The Influence of Internal and External Support on Innovation Ability of Medical Device Enterprises: Based on a Study of Listed Medical Device Companies

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Abstract: As a high-tech industry, improving innovation capabilities in the medical device industry is an important manifestation of responding to the call of the country to build a world science and technology powerhouse. This study takes 43 listed medical device enterprises in China from 2018 to 2022 as samples to explore the impact of internal human, material and financial resources as well as external government R&D funding support on innovation ability. After reviewing the literature and considering the availability of data, the index system was established and the empirical research was carried out by stepwise regression. The results showed that the internal input of human resources and capital of medical device enterprises had a positive promoting effect on the innovation ability of enterprises. The equipment invested in R&D has a significant negative impact on the innovation ability of enterprises. The government investment outside the medical device enterprise has a negative impact on the innovation ability of the enterprise, but it is not obvious. After regression analysis, multicollinearity test was carried out to verify the reliability of the regression results again. Therefore, the internal research and development investment of medical device enterprises should pursue the balance between marginal income and marginal cost, and the government should pay attention to the rationality and efficiency of providing research and development funding support.

Keywords: Medical Device Enterprise; Enterprise Innovation Input; Innovation Ability

1. Introduction

1.1 Research Background and Significance

1.1.1 Research Background

With the improvement of people's attention to health and the promotion of domestic substitution by policies to become the mainstream trend, China's medical device industry has made great progress. The report to the 20th National Congress of the Communist Party of China pointed out that we must insist that "Science and technology are the primary productive forces and innovation is the primary driving force" and "we must insist on the core position of innovation in China's overall modernization drive." The medical device industry is a knowledge and technology intensive industry, the innovation ability of medical device enterprises is an important reflection of the core competitiveness of enterprises, continue to improve the independent innovation ability of enterprises, in order to promote the high-quality development of China's medical device industry, for China to enter the forefront of innovative country, build a stronger power of science and technology.

1.1.2 Research Significance

Through empirical research on the factors affecting the innovation ability of listed medical device enterprises and their impact degree, from a theoretical point of view, it fills the gap in the research on the dynamic change of the innovation ability of medical device enterprises, provides a new angle and logical analysis method for the research on improving the innovation ability and level of medical device industry, and broadens the cause and ideas of medical device innovation research. From a practical point of view, objectively reflect the

status quo and problems of China's medical device enterprise innovation ability, but also for enterprises how to improve innovation ability to provide basis and suggestions, better promote the development of the medical device industry.

1.2 Methods and Structure

Scientific and technological innovation of medical devices is an important part of the national scientific and technological innovation system, and is also the core driving force and support for promoting the construction of healthy China. This paper reviews the existing research, summarizes the indicators used to evaluate the innovation ability of enterprises in previous literatures, selects or adds or subtraction index systems to evaluate the innovation level of Chinese medical device enterprises according to the research needs of this paper and considers the availability of data, and makes research hypotheses, and selects 43 listed enterprises in China's medical device industry. The company's annual report from 2018 to 2022 and local statistical data were extracted and sorted out to observe and describe the innovation situation of each company. Pearson correlation was used to analyze the correlation between variables, stepwise regression was used to conduct regression analysis and the regression results were discussed, and the influence degree and possible reasons for the results were analyzed. After regression, multicollinearity test was carried out to verify the accuracy and reliability of the regression results. Finally, according to the empirical results, this paper puts forward some suggestions to promote the innovation and development of medical device industry from the aspects of medical device enterprises, industry and government.

1.3 The Innovation of Research

In the selection of research data range, most of the research on innovation ability selects cross-sectional data, ignoring its possible dynamic changes. This paper extracts data from the annual reports of 43 medical device enterprises in China from 2018 to 2022, which can reflect the change trend of the innovation capability of medical device enterprises supported by internal and external support in time dimension. Compared with cross-sectional data, the data in this paper includes multiple time observations of the same individuals, providing more data points and effectively improving the accuracy of estimation.

2. Definition of Relevant Concepts

2.1 Definition of Innovation Ability of Medical Device Enterprises

In his Theory of Economic Development published in 1912, Austrian economist Joseph Schumpeter defined innovation as introducing an unprecedented "new combination" of production factors, including new products, new technologies, new markets, new sources of raw materials, and new organizations to realize enterprises into the production system [1]. Enterprise innovation ability is market-oriented, combined with the characteristics of the enterprise to integrate resources, through innovation activities to create new value for the enterprise, improve the overall competitiveness of the enterprise. The innovation ability of medical device enterprises discussed in this paper refers to the ability of medical device enterprises to systematically complete various activities related to innovation with the support of human, material and financial resources.

2.2 Definition of Medical Device Enterprise Internal Support

As the main body of innovation activities, enterprises are the main investors of innovation activities. Enterprises carry out innovation activities, R&D personnel, R&D related equipment, R&D funds are the three most basic elements. The internal support of medical device enterprises discussed in this paper refers to the R&D personnel, R&D funds and R&D equipment strength invested by medical device enterprises in R&D activities.

2.3 Definition of Medical Device Enterprise External Support

The more regional governments attach importance to regional scientific and technological innovation, the more they invest in scientific and technological innovation activities, and the enterprises are more motivated to innovate in an environment that encourages innovation. According to the review of existing literature, the investment of regional governments in scientific and technological innovation is mainly reflected in the formulation of regulations, policy promulgation, financial investment, land planning and other aspects

[2][3][4]. Considering the availability of data, the external support of medical device enterprises discussed in this paper refers to the funding investment in scientific and technological innovation in various regions.

3. Literature Review

3.1 Research on the Impact of Internal Support on Innovation Capability of Medical Device Enterprises

In terms of internal system, Huawei, as the world's largest telecommunications equipment manufacturer, has far-reaching research significance in its institutional structure, which is also of high reference value for the innovation and development of medical device enterprises in China. In order to mobilize the enthusiasm and innovation of employees, Huawei gives priority to sharing the development results of the company to workers rather than shareholders. And constantly increase the proportion of employees' income, the benefits to the knowledge owners control. In terms of organizational structure and management, BiZZdesign, a professional enterprise architecture design firm, says that if enterprises want to control the cost of innovation, it is best to use a borderless organizational structure to share resources within the enterprise. However, when the difference in business needs increases, the sharing of resources will hinder the development of innovation. In this case, department independence is the better choice. Each department is responsible for allocating its own resources, reducing unnecessary communication, and thus improving innovation efficiency. When enterprises pay more attention to the speed of innovation, they should realize the management of de-leadership and flatness, because the highly controlled and disciplined management mode will exert constraints on enterprise innovation [5]. In terms of enterprise incentive mechanism, Cheng Yu conducted an empirical analysis on the data of listed companies in China's medical device industry from 2010 to 2021, and the results showed that performance-based equity incentive has a positive impact on the innovation level of enterprises. The larger the scope of performance-based equity incentive, the more conducive it is to increase the enthusiasm of employees, and the longer the incentive implementation period, the more it can promote enterprise innovation [6].

3.2 Research on the Impact of External Support on Innovation Ability of Medical Device Enterprises

From the perspective of industry aggregation, Jiang Zhaojun found that under the regulation of absorptive capacity, knowledge spillover has an impact on the innovation ability of enterprises in different dimensions [7]. Jiang Lei believes that the more types of enterprises in industrial agglomeration areas, the more obvious the positive effect on the improvement of enterprises' innovation ability [8]. In terms of the implementation of relevant policies, Ashrafe &Ray studied the impact of the human capital supply crisis caused by the change of immigration policy in the United States on enterprise innovation, and found that the decrease of human capital is not conducive to enterprise innovation, which proves from the negative side that human capital promotes enterprise innovation [9]. After Liu Xin encoded the medical device industrial policy issued by China, from the dimension of innovation value chain analysis, statistics found that the government in the formulation of medical device related policies, in the commercialization and industrialization policy and research and development experiment policy, more emphasis on the former, that is, the government's attention on the innovation industry chain of medical devices is unbalanced, because the investment in the research and development experiment stage is large and the profit is small. On the contrary, commercialization and industrialization stage [10]. From the perspective of intellectual property protection and financing, Wu Ying studied the impact of digital economy development on regional innovation in prefecture-level cities from 2011 to 2018, and found that digital economy has a significant positive impact on regional innovation, and the relationship between the two is not significantly different between regions [11]. Wang Na analyzed the data of listed medical device enterprises in China from 2014 to 2021, and found that the greater the tax incentives, the stronger the innovation ability of enterprises. Compared with state-owned enterprises, the effect of tax incentives on non-state-owned enterprises is more obvious, and compared with enterprises in northern regions, tax incentives are more significant in the more open south [12].

A Svistounov survey of medical device manufacturers in Australia to understand the impact of Australia's medical device laws, such as the Therapeutic Goods Act, on the development and production of their products shows that Legislation has a positive impact on product quality and reliability, but has a negative impact on innovation cost and time to market of new products [13]. Chih-Hao studied the impact of mergers and acquisitions on the innovation performance of American medical device enterprises, and found that the significant improvement of innovation performance in the acquisition of enterprises with similar technology fields was only reflected in the acquired enterprises, and the innovation performance of the acquired enterprises did not change significantly [14].

In terms of the impact of enterprise internal support on innovation ability, scholars have conducted in-depth studies on the impact of enterprise innovation from the aspects of enterprise internal system, enterprise organizational structure and management, and enterprise incentive mechanism. In terms of the impact of external support on innovation ability, scholars have studied the impact of industry clustering perspective, policy impact perspective and enterprise merger and acquisition perspective on enterprise innovation. It can be found that most of the existing studies focus on the impact of government support on R&D investment in high-tech industry or the development or differences of innovation ability of regional high-tech industry, and the research on the factors affecting innovation ability of medical device enterprises is very limited. In this paper, medical device enterprises, a specific type of enterprise, are selected for empirical research. To provide guidance and suggestions for medical device enterprises how to improve innovation ability.

4. Index System and Theoretical Hypothesis

4.1 Index System

Table 1. Specification of Index System

Variable type	Primary index	Secondary index	Index symbol	Unit
Explained variable	The innovation ability of medical device enterprise	Number of patent applications per year	Patent	pcs
Explanatory variable	The internal support of medical device enterprise	Number of R&D personnel	Staff	person
		R&D equipment fund	Facility	yuan
		Ratio of R&D funding to revenue	Finance%	/
	The external support of medical device enterprise	R&D funds by region	Government	million yuan
Control variable	Proportion of R&D personnel	Ratio of R&D personnel to total workforce	Staff%	/
	Proportion of R&D equipment	Ratio of fixed assets to total assets	Facility%	/
	Enterprise ownership structure	The shareholding ratio of the largest shareholder of the enterprise	Own	/
	Enterprise annual profit	Net profit	Profit	yuan
	Enterprise growth ability	Revenue growth rate	Growth	/
	Regional openness	Total imports and exports/Regional GDP	Open	/

4.2 Explained Variable

Medical Device Enterprise Innovation Capability (Patent). Zhao Yanyuan and Zhang Jie argue that patents are most commonly used to measure innovation ability and are widely recognized [15][16]. In view of the relatively long period from patent application to patent authorization, usually more than 2 years, there is a data lag. Therefore, the annual number of invention patent applications is selected in this study to reflect the innovation ability of enterprises.

4.3 Explanatory Variables and Theoretical Hypotheses

Intra-enterprise Support (Intra). This study reflects the internal investment in R&D from three dimensions: human resources (Staff), material resources (Facility) and financial resources (Finance%). Considering the availability of data, the number of R&D

personnel is used to represent the manpower input of the enterprise. Because the enterprise R&D related instruments and equipment are included in the amount of fixed assets, the amount of fixed assets is used to represent the material input of the enterprise; The percentage of R&D investment to business revenue is used to represent the financial investment of the enterprise, and the following assumptions are put forward:

H1: The input of R&D personnel in medical device enterprises has a significant impact on the innovation ability of enterprises.

H2: The investment in instruments and equipment of medical device enterprises has a significant impact on the innovation ability of enterprises.

H3: The R&D investment of medical device enterprises has a significant impact on the innovation ability of enterprises.

Corporate external support (Government). Guo Jingxian and Yang Zhiqing believe that government subsidies have a positive impact on enterprise innovation. The funds invested by the government reduce the operating cost of enterprises and increase the proportion of funds invested in R&D, which helps to stimulate the R&D potential [17][18]. Saul Lach found that government subsidies can stimulate and promote the R&D of small enterprises, but have a negative impact on the R&D of large enterprises [19]. Since the data of government R&D funding obtained by each enterprise is not available, this study selects the R&D funding of each region of the country to represent the external support of the enterprise, and proposes the following hypothesis:

H4: The level of government support has a significant impact on the innovation ability of medical device enterprises.

4.4 Control Variable

The proportion of R&D personnel (Staff%) and the proportion of R&D equipment (Facility%) can well reflect the personnel structure and equipment investment of the enterprise and the importance of the enterprise to research and development. In this study, the proportion of the number of R&D personnel in the total number of employees and the percentage of the amount of R&D equipment in the total assets of the enterprise were included in the control variables.

Corporate ownership structure (Own). Yin Shuying believes that ownership concentration can reflect the stable state of an enterprise [20], and Zhang Chun finds an "inverted U-shaped" relationship between the shareholding ratio of the largest shareholder of an enterprise and the innovation performance of an enterprise through empirical research [21]. In this study, the shareholding ratio of the largest shareholder of listed medical device companies was taken as one of the control variables.

Corporate profitability (Profit). Zhan Yubo's research found that enterprises with strong perseverance ability can carry out innovation activities better [22]. This study refers to Yang Yang's index system and selects net profit as an indicator of enterprise growth ability [23], which is included in the control variable.

Enterprise Growth ability (Growth). Enterprise growth ability refers to the future development trend and speed of an enterprise. Existing literatures usually use sales growth rate, total asset growth rate and net profit growth rate as indicators to evaluate enterprise growth ability [24]. In this study, operating income growth rate is selected as the indicator to measure enterprise growth ability.

Regional openness (Open). Sun Fenge used the spatial panel model to study the impact of domestic and foreign trade opening on innovation efficiency in each region of China, and the result showed that the region with higher foreign trade opening had higher comprehensive innovation efficiency [25]. In this paper, the ratio of the total import and export volume of the province where the enterprise is located to the regional GDP is used to indicate the degree of regional openness.

5. Data Sources and Descriptive Statistics

5.1 Data Sources

The samples of this study were selected from 43 listed medical device companies across the country. The research data came from the 2018-2022 annual reports of 43 selected enterprises, the Database of the State Intellectual Property Office, the 2018-2022 Statistical Bulletin of National Science and Technology Funding Input, the China Statistical Yearbook and the Local Statistical Yearbook.

5.2 Descriptive Statistical Analysis

The descriptive statistics of the selected variable data in this study are shown in Table 2.

Table 2. Descriptive Statistics of Variable Indicators

Variable	N	Mean	p50	SD	Min	Max
Patent	215	21.57	7	53.87	0	415
Staff	215	488.1	313	560.7	47	3927
Facility	215	7.873e+08	3.930e+08	1.004e+09	2.614e+07	7.199e+09
Finance%	215	8.013	7.720	3.832	1.210	20.72
Government	215	2168	1982	1182	115	4412
Staff%	215	18.85	17.80	7.855	5.450	42.72
Facility%	215	15.82	14.89	8.524	1.790	40.86
Own	215	30.11	28.77	11.73	5.610	61.45
Profit	215	5.902e+08	1.985e+08	1.330e+09	-5.599e+08	9.607e+09
Growth	215	21.30	14.92	52.44	-59.27	564.3
Open	215	51	63.55	26.83	5.830	94.76

As can be seen from Table 2, the median number of patent applications of medical device companies is 7, the minimum value is 0, and the maximum value is 415, indicating that the innovation status quo of medical device companies varies greatly. The maximum number of personnel invested in innovation by medical device enterprises is 3927, and the minimum is only 47, with a large standard deviation, indicating that there is a large gap between enterprises in the investment of human resources in innovation. On the equipment invested in innovation, the standard deviation value is huge, indicating that the investment gap of medical device companies in this area is very large. In terms of the percentage of investment in R&D, the highest is 20.72% and the lowest is 1.21%, which is very obvious.

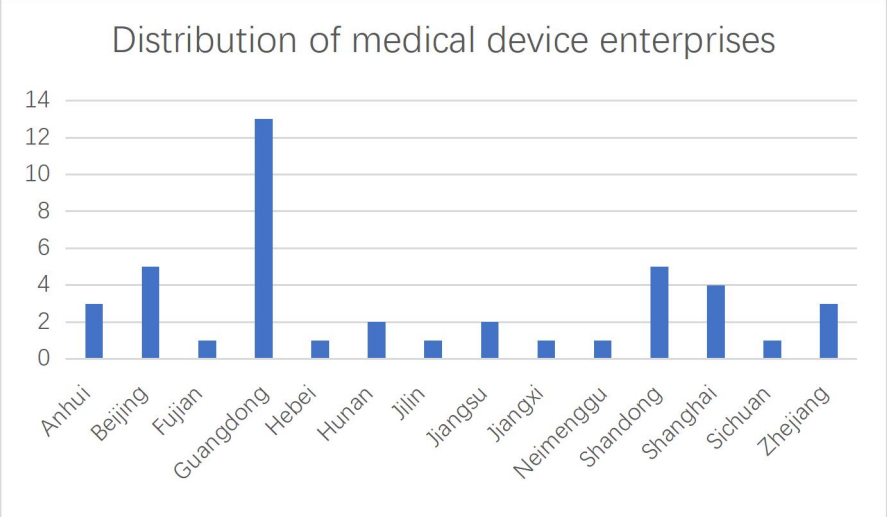

Figure 1. Distribution of Medical Device Enterprises

The regional distribution of 43 listed medical device enterprises selected in this study is shown in Figure 1. Medical device sample enterprises are distributed in 14 provinces, of which Guangdong Province accounts for the highest proportion, with 13 enterprises; Secondly, there are 5 sample enterprises located in Beijing and Shandong respectively. In Shanghai, there are 4 sample enterprises; There are 3 sample enterprises in Anhui and Zhejiang respectively. There are 2 sample enterprises in Hunan and Jiangsu respectively. Fujian, Hebei, Jilin, Jiangxi, Inner Mongolia and Sichuan each have one sample enterprise.

6. Model Setting and Correlation Analysis

6.1 Measurement Model Setting

The stepwise regression model of this study is set as follows:

Patent it = α0+βX+ ε it （Model 1）

Patent it = α0+α1Staff it +α2Facility it +α3Finance% it+βX+ ε it （Model 2）

Patent it = α0+α1Staff it +α2Facility it +α3Finance% it +α4Government it +βX+ ε it （Model 3）

Where i represents the enterprise, t represents the year, ε represents the random error, and α

represents the constant term. The meanings of Patent, Staff, Facility, Finance%, Government are as shown in the previous paragraph. X represents other control variables, including Staff%, Facility%, Own, Profit, Growth and open.

6.2 Correlation Analysis

In this study, Stata17.0 software and Pearson correlation analysis were used to conduct a preliminary analysis of the correlation between internal and external support and control variables of medical device enterprises and the innovation ability of medical device enterprises, as shown in Table 3.

Table 3. Correlation Analysis

Variable	Patent
Staff	0.684***
Facility	0.326***
Finance%	0.182***
Government	0.143**
Staff%	0.216***
Facility%	-0.156**
Own	-0.005
Profit	0.569***
Growth	-0.001
Open	0.037

*** p<0.01, ** p<0.05, * p<0.1

The human resources (Staff), material resources (Facility) and financial resources (Finance%) are significantly positively correlated with the innovation ability of medical device enterprises (Patent) at the level of 1%, and external support of enterprises (Government) is significantly positively correlated with the innovation ability of medical device enterprises (Patent) at the level of 5%. In addition, the proportion of R&D personnel (Staff%), annual Profit (Profit) and medical device enterprise innovation ability (Patent) at the level of 1% is significantly positive correlation, and the proportion of R&D equipment (Facility%) and medical device enterprise innovation ability (Patent) at the level of 5% is significantly negative correlation.

7. Regression Analysis

7.1 Regression Analysis And Results

Stepwise regression analysis was used in this study, and the regression results were shown in Table 4.

The regression results show that among the internal supporting factors, the human resources (Staff) coefficient is 0.0601, and the regression is significant at the 1% level, it shows that medical device enterprises invest manpower in research and development has a significant positive impact on the innovation ability of enterprises. For every person invested in research and development, the number of patent applications increases by 0.0601. The coefficient of material resources (Facility) is -1.25e-08, and the regression is significant at the level of 10%, indicating that the equipment invested in research and development of medical device enterprises has a significant negative impact on the innovation ability of enterprises. The financial resources (Finance%) coefficient of the internal supporting factors of the enterprise is 1.453, and the regression is significant at the 10% level, indicating that the investment in R&D has a significant positive impact on the innovation ability of the enterprise

Table 4. Regression Results

Model	Model 1	Model 2	Model 3
Variable	Patent	Patent	Patent
Staff		0.0599***	0.0601***
		(3.64)	(3.59)
Facility		-1.25e-08*	-1.25e-08*
		(-2.53)	(-2.51)
Finance%		1.449*	1.453*
		(2.32)	(2.30)
Government			-0.00139
			(-0.66)
Staff%	0.949**	0.00839	0.0140
	(3.31)	(0.04)	(0.06)
Facility%	-0.463	-0.0337	-0.0301
	(-1.92)	(-0.19)	(-0.17)
Own	0.278	0.397*	0.404*
	(1.82)	(2.45)	(2.50)
Profit	2.72e-08**	1.22e-08	1.24e-08
	(3.12)	(1.70)	(1.72)
Growth	-0.266*	-0.137	-0.138
	(-2.54)	(-1.84)	(-1.83)
Open	0.0148	0.00906	0.0465
	(0.21)	(0.14)	(0.44)
Constant	2.024	-25.80*	-25.30*
	(0.38)	(-2.55)	(-2.55)
Observations	215	215	215

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Among the external support factors of enterprises, the regression coefficient of Government financial support (Government) is -0.00139, which is not significant, indicating that

it has a negative impact on the innovation ability of enterprises, but the impact is not obvious.

In addition, ownership structure (Own) has a significant positive impact on the innovation capability of enterprises.

7.2 Collinearity Test

In this study, a collinearity test was conducted for regression, and the results are shown in Table 5.

Table 5. Results of Collinearity Test

Variable	VIF	1/VIF
Staff	3.45	0.289710
Profit	3.43	0.291154
Facility	2.90	0.344287
Open	1.74	0.576003
Government	1.72	0.582616
Growth	1.41	0.709287
Finance%	1.40	0.714089
Staff%	1.40	0.715583
Facility%	1.38	0.726736
Own	1.10	0.905679
Mean VIF	1.99	

Variance inflation factor (VIF) is used to measure the strength of multicollinearity. It can observe whether the independent variables in the model are highly correlated with each other, which leads to large variance, and is used to verify the accuracy of regression analysis. VIF=1 indicates that there is no correlation between the independent variables; $1<VIF \leqslant 5$ indicates that the correlation between the independent variables is acceptable and the multicollinearity is not serious; VIF>5 indicates that there is a serious multicollinearity problem between the independent variables. According to the VIF value in Table 5, the maximum value is 3.45 and the average VIF is 1.99, both of which are less than 5. Therefore, the overall multicollinearity among independent variables is within the acceptable range, indicating that the correlation between each predictor and other predictor variables is not high, and each variable contributes relatively independently to the model, which verifies the accuracy and reliability of regression analysis.

8. Result Discussion

8.1 The Impact of Internal Support on Innovation Capability of Medical Device Enterprises

The investment of human resources in R&D of medical device enterprises has a significant positive impact on the innovation ability of enterprises, assuming that H1 is verified. The greater the number of personnel invested in R&D, the more conducive to innovation output, in line with the general law. As the owner and user of knowledge, the more research and development personnel, the more conducive to the use of knowledge for innovation activities. The more R&D personnel invested in the enterprise, the more perfect the organizational structure of enterprise personnel, the more meticulous division of labor, which is conducive to the maximum improvement of the work efficiency of R&D personnel. The more research and development personnel, the more research and development projects can be carried out at the same time, and the output of innovation results will increase correspondingly.

The investment of equipment in R&D within the medical device enterprise has a significant negative impact on the innovation ability of the enterprise, assuming that H2 passes. The research and development of medical devices and equipment is rather expensive, and the investment of enterprises in this aspect reflects the long-term development potential of enterprises, and the innovation efficiency of enterprises has a lag in the short term [26]. The more enterprises invest in research and development equipment and ensure research and development work at the same time, the effective utilization rate of equipment may be low.

The R&D investment within the medical device enterprise has a significant positive impact on the innovation ability of the enterprise, assuming that H3 is verified. Medical device companies' R&D funds accounted for a higher percentage of operating income, indicating that enterprises attach importance to and promote innovation, from the management and corporate culture, help to improve the enthusiasm of research and development personnel, in the economic aspect, research and development projects have sufficient funds, you can learn from the frontier technology, the introduction of leading talents, is conducive to improving innovation strength from the root.

8.2 Influence of External Support on Innovation Ability of Medical Device Enterprises

The research and experimental development

funds invested by regional governments have a negative impact on the innovation ability of medical device enterprises, assuming that H4 is not verified. Because the government invests in research and development, focuses on guiding and encouraging enterprise innovation, for medical device companies, the government's research and development funding support is very limited, only plays a supporting role, and the improvement of innovation ability also requires sufficient investment within the enterprise. The low utilization rate of research and development funds invested by the government by medical device enterprises is also a possible reason for the negative impact on innovation ability.

9. Research Limitation

In the selection of research samples, due to the large number of small medical device enterprises in China, only 43 listed medical device enterprises in China were selected for empirical research, and the conclusions and suggestions have certain limitations, which are not applicable to the innovation and development of the national medical device industry.

In terms of data acquisition, due to the limited data source channels, it is impossible to know the amount of government R&D funds and R&D equipment funds obtained by each enterprise, and relevant data can only be obtained through the public statements of government departments and the annual reports of enterprises. There is no way to investigate whether the data is exaggerated or distorted.

10. Research Conclusion and Suggestion

10.1 Research Conclusion

Based on the panel data of 43 listed medical device enterprises in China from 2018 to 2022, this study conducted an empirical analysis of the impact of internal and external support on innovation ability of medical device enterprises, and drew the following conclusions: Among the internal support factors, the investment of manpower and capital in R&D of medical device enterprises has a significant positive impact on the innovation ability of enterprises; The investment of equipment in R&D has a significant negative impact on the innovation ability of enterprises. Among the external support factors, the government financial support has a negative impact on the innovation ability of enterprises, but the impact is not obvious.

10.2 Research Recommendations

10.2.1 Suggestions on Internal R&D Investment of Medical Device Enterprises

As a high-tech industry, the medical device industry has large R&D investment and high cost, and there is delay in the output and benefit return. This study applies the law of diminishing marginal benefit in economics to put forward countermeasures and suggestions for the internal investment and innovation development of medical device enterprises. Medical device enterprises should make long-term plans in advance and adjust the innovation investment structure in a timely manner according to their own enterprise characteristics and research and development conditions, so as to avoid blindly increasing the investment of research and development personnel and equipment, resulting in an increase in marginal cost and waste of innovative resources. For individual tentative research and development projects, medical device enterprises can appropriately implement project simplification, concentrate resources on innovative projects with greater potential, optimize resource allocation, improve resource utilization, and pursue higher innovation efficiency.

10.2.2 Suggestions on External R&D Investment of Medical Device Enterprises

The government's research and development fund support has a certain limiting effect on the research and development efficiency of medical device enterprises, but it should not blindly deny the role and status of the government in enterprise innovation, but should pay attention to the improvement of government investment behavior. The government should consider the characteristics and policy environment of medical device enterprises before making decisions on innovation capital investment, and should also pay attention to the supervision of the use of funds by enterprises after funding, to ensure the rationality and efficiency of funding, and to maximize the use of funds for enterprise innovation activities.

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