t^{-1}, tu = w, tv = \lambda \qquad (3)$$

The equation transforms into

$$\max\{w^\tau y_k\}$$

$$\text{sub.to:}$$

$$w^\tau y_j - \lambda^\tau x_j \leq c_j j = 1, 2, ..., n.$$

$$\lambda^\tau x_k = 1$$

$$\sum_{r=1}^{s} w_{rj} = \sum_{i=1}^{m} \lambda_{ij}$$

$$w \geq 0, \lambda \geq 0 \qquad (4)$$

By performing the inverse transformation of equation 3, we obtain $t=\sum_{r=l}^{s} w_r=\sum_{i=l}^{m} \lambda_i$. Therefore, we derive the value structure that is most favorable for the output and input of each region, which constitutes the individual advantage characteristics.

$$u_{rk}^{*}=\frac{w_{rk}^{*}}{\sum_{r=l}^{s} w_{rk}^{*}} \quad v_{ik}^{*}=\frac{\lambda_{ik}^{*}}{\sum_{i=l}^{m} \lambda_{ik}^{*}} \quad (5)$$

2.2. Constructing the Index System

On the basis of constructing the model, the individual advantage features can be identified, but it also needs the support of specific innovation input and innovation output indicators. As scholars have different research perspectives on innovation resources, the specific indicators selected are also different, which can be roughly divided into macro and micro levels. At the macro level, the national, provincial and regional governments are selected to build the evaluation index system for innovation-driven development; at the micro level, more research are from the industry or enterprise level.

2.2.1. Output Indicators

Existing research usually evaluates the output of technological innovation through two dimensions of scientific and technological achievements and economic benefits. Scientific and technological achievements directly reflect the effectiveness of technological innovation, which is usually measured by the number of patents. This research uses the number of patent applications as the measurement index, which can more directly reflect the immediate effect of innovation activities and resource investment during the period, and ensure higher accuracy. In addition, the output of high-tech manufacturing industry should be measured by economic benefits in the final analysis. In this study, the three indicators of total profit, new product sales revenue and export revenue of new product sales revenue are used to reflect the economic benefits of high-tech manufacturing industry. In this research, the profit amount is used to reflect the overall economic benefit of high-tech manufacturing industry, and the sales revenue of new products is used to measure the market acceptance of new products, directly showing the commercial value of technological innovation results. These two indicators together describe the actual impact of technological innovation in the economic and market level; export revenue in new product sales revenue reflects the overseas market response of high-tech manufacturing innovation output and reflects the international competitiveness of China's high-tech manufacturing products.

2.2.2. Input Indicators

Many scholars choose the relevant investment of research and experimental development (R&D) as the basis to measure the innovation efficiency, so as to build the evaluation index of the innovation efficiency. The investment indicators of this research cover the following aspects: the number of enterprises participating in R&D activities, the full-time equivalent of R&D personnel, the internal expenditure of R&D funds, the expenditure of technical transformation, and the expenditure of new product development. These indicators comprehensively consider the degree and scope of enterprise resource investment in R&D activities, and provide comprehensive data support for the evaluation of innovation efficiency. The number of enterprises with R&D activities reflects the investment of scientific research land, so this research regards the number of enterprises with R&D activities as land input. In the R&D project research of the high-tech manufacturing industry, the participants reflect the scale of the labor force invested in the innovation activity, and it is an important labor input index of the technological innovation. In addition, high R&D spending often means that companies pay more attention to technology research and development and are willing to invest more resources in innovation. Technological transformation usually involves the introduction of new technologies, updating machinery and equipment or improving the production process. The expenditure of technological transformation reflects the investment of enterprises in maintaining and enhancing the competitiveness of existing technologies. New product development covers multiple stages from market research to product design, prototype manufacturing, testing and verification, product improvement and ultimately marketing. New product development can enhance market competitiveness and sustainable development ability. Therefore, this research regards the internal expenditure of R&D funds, technical transformation expenditure and new product development expenditure as capital investment, technology optimization and upgrading, research and development and marketization of new products.

Table 1

Evaluation Index System for Innovation Input and Innovation Output in High tech Manufacturing Industry

First-level Indicators	*Second-level Indicators*	*Third-level Indicators*	*Data Sources*
Innovation Input	Land	Number of enterprises engaged in R&D activities	China Science and Technology Statistics Yearbook
	Labor	Full-time equivalent of R&D personnel (person-years)	China Science and Technology Statistics Yearbook
	Capital	Internal expenditure of R&D funds (ten thousand yuan)	China Science and Technology Statistics Yearbook
	Technological Optimization and Upgrading	Expenditure on technological transformation (ten thousand yuan)	China Science and Technology Statistics Yearbook
	New Product R&D and Commercialization	Expenditure on new product development (ten thousand yuan)	China Science and Technology Statistics Yearbook
Innovation Output	Technological Research and Development Achievements	Number of patent applications (number)	High-tech Industry Statistics Yearbook
	Corporate Economic Benefits	Total profit (billion yuan)	High-tech Industry Statistics Yearbook
	Market Response Speed of New Products	New product sales revenue (ten thousand yuan)	High-tech Industry Statistics Yearbook
	International Market Response Speed	New product export sales revenue (ten thousand yuan)	High-tech Industry Statistics Yearbook

2.2.3. Data Sources

This research analyzes the data from 29 provinces and municipalities in China. According to the data limitation, Xinjiang Uyghur Autonomous Region, Tibet Autonomous Region, Taiwan Province, Hong Kong Special Administrative Region, and Macau Special Administrative Region are not considered. The data involved in the study are taken from the China Statistical Yearbook and China Science and Technology Statistics Yearbook for 2021. To enhance data comparability, the standardized innovation input and output conditions of these 29 provinces are provided in the table. The standardization method for a particular indicator is to take the best value among the sample provinces as the benchmark, i.e., for indicators where larger values are better, use the best value as the denominator and divide the value of each province by it; for indicators where smaller values are better, use the best value as the numerator and divide it by the value of each province.

3. Results

3.1. Identifying Individual Advantage Characteristics

In the analysis and evaluation of individual things, we can stand in the perspective of individuals, as far as possible to highlight individual achievements. The larger the output-input ratio, the better. The output and input indicators are multi-dimensional, thus combining the output and input respectively. As different regions live in different environments, they have different input resources and focused outputs. Usually, regions pay more attention to less accessible resources and despise easily accessible resources. Pay attention to the output with large market demand, despise the output with small market demand. This is the priority setting of resource allocation, which emphasizes the importance of efficiency and market orientation in resource allocation. Therefore, the comprehensive way of input-output problems can be conducted from the perspective of highlighting individual achievements as much as possible.

The optimal solutions $u_k^* = (u_{1k}, u_{2k}, ..., u_{sk})$ and $v_k^* = (v_{1k}, v_{2k}, ..., v_{mk})$ $k = 1, 2, ..., n$ of equation 1 represent the individual advantage characteristics of region k under the input-output criteria.

Substitute the data from Table 2 into equation 1 for solving, and obtain Table 3.

3.2. Extracting Patterns

According to the results of the feature identification of individual advantages, it can be seen that each region has its own advantages. In order to explore the individual advantages, the cluster analysis is done based on whether the consistency of the resource allocation strategy is achieved, and the provinces with the same characteristics are summarized into a category.

From Table 4, it can be seen that the actual development patterns of the 29 provinces are divided into three major categories. Analyzing the characteristics of the three typical patterns, it is not difficult to find: Pattern I characteristics: Technology-driven innovation resource allocation strategy. This pattern mainly focuses on the optimization and upgrading of technology. In terms of input, significantly increasing expenditure on technological transformation to improve existing technology, processes, or equipment to enhance production efficiency, reduce production costs, or improve product quality. Expenditure on technological transformation reflects the investment of enterprises in maintaining and enhancing the competitiveness of existing technologies. These provinces' high-tech manufacturing enterprises support in-depth development of basic and applied research, thereby improving economic

Table 2

Standardization of Innovation Input and Output in 29 Provinces

Province	Innovation Input					Innovation Output			
	Number of enterprises engaged in R&D activities	Full-time equivalent of R&D personnel	Internal expenditure on R&D funds	Expenditure on technological transformation	Expenditure on new product development	Number of patent applications	Total profit	New product sales revenue	New product export sales revenue
Shanghai	0.9033	0.9162	0.8302	0.9767	0.8591	0.0760	0.1276	0.0724	0.0781
Yunnan	0.9573	0.9878	0.9829	0.9838	0.9922	0.0047	0.0502	0.0052	0.0005
Inner Mongolia	0.9857	0.9976	0.9942	0.9990	0.9954	0.0022	0.0060	0.0025	0.0013
Beijing	0.9577	0.9323	0.8723	0.9982	0.8473	0.0972	0.6263	0.2181	0.2095
Jilin	0.9876	0.9879	0.9910	0.9977	0.9901	0.0053	0.0432	0.0053	0.0036
Sichuan	0.8271	0.8983	0.8783	0.8488	0.9080	0.0970	0.1462	0.0972	0.0428
Tianjin	0.9428	0.9546	0.9519	0.9907	0.9683	0.0309	0.0588	0.0515	0.0581
Ningxia	0.9829	0.9963	0.9922	0.9920	0.9967	0.0014	0.0085	0.0057	0.0011
Anhui	0.7100	0.8773	0.8829	0.8357	0.9104	0.1204	0.0991	0.1282	0.1143
Shandong	0.4284	0.8163	0.8356	0.8440	0.8854	0.1157	0.1761	0.1529	0.1158
Shanxi	0.9675	0.9803	0.9929	0.9983	0.9913	0.0053	0.0206	0.0134	0.0098
Guangdong	0.0226	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000
Guangxi	0.9524	0.9895	0.9940	0.9857	0.9936	0.0094	0.0211	0.0084	0.0125
Jiangsu	0.0000	0.4667	0.4485	0.6170	0.6012	0.3728	0.5538	0.5065	0.5890
Jiangxi	0.7834	0.9080	0.9199	0.9124	0.9338	0.0608	0.1340	0.1139	0.0576
Hebei	0.8598	0.9703	0.9729	0.9898	0.9753	0.0225	0.0598	0.0346	0.0173
Henan	0.7795	0.8884	0.9208	0.9771	0.9580	0.0503	0.0924	0.1236	0.2423

Zhejiang	0.0409	0.7053	0.7470	0.8067	0.7707	0.2324	0.3333	0.2931	0.2019
Hainan	0.9984	0.9982	0.9979	0.9990	0.9976	0.0008	0.0053	0.0000	0.0001
Hubei	0.7559	0.8847	0.8573	0.9549	0.8918	0.1051	0.1104	0.0877	0.0380
Hunan	0.6359	0.9087	0.9028	0.8966	0.9275	0.0515	0.0932	0.0820	0.0440
Gansu	0.9861	0.9939	0.9931	1.0000	0.9959	0.0021	0.0166	0.0038	0.0029
Fujian	0.7495	0.8524	0.8435	0.8414	0.8937	0.1010	0.2206	0.1267	0.1233
Guizhou	0.9449	0.9794	0.9797	0.9678	0.9869	0.0132	0.0131	0.0089	0.0006
Liaoning	0.9254	0.9543	0.9569	0.9355	0.9708	0.0240	0.0878	0.0218	0.0047
Chongqing	0.8799	0.9363	0.9373	0.9769	0.9557	0.0295	0.1177	0.0770	0.1212
Shaanxi	0.9462	0.9331	0.9128	0.9513	0.9337	0.0343	0.0960	0.0397	0.0058
Qinghai	1.0000	1.0000	1.0000	0.9986	1.0000	0.0000	0.0000	0.0006	0.0000
Heilongjiang	0.9797	0.9898	0.9905	0.9751	0.9915	0.0056	0.0060	0.0094	0.0006

Table 3

Personality Advantage Characteristics of Input and Output in 29 Provinces

Province	***Innovation Input***					***Innovation Output***			
	Number of enterprises engaged in R&D activities	***Full-time equivalent of R&D personnel***	***Internal expenditure on R&D funds***	***Expenditure on technological transformation***	***Expenditure on new product development***	***Number of patent applications***	***Total profit***	***New product sales revenue***	***New product export sales revenue***
Shanghai	0.0490	0.0652	0.0159	0.8468	0.0231	0.2428	0.2724	0.2409	0.2439
Yunnan	0.0177	0.2162	0.1100	0.1236	0.5326	0.2444	0.2684	0.2447	0.2424
Inner Mongolia	0.0038	0.1333	0.0234	0.8024	0.0371	0.2496	0.2515	0.2498	0.2492
Beijing	0.0019	0.0007	0.0002	0.9971	0.0001	0.1056	0.6161	0.1407	0.1377

Jilin	0.0291	0.0307	0.0550	0.8394	0.0459	0.2453	0.2650	0.2453	0.2444
Sichuan	0.0930	0.2688	0.1878	0.1218	0.3286	0.2494	0.2790	0.2495	0.2220
Tianjin	0.0220	0.0350	0.0312	0.8402	0.0717	0.2402	0.2547	0.2508	0.2543
Ningxia	0.0173	0.3614	0.0829	0.0784	0.4601	0.2486	0.2522	0.2507	0.2485
Anhui	0.0380	0.2123	0.2330	0.1184	0.3983	0.2527	0.2409	0.2572	0.2492
Shandong	0.0164	0.1585	0.1979	0.2198	0.4075	0.2357	0.2716	0.2569	0.2358
Shanxi	0.0025	0.0068	0.0521	0.9040	0.0347	0.2465	0.2542	0.2506	0.2487
Guangdong	0.2074	0.1981	0.1981	0.1981	0.1981	0.2500	0.2500	0.2500	0.2500
Guangxi	0.0067	0.1362	0.4209	0.0732	0.3630	0.2483	0.2542	0.2478	0.2498
Jiangsu	0.0478	0.1682	0.1573	0.3260	0.3007	0.1445	0.2855	0.2334	0.3365
Jiangxi	0.0326	0.1807	0.2382	0.1994	0.3491	0.2329	0.2740	0.2617	0.2314
Hebei	0.0037	0.0822	0.0987	0.6965	0.1189	0.2442	0.2639	0.2503	0.2416
Henan	0.0075	0.0294	0.0583	0.6976	0.2072	0.2066	0.2262	0.2426	0.3246
Zhejiang	0.0147	0.1555	0.2111	0.3617	0.2570	0.2258	0.2992	0.2662	0.2088
Hainan	0.1823	0.1362	0.1042	0.5001	0.0772	0.2496	0.2519	0.2492	0.2493
Hubei	0.0234	0.1048	0.0684	0.6845	0.1189	0.2604	0.2635	0.2506	0.2254
Hunan	0.0146	0.2321	0.2048	0.1810	0.3675	0.2412	0.2639	0.2575	0.2374
Gansu	0.0000	0.0000	0.0000	1.0000	0.0000	0.2479	0.2552	0.2487	0.2482
Fujian	0.0690	0.1988	0.1768	0.1722	0.3831	0.2251	0.2995	0.2386	0.2367
Guizhou	0.0276	0.1970	0.2028	0.0810	0.4916	0.2521	0.2521	0.2499	0.2458
Liaoning	0.0688	0.1839	0.2060	0.0921	0.4493	0.2438	0.2791	0.2427	0.2344
Chongqing	0.0234	0.0832	0.0860	0.6354	0.1720	0.2205	0.2668	0.2438	0.2689
Shaanxi	0.2556	0.1655	0.0975	0.3126	0.1687	0.2441	0.2786	0.2469	0.2303
Qinghai	0.2500	0.2500	0.2500	0.0000	0.2500	0.2499	0.2499	0.2502	0.2499
Heilongjiang	0.0628	0.2516	0.2878	0.0418	0.3560	0.2501	0.2503	0.2520	0.2476

Table 4

Pattern inference results

Pattern	***Pattern Characteristics***									***Affiliated Provinces***
	Land	***Labor***	***Capital***	***Technological Optimization and Upgrading***	***New Product R&D and Commercia-lization***	***Technological Research and Development Achieve-ments***	***Corporate Economic Benefits***	***Market Response Speed of New Products***	***International Market Response Speed***	
I	0.0155	0.0388	0.0254	0.8900	0.0304	0.2254	0.3099	0.2324	0.2324	Shanghai, Inner Mongolia, Beijing, Jilin, Tianjin, Shanxi, Gansu
II	0.0729	0.2079	0.2037	0.1589	0.3565	0.2376	0.2676	0.2504	0.2445	Yunnan, Sichuan, Ningxia, Anhui, Shandong, Guangdong, Guangxi, Jiangsu, Jiangxi, Zhejiang, Hunan, Fujian, Guizhou, Liaoning, Shaanxi, Qinghai, Heilongjiang
III	0.0481	0.0872	0.0831	0.6428	0.1388	0.2363	0.2545	0.2473	0.2619	Hebei, Henan, Hainan, Hubei, Chongqing

benefits. Pattern II characteristics: Comprehensive balanced innovation resource allocation strategy. This pattern emphasizes balanced distribution in innovation input indicators, focusing on increasing internal R&D expenditure, technological transformation expenditure, and new product development expenditure. At the same time, in terms of human resources, it expands the number of enterprises engaged in R&D activities, building a moderately scaled and reasonably structured R&D team. In terms of innovation output, this strategy pursues comprehensive improvements in patent applications, total profit, new product sales revenue, and new product export sales revenue, achieving multidimensional conversion of innovation outcomes. Pattern III characteristics: Market-oriented innovation resource allocation strategy. This pattern emphasizes that innovation resource allocation should be closely aligned with market demand. In terms of input, besides the necessary R&D expenditure and personnel input, more attention is paid to technological transformation and new product development expenditure to meet the demand for new products and technologies in the market. In terms of output, it focuses on corporate economic benefits, paying more attention to the international market response speed compared to the previous two patterns. Through optimizing innovation resource allocation, it enhances the market competitiveness of products, achieving commercialization and internationalization of innovation outcomes.

4. Conclusion and Discussion

4.1. Research Conclusions

By constructing the evaluation index system of innovation input and innovation output of high-tech manufacturing industry in China, this research uses the individual advantage feature identification model to identify the innovation input and innovation output of high-tech manufacturing industry in China in 2021, and then applies the cluster analysis method to classify the identified individual weights. It is found that the innovation resource allocation strategy of China's regional high-tech manufacturing industry can be summarized into three modes: (1) technology-driven innovation resource allocation strategy. It mainly focuses on the optimization and upgrading of technology. By significantly increasing the funds for technical transformation, improving and upgrading the existing technology, technology or equipment, so as to improve the production efficiency. This strategy can not only help to improve the product quality and the efficiency of production processes, but also can enhance the competitiveness of enterprises in the market, responding to the rapidly changing market demand and technology development trends. (2) Comprehensive and balanced innovative resource allocation strategy. Emphasis on maintaining a balanced allocation of innovation investment indicators. (3) Market-oriented innovative resource allocation strategy. It is emphasized that the allocation of innovation resources should be closely focused on the market demand, and more attention should be paid to the investment of new product development funds, so as to meet the market demand for new products and new technologies.

Based on different model division, this research gives some policy suggestions for the factor endowments of different regions to help regions choose suitable innovative resource allocation strategies: (1) The technology-driven innovation resource allocation strategy is applicable to those regions with strong advantages in the technical foundation and talent reserve. These regions may have accumulated certain scientific research institutions and universities, with a strong ability of scientific and technological innovation. The government can increase funding support for technical transformation in these areas, and encourage enterprises to upgrade their technology and equipment, so as to improve production efficiency and product quality. At the same time, enterprises should be encouraged to strengthen cooperation with universities and research institutes, strengthen in-depth cooperation in basic research and applied research, promote the transformation of scientific and technological achievements, and improve economic benefits. (2) The comprehensive and balanced innovation resource allocation strategy is applicable to those regions with balanced development in science and technology, talent, market and other aspects. These regions have a relatively complete industrial chain and market system, which can better support various innovation activities. The government can promote scientific and technological innovation and market-oriented product research and development through comprehensive investment, including the balanced allocation of R&D funds, technological transformation funds and new product development funds. At the same time, enterprises should be encouraged to strengthen cooperation with research institutions and markets, increase support for cross-border integration innovation and market-orientation, and improve the competitiveness and market share of enterprises. (3) The market-oriented innovative resource allocation strategy is applicable to those regions with relatively concentrated market demand and high demand for new products and new technologies. These areas may have more mature markets, and have a certain consumption base and a market network. The government can increase its support for market-oriented innovation activities, encourage enterprises to increase their investment in new product development and technological transformation, meet the market demand, and improve their product competitiveness. At the same time, enterprises should be encouraged to strengthen international cooperation, expand the international market, increase the proportion of products in exports, and enhance their international competitiveness and influence.

4.2. Theoretical Contributions

This study on the basis of fully understand the jingyou theory and the jingyou evaluation method, based on jingyou theory, build high technology manufacturing individual advantage characteristic identification method, the method is characterized by strong objectivity, minimize the subjective interference, and the method can be from the most beneficial to the individual itself, objective excavation individual potential individual advantage. This method helps the high-tech manufacturing industry to identify its own individual advantages, and has great theoretical significance for the implementation of high-quality development of high-tech manufacturing industry and high-quality economic development.

According to the limited availability of data, it is still difficult to use the indicator system presented in this study to comprehensively portray all the implications of the innovative resource allocation in high-tech manufacturing industry, so the construction of a more comprehensive and reasonable indicator system deserves further exploration.In addition, this study selects high-tech manufacturing as a representative, and in the future, the research scope can be expanded or other types of enterprises can be selected for research.

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