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The impact of technical expert directors and r&d investment on business growth(short-term growth)——based on the chinese listed manufacturing companies

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Abstract

Based on the data of listed manufacturing companies from 2011 to 2016, this paper builds two models: the theoretical model of the influence of technical expert directors on the growth of manufacturing companies and the mediating role model of technical expert directors affecting the short-term growth of enterprises through R & D investment. This paper uses panel regression to conduct an empirical analysis to test the impact of technical expert directors and R & D investment on the short-term growth of enterprises.

The research results illustrates that: technical expert directors can significantly promote the short-term growth of enterprises by improving innovation efficiency, and can also enhance the quality of R & D investment; at the same time, R & D investment also plays an intermediary role in the short-term growth of technical expert directors; Finally, based on the conclusions obtained in this paper, suggestions and measures are provided to optimize the role of technical expert directors on the board of directors of listed companies in China's manufacturing industry, and use their role in R & D investment to promote the growth of listed companies in China's manufacturing companies.

Introduction

From the perspective of enterprise development, strengthening R & D investment is essentially a problem of resource integration and reasonable allocation. In fact, it is a strategic decision-making issue for the company. In addition, a company manager play a key role in the development of R & D investment, especially as a technical expert director who combines technical management responsibility and strategic responsibility (Heller, 1992). On the one hand, they can provide professional technical advice for enterprise innovation research and development decisions, on the other hand, they can also maintain their independence and supervise the behavior of specific managers responsible for the implementation of corporate strategic development decisions. Therefore, they are an important internal factor affecting management's R & D.

Literature review and research hypotheses

Resource dependence theory holds that organizations must continuously obtain external resources from the surrounding environment to maintain their operations, and that organizations also have an impact on the surrounding environment. Organizations and the surrounding environment interact (Ma Yingxian, 2005). The resource dependency theory emphasizes that the development of an enterprise must not only focus on the external competitive environment, but also cooperate with the management and utilization of the company's internal resources. Only by using the internal and external resources of the company can it grasp the direction of the company's development and make the company develop in a better direction. The board of directors is the company's operating decision-making and business execution agency. It grasps the strategic development direction of the enterprise and formulates important investment plans. Therefore, it will play a decisive role in important decisions related to enterprise R & D investment. According to the theory of resource dependence, the board of directors can obtain resources such as relevant expert opinions and market leading-edge information from internal and external sources, and then use these resources to formulate and implement company strategies to achieve better results in research and development.

Technical expert directors originated from the term "chief technology officer". Subsequently, two well-known American economists Adler and Ferdows (1990) made the chief technical officer with both technical management responsibility and strategic decision-making responsibility "technical director". Technical expert directors have the function of performing boundary scan. This is an important way for companies to establish external contacts and obtain resources. On the whole, technical expert directors can obtain information such as external stakeholders, core competitiveness, and environmental changes in a timely manner, which can effectively reduce dependence and uncertainty on the overall environment, and then have a great impact on its governance effect (Zhou Yang, 2002).

Many researchers at home and abroad have found that technical directors will play an effective role in decision-making and supervision and management due to their professional background and work experience (Yao Menglu, 2019), which has improved the output rate and R & D level of scientific research results of

enterprises, and further affect the company's growth (Wang Yanming, Lin Yingze, 2012), at the same time, the transformation of technical talents into technical independent directors, has a significant incentive role for technical staff.

Research on the relationship between R & D investment and performance originated in the 1960s. The research results can be divided into three types: the first is that there is a significant correlation between the two, and it is a positive correlation; the second is that there is not a simple linear relationship between R & D investment and technological innovation performance (Guo Yan, Liu Yibo, 2008); The third type includes research on lag time and industry factors other than R & D investment and innovation performance, and the results are similar to the first one. It is also believed that the more R & D investment of an enterprise, the better the R & D performance (Fang Shu, 2005; Xu Kai, Gao Shanxing, 2002).

It can be seen that the previous literature mostly focused on the correlation between technical expert directors and corporate development or R&D investment and innovation. From the perspective of R&D investment, it is rare to study the mediating effects that may exist in the relationship between technical expert directors and corporate growth. In addition, product market concentration has played an important role in regulating the R&D investment of the company's board of directors, but the existing literature fails to incorporate the relationship between technical expert directors, corporate R&D investment and company growth into a research framework. Therefore, on the basis of the predecessors, this article takes the technical expert director as the explanatory variable, R & D investment as the intermediate variable, and the company's short-term growth as the explanatory variable. They are included in the same research framework, analyzing how technical expert directors influence the short-term growth of listed companies in manufacturing through R & D investment, so as to provide scientific advice for the strategic development of enterprises.

In the day-to-day operations of the company, technical expert directors not only actively assist management in implementing high-quality strategic decisions, but they also have a positive impact on corporate performance by providing endowments such as skills, experience, knowledge, and information. Therefore, in the current critical period of the development of China's manufacturing industry from a low-tech industry to a high-tech industry, technical directors can effectively promote the short-term growth of manufacturing enterprises by their expertise and technical experience. Based on this, we propose the following assumptions:

H1: Technical expert directors are significantly positively related to the short-term growth of the company.

During the operation process, the manufacturing investment cost is enormous, especially in the implementation of its R&D investment. Once the R&D investment is not implemented well, it will have a substantial negative impact on the development of the enterprise. The technical expert directors are to maximize its "expert effect", and it can effectively reduce the negative impact of activities and reduce the risk

of corporate innovation activities, thereby improving the innovation performance of enterprises. Therefore, the research hypothesis is proposed:

H2: Technical expert directors are significantly positively related to R&D investment.

The impact of R & D investment on the short-term growth of enterprises is currently controversial in academic circles. Scholars who believe that corporate R & D investment has a negative impact on the short-term growth of enterprises mainly believe that corporate R & D activities require a large amount of investment, which reduces corporate performance in a short time (Yang Sunwei, 2007). However, more scholars believe that R & D investment has a positive impact on the short-term growth of enterprises (Yang Kun, Wang Guoshun, 2009). This article believes that R & D investment is positively related to the short-term growth of enterprises. Therefore, this article makes the following assumptions:

H3: R&D investment is significantly positively related to the short-term growth of the company.

Technical expert directors can have a direct or indirect impact on a company's operating performance, and a company's R & D investment and innovation efficiency often have a greater correlation (Hu Yuanmu, 2012). Therefore, the choice of R & D investment can have a positive impact on the normal production activities of the enterprise, effectively reduce the production growth of the enterprise, improve innovation efficiency, and strengthen process improvement. Technical expert directors can economically put forward highly professional opinions in their work, implement effective supervision of corporate decision-making and development, improve the level of corporate risk control, maximize the mobilization of advantageous resources to participate in development, and enable enterprises to obtain unprecedented development opportunities. Therefore, this article makes the following assumptions:

H4: R & D investment is an intermediary variable between the technical expert directors and the short-term growth of the enterprise, that is, the technical expert directors can promote the short-term growth of the enterprise by improving innovation efficiency.

2.Study design and data sources

2.1 Data source and sample selection

This article takes China's manufacturing listed companies as the research object, and selects the relevant data from 2011 to 2016 as the initial sample. The data required for the research of listed companies in this paper mainly comes from the CSMAR database, so as to build a database on technical expert directors and R & D investment. Data collection for technical expert directors is difficult and tedious. The author defines directors with technical expertise as technical expert directors. The criteria for judging technical expertise include the following three aspects: ① degree, graduated from engineering, pharmaceuticals, etc. ② work experience, experience in R & D or key technical positions, or person in charge of industry technical associations; ③ professional title evaluation, with technical related titles, such as professor-level engineer, engineer, researcher, etc .;If a director meets any of the above, he or she is judged to have technical expertise.

It is worth noting that for technical expert directors who are only responsible for the secretary of the board of directors, their resumes need to be read to determine the type of attribution. First the CSMAR listed company's governance structure research database should be searched for the names of the chairman and general manager of each listed company for the corresponding year, and then technical expert information can be extracted from its corresponding resume information. To ensure the accuracy, this paper uses a two-way verification method. This article searches from Baidu or the official website of a listed company, retrieves the relevant executive name of the listed company for the corresponding year, and obtains the relevant information of the technical expert director through the resume of the senior executive in the company announcement. The data collected from the two channels were compared, verified and supplemented, and 9441 samples of technical expert directors were finally obtained.

      This article will be eliminated and sorted in the following order: (1) Because cross-section regression requires that each industry sample must reach at least 10 per year, industries that do not reach 10 samples will be merged and deleted as necessary; (2) ST , * ST and PT listed companies; (3) Samples with missing main variables are eliminated; this article mainly uses stata15.0 to collect, sort, and screen the original data, and performs descriptive statistical analysis, correlation analysis, and regression analysis on the formal data after screening.

Variable Design

      Measure of dependent variable

      The dependent variable of this article is the short-term growth of the enterprise, and a single index method is selected for measurement. For the short-term growth of enterprises, the investment in research and development of enterprises is to improve the competitiveness of enterprises by affecting the market share of commodities. Therefore, in this paper, the short-term growth is mainly evaluated by the growth rate of sales revenue of enterprises (Li Chang'e, Xie Yongzhen, 2017).

      independent variable measurement

      The independent variable in this article is a technical expert director. Generally, the method of measuring technical expert directors is divided into two categories: one is to take dummy variables, based on whether the directors have relevant technical learning and practical experience, which is set to 1, otherwise 0 (Zeng Jianghong, 2015; Ma Guangqi, Wang Wenxin , 2018). The second type is to directly measure the proportion of technical directors in the board of directors. In this type of measurement method (Hu Yuanmu, Ji Duan, 2017), the three criteria of learning experience, work experience, and title evaluation are selected as the judgement of technical directors. Those who meet one of the three conditions can be regarded as technical expert directors, and those meeting the technical directors' judgment criteria are 1, otherwise 0.

      Measurement of Intermediate Variables

This article draws on previous studies (Hu Yuanmu (2012), Li Lan (2015)), and uses the ratio of R & D expenditure to company sales income to measure innovation strategies, and the data is highly available. This can help to avoid the impact of enterprise size and development stage on innovation strategy.

Measurement of Manipulated Variables and Dummy Variables

Through the study and reference of previous research results, this article selected company size, return on assets, solvency, equity concentration, investment expenditures, and board meetings (the research in this article does not consider temporary or special meetings, we only analyze the number of board meetings held regularly in the annual report. the number of board meetings of each company from 2011 to 2016 is used), the proportion of independent directors, the size of the board of directors, and the proportion of executive management are regarded as the control variables.

In summary, the variables involved in this article are shown in Table 1:

Table 1 Definition and description of variables involved in this article

Variable category	Variable name	Variable abbreviation	Variable definition
Dependent variable	Short-term growth of the company	GS	Sales revenue growth rate
Independent variable	Technical expert director	Tid	Technical expert director is 1, otherwise it is 0.
Intermediate variable	R & D investment	RD	R & D expenditure to sales revenue ratio
Controlled variable	Company Size	Csize	Natural logarithm of total assets at the end of the year
	Return on Assets	ROA	Net profit / (Beginning of period + End of period) / 2
	Solvency	DPA	Assets and liabilities
	Equity concentration	EO	Sum of the top 5 shareholders' shareholdings
	Investment expenditure	INVE	Payment of intangible assets and other assets in cash / total assets
	Board meeting	Bmeet	Board meetings
	Independent director ratio	IDP	Number of independent directors / board
	Board size	Bsize	Board of Directors

	Senior executive holdings	EHI	Ratio of executive holdings to total equity
	Annual dummy variable	Year	Annual dummy variable

Model design

To ensure that the regression analysis in this study is more effective and robust, this paper uses panel data regression models for data analysis. The main theoretical models are as follows:

(1) Independent variable model

A. Theoretical model of the impact of technical expert directors on corporate growth

Based on Hypothesis 1 above, technical expert directors are significantly positively related to the short-term growth of the enterprise. This paper constructs the following model to test this:

$$GS_{t+1} = a_0 + a_1 Tid_t + \sum_{j=1}^{k} \rho_j Controls_{j,t} + \varepsilon \ (1)$$

Among them, GS indicates the short-term growth of the enterprise, Tid indicates a technical expert director, and Controls indicates a control variable, which has a total of k control variables.

B. Theoretical model of the impact of technical expert directors on R & D investment

Based on Hypothesis 2 above, technical expert directors are significantly positively related to R & D investment. This paper builds the following models for testing:

$$RD_{t+1} = c_0 + c_1 Tid_t + \sum_{j=1}^{k} \delta_j Controls_{j,t} + \varepsilon \ (2)$$

Among them, RD stands for R & D investment.

(2) Intermediate Variable Model

A. Theoretical model of the impact of R & D investment on corporate growth

Based on hypothesis 3 above, R & D investment is significantly positively related to the short-term growth of the enterprise. This paper builds the following model (3) for testing:

$$GS_{t+1} = d_0 + d_1 RD_t + \sum_{j=1}^{k} \varsigma_j Controls_{j,t} + \varepsilon \ (3)$$

B. The linear mediating effect of R & D investment on technical expert directors and corporate growth

Refer to the stepwise method proposed by Baron and Kenny (1986) for the mediation effect test method.

$$GS_{t+1} = h_0 + h_1 Tid_t + h_2 RD_t + \sum_{j=1}^{k} \xi_j Controls_{j,t} + \varepsilon \ (4)$$

Empirical tests and results

Descriptive statistics and analysis

The descriptive statistical results of each variable in the sample are shown in Table 2.

Table 2 Variable descriptive statistics

Index		2011	2012	2013	2014	2015	2016	Total
Tid	None	172	185	190	234	249	318	1348
	Proportion	12.68%	12.81%	12.87%	14.96%	14.65%	16.73%	14.30%
	Exist	1184	1259	1286	1330	1451	1583	8093
	Proportion	87.32%	87.19%	87.13%	85.04%	85.35%	83.27%	85.70%
	Total	1356	1444	1476	1564	1700	1901	9441
RD	N	1909	2075	2169	2170	2170	2170	12663
	Mean	0.03	0.038	0.04	0.041	0.043	0.045	0.039
	S.D.	0.03	0.037	0.037	0.053	0.045	0.048	0.043
	Min.	0	0	0	0	0	0	0
	Max.	0.291	0.527	0.465	1.694	0.886	1.259	1.694
GS	N	2170	2170	2170	2170	2170	2170	13020
	Mean	0.108	0.221	0.136	0.088	0.21	0.361	0.187
	S.D.	0.586	2.51	0.355	0.353	1.075	2.391	1.517
	Min.	-0.967	-0.991	-0.941	-0.91	-0.918	-0.953	-0.991
	Max.	20.802	107.065	6.175	4.519	31.502	82.699	28.667
IDP	N	1345	1444	1476	1564	1700	1900	9429
	Mean	0.367	0.37	0.372	0.372	0.37	0.374	0.372
	S.D.	0.052	0.054	0.054	0.053	0.056	0.054	0.054
	Min.	0.2	0.25	0.181	0.25	0.25	0.2	0.181
	Max.	0.666	0.666	0.666	0.625	0.666	0.625	0.666
Csize	N	1911	2080	2169	2170	2170	2170	12670
	Mean	21.139	21.172	21.256	21.408	21.583	21.77	21.395
	S.D.	1.321	1.328	1.313	1.297	1.269	1.255	1.316
	Min.	17.348	17.018	17.758	17.277	17.388	17.778	17.018
	Max.	26.487	26.482	26.646	26.751	26.96	27.104	27.104
ROA	N	2170	2170	2170	2170	2170	2170	13020
	Mean	0.084	0.072	0.076	0.061	0.059	0.06	0.069

	S.D.	0.453	0.094	0.231	0.357	0.818	0.069	0.26
	Min.	-0.616	-0.638	-0.699	-16.112	-0.686	-0.31	-16.112
	Max.	20.787	1.181	10.032	0.622	0.564	0.604	20.787
DPA	N	2170	2170	2170	2170	2170	2170	13020
	Mean	0.378	0.405	0.418	0.436	0.396	0.383	0.403
	S.D.	0.432	0.414	0.202	1.002	0.203	0.194	0.497
	Min.	0	0	0	0.0091	0.0197	0.0189	0
	Max.	13.396	12.127	1.094	46.159	3.261	1.157	46.159
EO	N	2170	2170	2170	2170	2170	2170	13020
	Mean	0.363	0.393	0.387	0.421	0.467	0.501	0.422
	S.D.	0.302	0.296	0.29	0.279	0.256	0.224	0.28
	Min.	0	0	0	0	0	0	0
	Max.	1	1	1	1	1	1	1
EHI	N	1356	1444	1476	1564	1700	1901	9441
	Mean	0.083	0.082	0.078	0.078	0.082	0.091	0.083
	S.D.	0.158	0.156	0.151	0.148	0.149	0.156	0.153
	Min.	0	0	0	0	0	0	0
	Max.	0.843	0.795	0.811	0.81	0.81	0.79	0.843
Bsize	N	1356	1444	1476	1564	1700	1901	9441
	Mean	8.776	8.784	8.691	8.528	8.445	8.4	8.587
	S.D.	1.81	1.621	1.628	1.584	1.587	1.57	1.635
	Min.	0	4	4	4	4	0	0
	Max.	18	18	18	18	17	17	18
Bmeet	N	1356	1444	1476	1564	1700	1901	9441
	Mean	9.134	9.087	8.667	8.995	9.79	9.831	9.289
	S.D.	3.291	3.237	3.141	3.429	3.863	4	3.569
	Min.	2	3	2	0	0	2	0
	Max.	30	49	31	28	40	41	49
INVE	N	1911	2080	2169	2170	2170	2170	12670
	Mean	0.085	0.076	0.068	0.06	0.052	0.0476	0.064
	S.D.	0.068	0.059	0.056	0.053	0.049	0.045	0.057

	Min.	0	0	0	0	0	0	0
	Max.	0.468	0.392	0.503	0.452	0.602	0.641	0.641

As can be seen from Table 2, the absolute value of the number of companies with technical expert directors has increased slightly year by year. This shows that most listed manufacturing companies have fully realized the importance of technical expert directors in promoting the growth of manufacturing companies through R & D investment. The analysis of the R & D investment of the intermediary variable found that the ratio of R & D expenditure and sales income of listed manufacturing companies in each year in the sample has been increasing year by year, which is likely to be related to the country's increasing emphasis on innovation and investment. In terms of short-term growth of the company, the overall sales revenue growth rate is relatively low, which is likely due to the lag in the conversion of R & D investment results. The annual average value generally shows an increasing trend. After a series of results transformation, new products are introduced, product quality is improved, production costs are reduced, and more returns can be obtained.

Correlation analysis

In this paper, the sprealman method is used to make a preliminary judgment on the relationship between variables. The relevant analysis results are shown in Table 3. Because the absolute values of all correlation coefficients are less than 0.4, there is no serious multicollinearity problem among the variables, and it can be included in the regression equation at the same time.

Table 3 Correlation coefficient table

Variables	GS	Tid	RD	IDP	Csize	ROA	DPA	EO	EHI	Bsize	Bmeet	INVE
GS	1.000											
Tid	0.301***	1.000										
RD	0.107***	0.060***	1.000									
IDP	0.003	-0.032***	0.045***	1.000								
Csize	-0.058***	0.056***	-0.178***	-0.021***	1.000							
ROA	-0.014	0.001	0.022**	0.002	-0.114***	1.000						
DPA	0.119***	-0.009	-	-0.013	0.090**	-	1.000					

			0.109***		*	0.479***						
EO	0.002	0.005	-0.035***	0.055***	0.386***	-0.056***	-0.031***	1.000				
EHI	0.010	0.006	0.170***	0.012**	-0.263***	0.038***	-0.119***	0.218***	1.000			
Bsize	-0.023**	0.096***	-0.097***	-0.477***	0.286***	-0.000	0.055***	-0.026*	-0.154***	1.000		
Bmeet	0.024***	0.017*	-0.020*	0.034***	0.211***	-0.024**	0.060***	-0.080***	-0,035***	0.001	1.000	
INVE	0.012	0.025**	0.036***	0.010	-0.128***	0.064***	-0.032***	-0.083***	0.121***	-0.001	-0.019*	1.000

Note: N = 4660, * indicates significant correlation at the 0.1 level; ** indicates significant correlation at the 0.05 level; *** indicates significant correlation at the 0.01 level

Multiple regression analysis

In order to further study the mutual influence degree and influence direction of technical expert directors, R & D investment, and short-term growth of listed companies in Chinese manufacturing companies, this article uses multiple regression to analyze them in depth.

Model 1 shows the regression results of short-term growth of technical expert directors and companies in manufacturing listed companies. The regression coefficient of technical expert directors is 0.507, and it is significant at a significance level of 1%, which indicates that manufacturing listed companies have technical expert directors that can promote the short-term growth of enterprises. Therefore, the hypothesis H1 is verified. This is roughly consistent with the conclusions of Sun Wei (2007) and others.

Model 2 shows the regression results of technical expert directors and R & D investment of listed manufacturing companies. The regression coefficient of technical expert directors is 0.005, and it is significant at a significance level of 5%, which indicates that manufacturing listed companies with technical expert directors invest more in research and development, which validates hypothesis H2. This is basically consistent with the views of scholars such as Zhang Wenlong [25].

Model 3 shows the regression results of R & D investment and short-term growth of listed companies in manufacturing. The regression coefficient of R & D investment is 11.926, and it is significant at a significance level of 1%, which indicates that the R & D investment of listed manufacturing companies is positively related to their short-term growth and can promote the short-term growth of the company. The hypothesis H3 was verified. This is roughly consistent with the conclusion of Sun Wei [28] and others.

Model 4 shows the regression results of the mediating effect of R & D investment of manufacturing listed companies between technical expert directors and short-term growth of enterprises. It was found that at a significance level of 1%, the impact of R & D investment (P <0.01) and technical expert directors (P <0.01) on the short-term growth of the company was significant at the same time. Therefore, according to the judgment method of the intermediary effect, it can be known that technical expert directors have a positive impact on the short-term growth of the company through R & D investment. This shows that the higher the R & D investment (ie, the ratio of R & D expenditure to sales income) of a listed manufacturing company with technical expert directors, the better its short-term growth. The technical expert directors of manufacturing listed companies have promoted the short-term growth of the company through corporate R & D investment and verified the hypothesis H4.

Table 4 Summary of the regression results of technical expert directors affecting the short-term growth of enterprises through R & D investment

Variables	Model1	Model2	Model3	Model4
Tid	0.507*** (-3.82)	0.005** (-2.65)		0.449** (-3.45)
IDP	0.229 (-0.26)	0.187 (-1.36)	0.128 (-0.15)	0.062 (-0.07)
Csize	-0.510*** (-5.75)	0.001 (-0.91)	-0.583*** (-6.64)	-0.578*** (-6.59)
ROA	0.125 (-1.38)	-0.001 (-0.43)	0.958*** (-4.95)	0.952*** (-4.92)
DPA	0.232***	-0.001	0.493***	0.497***

	(-4.52)	(-0.48)	(-6.62)	(-6.69)
EO	0.007	0.003	-0.104	-0.055
	(-0.02)	(-0.48)	(-0.25)	(-0.13)
EHI	-0.342	0.001	-0.302	-0.348
	(-0.73)	(-0.13)	(-0.66)	(-0.76)
Bsize	0.037	0	0.043	0.036
	(-0.96)	(-0.1)	(-1.13)	(-0.96)
Bmeet	-0.012	-0.0001	-0.01	-0.01
	(-1.17)	(-0.71)	(-1.02)	(-1.02)
INVE	1.138*	0.011	0.971	0.971
	(-1.79)	(-1.14)	(-1.56)	(-1.56)
Year	Manipulated	Manipulated	Manipulated	Manipulated
RD			11.926***	11.830***
			(-14.6)	(-14.48)
Constant	10.186***	-0.005	11.650***	11.210***
	(-5.23)	(-0.16)	(-6.07)	(-5.83)
Observations	7529	7528	7528	7528
R-squared	0.02	0.009	0.056	0.058
F值	8.08***	3.85***	23.03***	22.38***
Number of id	1700	1700	1700	1700

Note: The values in the columns from the top to the bottom are the correlation coefficient and T test value; *,

, * represent the significance levels of 10%, 5%, and 1%, respectively (two-tailed test)

Conclusions and Implications

Conclusion

This article takes Chinese manufacturing listed companies as the research object, selects the relevant data from 2011 to 2016 as the original sample, and uses theoretical analysis and empirical models to construct two models: theoretical model of the influence of technical expert directors on the growth of manufacturing enterprises and the mediating role model of technical expert directors affecting the short-term growth of enterprises through R & D investment. The regression results of the fixed-effect model in the study of this paper demonstrates that: (1) Technical expert directors of listed manufacturing companies are significantly positively related to R & D investment. (2) Technical expert directors of listed manufacturing companies are significantly positively related to the corporate short-term growth. (3) R & D investment is significantly positively related to the short-term growth of the company. (4) R & D investment is an intermediary variable between the technical expert directors and the short-term growth of the enterprise, that is, the technical expert directors can promote the short-term growth of the enterprise by improving the efficiency of innovation.

Theoretical Contribution

First of all, for listed companies in the manufacturing industry, the empirical test reveals the impact of technical expert directors on corporate R & D investment and enriches the relevant literature to a certain extent.

Secondly, in this paper, combining the industry characteristics of manufacturing companies, this article has targeted research on the impact of technical expert directors on short-term corporate growth, which is industry-specific. Therefore, it can provide a certain reference for the technical expert directors of manufacturing enterprises to promote their growth.

Thirdly, this article takes R & D investment as a mediating variable, and validated its mediating role between expert directors and the short-term growth of companies. In manufacturing enterprises, R & D investment is an important strategic decision-making issue of resource integration and reasonable allocation, which has played a key role in the innovation and development of enterprises.

Practical and Policy Implications

According to the theory of resource dependence, it is impossible for an enterprise to exist independently without contact with the outside world, and its development and survival have great dependence on the internal and external environment of the organization. As expert talents in the field, technical expert directors can rely on their technical experience and expertise to establish a certain network of relationships with other companies and experts to help companies obtain the latest information in the industry. This helps the senior management team to make the best strategic decisions that are beneficial to the development of the company. According to the principal-agent theory, "adverse selection" and "moral hazard" also inevitably exist in listed manufacturing companies. In this case, the client must strengthen supervision of

the enterprise. The addition of technical expert directors to the board of directors can not only better improve the basic configuration of the board of directors and the principal-agent relationship between the board of directors and shareholders, but also effectively improve the corporate governance level and efficiency, thereby promoting corporate growth.

Increasing investment in R & D. This paper demonstrates through empirical analysis that enterprises can promote their short-term growth by increasing R & D investment. Technical expert directors influence the growth of an enterprise by affecting its R & D investment. Therefore, at a time when the global manufacturing landscape is undergoing major changes, investment in research and development will help improve the core competitiveness of enterprises and reduce dependence on external environmental factors. Facing the double squeeze of the manufacturing industry in developed countries and emerging economies, the demographic dividend advantage of China's manufacturing industry has gradually disappeared, and the increase in R & D investment is an important measure for corporate transformation and upgrading and innovation and development, which can further improve enterprises' supply value chain status. Enterprises should increase investment in research and development, strengthen research and development capabilities, and promote the transformation and application of scientific and technological achievements. On the one hand, it can promote the improvement of performance, on the other hand, it can also enhance the ability of enterprises to resist risks. As a whole, the gap between China and developed countries will be shortened, and the competitive advantage of China's manufacturing industry will be re-established.

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