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RESEARCH ON THE IMPACT OF INTERNATIONALIZATION OF CHINESE GEM ENTERPRISES ON TECHNOLOGICAL INNOVATION: BASED ON THE PERSPECTIVE OF ACTUAL CONTROLLER AT HOME AND ABROAD

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ABSTRACT: *In this paper, we use data of Chinese GEM listed companies from 2009-2016, and analyze the impact of internationalization strategy on technological innovation, and the regression results show that there is an U-shaped relationship between internationalization and technological innovation in Chinese GEM listed companies. Further, from the perspective of actual controllers, according to the actual controllers belonging to foreign natural persons (foreign organizations) or domestic natural persons (domestic organizations), they are divided into two groups. It is found that the internationalization of foreign actual controllers is positively related to the technological innovation of enterprises, and the internationalization of domestic actual controllers is negatively related to technological innovation. And it is found that the patent of invention is a patent category that best reflects the R & D capability of the patent. The paper studies the relationship between internationalization of enterprise and technological innovation from a relatively new perspective, and further deepens the understanding of internationalization impact on technological innovation.*

KEYWORDS: Internationalization; Technological Innovation; Actual Control

INTRODUCTION

With the deepening of economic globalization and the rapid development of knowledge economy, internationalization and technological innovation have become the inevitable choice for the long-term development of enterprises. China has a deep understanding of the importance and urgency of internationalization and technological innovation. Since the founding of the country, China has been committed to developing friendly foreign relations. In recent years, China's national policies and development philosophy also highlight this point. The report of the 17th national congress of the communist party of China (CPC) clearly pointed out: "we must adhere to the basic state policy of opening up to the outside world and better integrate the concept of 'bringing in' and 'going out'.

Under the policy background of internationalization and technological innovation, this paper studies the relationship between enterprise internationalization and technological innovation from the micro perspective of the actual control person's domestic and foreign attributes by taking the data of gem enterprises from 2009 to 2016 as a sample. Considering that most of the GEM enterprises are still very young, the degree of internationalization is not high, so we use export data to measure the internationalization of enterprises. As for the technological innovation of enterprises, it is measured from the two aspects of innovation input and output.

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Moreover, from the perspective of technological innovation output, the total number of patents is divided into three categories (patent of invention, utility model patent, appearance design patent). Further research analyzes the impact of corporate internationalization on technological innovation. Finally, the proportion of technicians is used to test the robustness.

The main contributions of this paper are: First, different from the previous research, this paper measures the internationalization of the two dimensions of the enterprise's overseas sales intensity and the proportion of the overseas sales, and examines the impact of the internationalization of Chinese GEM enterprises on technological innovation from the two dimensions of R & D input and patent output, which will help us to be more comprehensive from the perspective of input and output. Recognizing the impact of internationalization on technological innovation, and making up for the lack of empirical evidence on how internationalization affects technological innovation, and partly revealing the internal mechanism of the international chemical works for enterprise behavior. Second, unlike the previous literatures, which are mostly mature large enterprises, this paper focuses on Chinese GEM companies, which makes up for the shortcomings of existing literature on GEM companies. Third, the current research on the characteristics of actual controllers is based on political identity and character characteristics, but almost no literature starts from the perspective of the actual controller's domestic and foreign attributes. This paper studies the relationship between internationalization and technological innovation based on principal-agent theory and organizational learning theory, and divides enterprises into different types from the perspective of actual controllers, and studies the relationship between internationalization and technological innovation under the different domestic and foreign attributes of actual controllers. Deepened the understanding of the relationship between internationalization and technological innovation.

LITERATURE REVIEW

Internationalization and Technological Innovation

At present, the most mainstream academic research on the relationship between enterprise internationalization and technological innovation is the positive correlation, and it is usually explained on the basis of relevant theories such as resource-based theory and organizational learning theory. The organizational learning theory (Zahra et al.， 2000 ; Kafouros et al.， 2008) studies the direct impact of internationalization on enterprise innovation. It holds that enterprises acquire the complementary resources needed for innovation through internationalization, and acquire the technology and knowledge needed for innovation through organizational learning, and ultimately improve the innovation performance of the enterprises. In addition to the simple positive relationship, some scholars have shown that the correlation between internationalization and technological innovation is also affected by the characteristics of enterprises. Danlu Liu（2013）proposed that in the innovation activities of service enterprises, different internationalization models have different effects. In the service industry, only when the internationalization strategy and innovation strategy of the enterprise match, can the

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enterprise obtain the benefits brought by both to the greatest extent. Ren et al. (2015) believe that internationalization has a positive impact on R&D when the innovation capability or marketing capability of small and medium-sized companies are relatively high. However, when the innovation capability or marketing capability of small and medium-sized companies are not high, internationalization has a negative impact on R&D.

Contrary to the positive correlation, some studies have proposed a negative correlation between the two. For example, Fisch(2003)believes that internationalization will increase the cost of management, coordination and information exchange, as well as incomprehensible and opportunistic behavior among R&D teams. Bin Dai et al.(2016)grouped the sample data according to the nature of property rights and financing constraints, and found that whether the patent or R&D intensity measures R&D innovation ability, it indicates that the company's internationalization strategy is negatively correlated with its R&D innovation ability. Jiang et al. (2016) believe that external knowledge acquired through overseas mergers and acquisitions is negatively related to indigenous innovation, because the knowledge that acquired company owns is already behind rivals to be acquired, so that external knowledge will soon be replaced by other knowledge, but the acquisition itself will cost a lot of money, making foreign technology acquisitions negatively correlated with local innovation.

Other studies have proved that the relationship between internationalization and technological innovation is not a simple linear relationship, but a complex non-linear one, based on various theories such as resource-based theory, outsiders' disadvantages and organizational learning theory. For example, Zhaojun Gao (2016) first found the inverted u-shaped relationship between internationalization level and innovation performance in the sample of national high-tech zone enterprises. Chen et al. (2012) think that multinational companies have problems in coordination and communication. Therefore, the relationship between R&D internationalization and innovation performance is not a linear relationship, but an S-type relationship. R&D performance rises in the decentralized stage and declines in the conversion stage. The concentration phase has risen again. Hsu et al. (2014)used Taiwan's high-tech technology companies as a sample to study the relationship between R&D internationalization and innovation performance. The results show that there is a positive U-type relationship between R&D internationalization and R&D performance.

In summary, organizational learning theory believes that internationalization is a process of learning and accumulating experience. In this process, internationalized enterprises can acquire more advanced knowledge and development opportunities than enterprises that operate in a single domestic business. With the advancement of internationalization, the experience of international enterprises gradually accumulates, the learning ability is gradually improved, and more and more international knowledge and market knowledge have been gained, thus promoting the progress of technological innovation. At the macro level, internationalization is one of the channels of international communication, which is conducive to the transfer of technology and information of all countries. Especially for developing countries, it provides an opportunity to increase the technological stock and speeds up the transfer of technology. However, because of internationalization, the difficulty of governance, the cost of

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communication and the complexity of organization are all higher than that of the single domestic operation. Therefore, based on the principal-agent theory, the more complex the actual controllers in the company are not easy to monitor the management decisions, which gives the executives more freedom of action. The probability of opportunism is greatly increased. For the long-term and risky investment of enterprise technology innovation, executives may avoid investing in enterprise technology innovation in the process of internationalization for the sake of their own reputation and interests, and the international operation carried out for these motives may have a negative impact on enterprise performance and technological innovation. That is to say, due to the opportunistic behavior of the executive, it deviates from the actual controller's rights and interests and has a negative impact on the technological innovation of the enterprise. At this time, the positive effect of internationalization to the enterprise based on the theory of organizational learning is less than the negative effect on the enterprise based on the theory of principal-agent. It is negatively related to the technological innovation of enterprises. With the deepening of internationalization, the enterprises gradually accumulate experience in the international market, and the learning ability is gradually enhanced. The positive effect of internationalization to enterprise technology innovation is gradually greater than the negative effect of opportunism. At this time, internationalization is positively related to enterprise technology innovation. Therefore, internationalization and technological innovation show a positive U-shaped relationship. Therefore, we propose hypothesis H1:

H1: Under the same conditions, the internationalization and technological innovation of the GEM enterprises have a positive U-shaped relationship.

Internationalization and Technological Innovation under The Actual Controllers Abroad

The actual controller can be the controlling shareholder and the large shareholder of the company, but it does not necessarily have to be the shareholders of the company or the large shareholder. They can control the company's management decision and the management of the company by direct or indirect way, and have an impact on the company's behavior. Actual controllers may be corporations, natural persons, non-profit organizations, legal persons or other organizations (government, universities, associations, etc.). A controlling shareholder directly holding shares of a listed company is a Immediate shareholder of a listed company. Immediate shareholders are often controlled by their upper shareholders and traced back to the ultimate controller. The actual controller can obtain the actual control of the company with less cost through a complex control chain structure. The actual control talents are the profit drivers of the behaviors of listed companies and the ultimate beneficiaries of the control rights. Therefore, the long-term development of enterprises is closely related to their interests. But for executives, the performance of the company is mainly due to its reputation, so the actual controller will pay more attention to the long-term development of the company.

Nowadays, although many enterprises actively participate in international division of labor and global competition, they still face many difficulties in the process of internationalization. One of them is the limitation of enterprises themselves. Due to the insufficient knowledge, experience and ability of enterprise internationalization, enterprise internationalization faces

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the bottleneck of resources, technology and management. It can be said that in the process of internationalization, enterprises must overcome the lack of relevant knowledge and experience in foreign markets in order to implement the internationalization strategy smoothly. It is the key factor for an enterprise to successfully implement the internationalization strategy that whether it can have good adaptability, strong learning ability and realize the advantage of later development. Moreover, in this era of information economy, the complexity and changeability of business environment have become the prominent features of this era. In the 21st century, the development of enterprises largely depends on their " Organizational Earning ". Organizational earning is often defined as the ability of a business or production unit to acquire knowledge and improve problem solving. Therefore, the ability of organizational earning has become a solid pillar and an important source of competitive advantage.

The international experience of entrepreneurs determines the ability of entrepreneurs to acquire knowledge in the international operation of enterprises, thus influencing the decision-making and choice of enterprise internationalization strategy. The early international experience is conducive to entrepreneurs' understanding of international operation problems and their ability to grasp opportunities, which will enable entrepreneurs to have a better understanding and positioning of overseas markets and customers, so as to achieve good results in the internationalization strategy of enterprises. Therefore, to some extent, entrepreneurs' correct understanding of overseas customers and reasonable choice of the market will help promote enterprises to launch new products in the overseas market and make more intelligent decisions for the effective allocation of enterprise resources and the integration of global resources.

Huber(1991)also pointed out that diversified experience can enhance the adaptability of entrepreneurs to the environment, and promote enterprises to enter the learning state as soon as possible in the international operation, so as to enable enterprises to acquire more knowledge and strong technical skills. In addition to learning management knowledge, the learning of management mode is also conducive to the improvement of enterprises' technical innovation ability. By learning different ways of doing things, enterprises can also improve their technological innovation and productivity. Aggarwal et al. (2011) agree with this view that foreign investors have played a role in improving corporate governance for non-US companies, which may lead to higher corporate value. An et al. (2014) believe that most foreign investors in China come from foreign financial institutions in developed economies, and they have more resources to analyze corporate performance and influence the operation and management of enterprises. Zhu et al. (2016) believe that the minority stake is controlled by foreign shareholders, which is a potential source of knowledge and can reduce the risk of Banks based on the organizational learning theory.

In the existing researches on the characteristics of the actual controllers, most of them are the researches on the political identities and characters of the actual controllers, but they ignore the research and analysis on different properties at home and abroad. But through the above relevant literature, we can find the importance of foreign experience for the internationalization of enterprises. If the actual controllers of the enterprises are foreign natural persons (foreign organizations), they have already had relevant international experience and knowledge before

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managing the internationalization of China GEM companies. Most of them come from some more developed regions with advanced experience. In the process of internationalization of GEM companies, organizational learning capabilities will be stronger. Moreover, the actual control of talents is the driver of the interests of listed companies, and the ultimate beneficiary of controlling rights and benefits. It can be said that the actual control of foreign natural persons (foreign organizations), both ability and motivation to promote enterprise technological innovation, therefore, based on the organizational learning theory of internationalization of the positive role of technological innovation will be greater, than the principal-agent problem to the negative effect of technological innovation. At this point, we propose the hypothesis H2:

H2: When the actual controller of an enterprise is a foreign natural person (foreign organization), internationalization is positively related to technological innovation in the process of enterprise internationalization.

Internationalization and Technological Innovation under The Actual Domestic Control

On the contrary, if the actual controller is a domestic natural person or domestic organization, they do not have such sufficient international experience, so they do not have strong organizational learning ability in the process of internationalization. In this case, despite their incentive to innovate, executives have greater freedom of action as a result of internationalization, giving them the opportunity to deviate from the rights of the actual controller. And they can take advantage of the complexity of administration and holes, for the sake of his reputation and short-term interests, to reduce the risky and long-term technological innovation investment. The entrusted agency problem has increased the negative impact on technological innovation in internationalized enterprises, and is greater than the positive effect brought by internationalization to enterprise technological innovation based on organizational learning theory. The negative influence of the principal-agent is dominant, so the reverse effect of enterprise internationalization on technological innovation will be significant. So we propose the hypothesis H3:

H3: When the actual controller of an enterprise is a domestic natural person (domestic organization), in the process of internationalization of the enterprise, internationalization is negatively related to technological innovation.

METHODOLOGY

Data Source and Sample Selection

This paper selects the data of the GEM listed companies from 2009 to 2016. The relevant data of internationalization comes from the annual report of the listed company and is completed by manual collection. The patent data of the enterprise and other financial related data are from CSMAR, and the data of the technical personnel is from Juchao database. From 2009 to 2016, the number of companies listed on the GEM and published annual reports has reached 633, with a total of 2791 data. For the grouping of the actual controlling person's domestic and

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foreign attributes, according to the classification criteria of the corporate relationship person displayed by CSMAR. This paper divides the actual controller into foreign natural person (foreign organization) or foreign natural person (foreign organization). Due to the differences between China's Hong Kong, Macao and Taiwan regions and mainland China, the actual controllers of Hong Kong, Macao and Taiwan are also classified as actual controllers (foreign organizations). According to this group except missing data, a total of 142 enterprises are controlled by foreign natural persons (foreign organizations) and 2,584 enterprises are actually controlled by domestic natural persons (domestic organizations).

Variable Definition and Model Design

Globalization: Considering that GEM companies are currently mainly adopting international export strategies through exports, this paper is based on the experience of previous research（ Hitt et al.,1997;Lu et al.,2004;Vithessonthi et al.,2016;Xiao et al.， 2013;Zhong Yang et al.,2009;Danlu Liu et al., 2013;Xin Xu et al.,2017） and the availability of data. We use Overseas sales intensity (Overseas sales revenue of the company in that year/Year-end total assets) and Proportion of overseas income (Overseas sales revenue of the company in that year/ Gross sales) to measure the degree of enterprise internationalization. Due to the differences in the system between Hong Kong, Macao and Taiwan and mainland China, the sales revenue in these areas will be included in the overseas sales revenue.

Technology innovation: The object of this paper is technological innovation. Therefore, refer to the research of Jiang et al., (2016), Siping Luo et al. (2012), Xuan Zhou et al., (2012) and Songlin Peng et al., (2017). First of all, the number of patents owned by enterprises is measured, but not all of them are patented. To avoid the resulting error, we also use R & D density (R & D investment/ Total sales) and R & D intensity (Enterprise R&D investment in that year/ Total assets of the enterprise in that year) as variables to measure technological innovation (Lin et al,2010; Singh et al,2013; Yun Xia et al,2008; Qingquan Tang et al,2011; Wenxi Li et al,2017). However, the total number of patents is still an important aspect of measuring technological innovation of enterprises, and the total number of patents is divided into three categories: patent of invention, utility model patent and appearance design patent. In order to better understand the influence of enterprise internationalization on technological innovation output, this paper will further study the relationship between enterprise internationalization and patent of invention, utility model patent, appearance design patent. In general, the technological innovation of enterprises is reflected from the input and output aspects, and the empirical tests are carried out respectively.

Control variables: We use return on equity (ROE), net assets per share, and earnings per share to measure enterprise performance (Yuanyang Song et al.,2010; Chun Liu et al.,2010; Shaolong Li et al.,2012; Hsu et al.,2015), and use virtual variables of strategic emerging industries, CEO age, the proportion of the top 5 shareholders, executives shareholding ratio, cash flow, asset-liability ratio to measure corporate governance characteristics(Chen et al.,2012; Singh et al.,2013; Purkayastha et al.,2016; Yunguo Liu et al.,2007; Weimin Xie et al.,2009).

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Table 1. Variable definition

Variable type	Variable name	Code	Variable definition
Dependent variables	R & D density	RD_density	R & D investment / Gross sales
	R & D intensity	RD_intensity	R & D investment / Total assets
	The total number of patents	Patent	Ln（patent+1）
	Patent of invention	POI	Ln（POI+1）
	Utility model patent	UM	Ln（UM+1）
	Appearance design patent	AD	Ln（AD+1）
	The proportion of technicians	TOR	The number of technicians / Total number of employees
Independent variables	Overseas sales intensity	OE	Overseas sales revenue / Total assets
	Overseas sales intensity squared	OE2	(Overseas sales revenue / Total assets)2
	Proportion of overseas income	ER	Overseas sales revenue / Gross sales
	Proportion of overseas income squared	ER2	(Overseas sales revenue / Gross sales)2
Control variables	Return on equity	ROE	Net profit/ Average balance of shareholders' equity
	Net assets per share	NASS	Net assets per share = equity / Total number of shares
	Earnings per share	EPS	Earnings per share = Net profit / Total equity
	Strategic emerging industries	SEI	If it’s strategic emerging industry, then=1, or=0
	CEO age	CEOage	Ln（CEO age）
	Equity concentration index	H5	The top five shareholders hold shares
	Executive shareholding ratio	OS	Executive shareholding ratio
	cash flow	Ncf	cash flow from operations/ Total assets
	Asset-liability ratio	Lev	Asset-liability ratio = Total liabilities / Total assets
	Industry effects	Industry	Listed companies are

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			divided into 13 industries, set up 12 industry virtual variables, if the company is in this industry, then take 1, otherwise take 0.
	Year effects	Year	Set 7 virtual variables from 2009-2016. If the data in this year, then take 1i, or take 0.

Model (1) is the total regression model, and model (2) is the grouping model of the actual controller's different domestic and foreign attributes:

$$RD\_density_t / RD\_\text{int}ensity_t / Lnpatent_t / LnPOI_t / LnUM_t / LnAD_t = a_0 + a_1 OE_t / ER_t + a_2 OE^2{}_t / ER^2{}_t + a_3 ROE_t + a_4 NASS_t + a_5 EPS_t + a_6 SEI_t + a_7 CEOage_t + a_8 H5_t + a_9 OS_t + a_{10} Ncf_t + a_{11} Lev_t + \sum_{i=1}^{m} a_{12+i} Industry + \sum_{i=1}^{n} a_{13+m+i} Year + \varepsilon \quad (1)$$

$$RD\_density_t / RD\_\text{int}ensity_t / Lnpatent_t / LnPOI_t / LnUM_t / LnAD_t = a_0 + a_1 OE_t / ER_t + a_2 ROE_t + a_3 NASS_t + a_4 EPS_t + a_5 SEI_t + a_6 CEOage_t + a_7 H5_t + a_8 OS_t + a_9 Ncf_t + a_{10} Lev_t + \sum_{i=1}^{m} a_{11+i} Industry + \sum_{i=1}^{n} a_{12+m+i} Year + \varepsilon \quad (2)$$

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RESULTS

Statistical Description

Table 2. Descriptive statistics

	N	Mean	Median	Max	Min	SD
RD_density	2726	0.0274	0.0216	0.2732	0.0001	0.0213
RD_intensity	2726	0.0706	0.0500	0.9839	0.0002	0.0687
Patent	2791	2.0067	2.0794	6.9847	0.0000	1.3378
POI	2791	1.5027	1.3863	6.8977	0.0000	1.2093
UM	2791	1.1002	0.6931	5.6240	0.0000	1.1002
AD	2791	0.3499	0.0000	4.6444	0.0000	0.3499
TOR	2445	0.2953	0.2183	0.9660	0.0021	0.20972
OE	1801	0.1015	0.0463	1.0737	-0.0001	0.1380
OE2	1801	0.0293	0.0021	1.1529	0.0000	0.0835
ER	1801	0.2016	0.1111	0.9930	-0.00003	0.2281
ER2	1801	0.0926	0.0124	0.9861	0.0000	0.1722
ROE	2230	0.0770	0.0739	0.5529	-1.8069	0.0985
NASS	2791	5.6717	5.0589	31.544	0.7524	3.1343
EPS	2546	133.81	57.30	52681.75	-7648.65	1456.61
SEI	2421	0.9224	1.0000	1.0000	0.0000	0.2650
CEOage	2165	3.88805	3.8918	4.2485	3.4012	0.1251
H5	2791	0.5704	0.5092	0.8934	0.0944	0.1249
OS	2778	0.1935	0.1351	0.8433	0.0000	0.1918
Ncf	2791	0.0338	0.0348	0.4876	-0.3544	0.0720
Lev	2791	0.2558	0.2261	0.8864	0.0110	0.1608

According to the descriptive statistics of the variables, for the companies listed on the GEM, the proportion of overseas sales revenue in the total sales revenue is still relatively small, and even negative, and during the period of 2009-2016, it is not All companies are involved in internationalization. With only 1801 export data, it can be known that the degree of internationalization of GEM companies is not high. It is a more appropriate choice to use exports to express internationalization. According to the data of strategic emerging industries (SEI), the average value reached 0.9224, indicating that a large number of enterprises in the gem are strategic emerging industries and have sufficient motivation for technological innovation.

Internationalization and R&D Investment

This paper uses empirical research methods to verify the hypotheses, and descriptive statistics, regression analysis and other methods to explore the relationship between the

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internationalization of GEM companies and technological innovation, the software used is stata12.0.

Table 3. Regression results of the impact of internationalization on R&D investment

Variable	RD_density		RD_intensity	
	(1)	(2)	(3)	(4)
OE	-0.0052 (-0.59)		-0.1550*** (-5.87)	
OE2	0.0184 (1.15)		0.1880*** (3.85)	
ER		-0.0125* (-1.93)		-0.0879*** (-4.42)
ER2		0.0113 (1.34)		0.0785*** (3.04)
ROE	0.0122* (1.87)	0.0109* (1.67)	-0.104*** (-5.23)	-0.105*** (-5.25)
NASS	-0.0003* (-1.75)	-0.0004** (-1.96)	0.0008 (1.31)	0.0009 (1.56)
EPS	1.38e-7 (0.60)	1.16e-7 (0.50)	6.05e-7 (0.87)	6.10e-7 (0.87)
SEI	0.0068** (2.40)	0.0067** (2.32)	0.0182** (2.10)	0.0213** (2.42)
CEOage	0.0005 (0.13)	0.0006 (0.15)	-0.0174 (-1.47)	-0.0145 (-1.21)
H5	-0.0071 (-1.64)	-0.0056 (-1.29)	-0.0489*** (-3.70)	-0.0515*** (-3.88)
OS	-0.0002 (-0.06)	0.0004 (0.15)	0.0137* (1.70)	0.0120 (1.47)
Ncf	0.0220*** (2.60)	0.0235*** (2.79)	0.0201 (0.78)	0.0109 (0.42)
Lev	-0.0143*** (-3.87)	-0.0136*** (-3.74)	-0.1000*** (-8.95)	-0.1080*** (-9.67)
Industry	Control	Control	Control	Control
Year	Control	Control	Control	Control
cons	0.0155 (0.96)	0.0164 (1.00)	0.1650*** (3.33)	0.1550*** (3.11)
F	9.92***	10.06***	12.30***	11.72***
Adj-R2	18.15%	18.39%	21.93%	21.05%
Prob>F	0.0000	0.0000	0.0000	0.0000
N	1167	1167	1167	1167
Remark： ***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.				

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From the perspective of enterprise technology innovation investment, in the regression of internationalization and R & D investment, R & D density (RD_density) is significantly correlated with overseas sales proportion (ER) at 10% level. R & D intensity (RD_intensity) is significantly correlated with overseas sales intensity (OE), overseas sales proportion (ER) and its square term (OE2) (ER2) at 1% level. The above results show that the internationalization and R&D investment of GEM companies are indeed positive U-shaped relationships. The constant term is positive. Firstly, it shows that the internationalization and R&D investment of the GEM enterprises have a positive and negative relationship in the first quadrant. Secondly, through further calculations, it can be seen that the positive U-shaped lowest points of the four regression results are greater than 0. Therefore, it means that the positive U-shaped graphs produced by the four regressions are quadratic function images located in the first quadrant. More importantly, the average overseas sales intensity (OE) and overseas sales (ER) of the GEM companies are lower than the lowest point corresponding to the overseas sales intensity (OE) and overseas sales (ER), This shows that in China's GEM companies are currently on the left side of the positive U-shaped graphics, internationalization and technological innovation are negatively correlated. This also shows that China's GEM companies are still in the initial stage of internationalization. The investment in technological innovation has not yet been beneficially affected by the process of internationalization of enterprises.

Table 4. Regression results of the impact of internationalization on R&D investment by foreign actual controllers

Variable	RD_density		RD_intensity	
	(1)	(2)	(3)	(4)
OE	0.0854***		0.0790*	
	(3.68)		(1.74)	
ER		0.0457***		0.0619**
		(3.50)		(2.51)
ROE	0.0716	0.0871	0.0522	0.0967
	(1.30)	(1.52)	(0.48)	(0.90)
NASS	-0.0003	-0.0002	-0.0038	-0.0030
	(-0.28)	(-0.15)	(-1.63)	(-1.31)
EPS	-7.82e-6	-6.57e-6	-7.38e-6	-8.90e-6
	(-0.67)	(-0.56)	(-0.32)	(-0.40)
SEI	0.0075	0.0072	0.0305	0.0233
	(0.62)	(0.59)	(1.29)	(1.01)
CEOage	0.0062	0.0057	-0.0040	-0.0013
	(0.25)	(0.23)	(-0.08)	(-0.03)
H5	-0.0338	-0.0413*	-0.0639	-0.0789*
	(-1.54)	(-1.83)	(-1.49)	(-1.86)
OS	-0.0161	-0.0237	0.0128	0.0004
	(-1.17)	(-1.65)	(0.47)	(0.01)

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Ncf	0.0150 (0.28)	0.0139 (0.26)	-0.0036 (-0.03)	-0.0102 (-0.10)
Lev	-0.0384* (-1.71)	-0.0340 (-1.51)	-0.1280*** (-2.92)	-0.1260*** (-2.97)
Industry	Control	Control	Control	Control
Year	Control	Control	Control	Control
cons	0.0400 (0.40)	0.0447 (0.44)	0.1950 (0.99)	0.1930 (1.01)
F	2.08**	1.98**	2.46***	2.76***
Adj-R2	21.50%	19.96%	26.96%	18.19%
Prob>F	0.0178	0.0247	0.0048	0.0017
N	76	76	76	76
Remark：***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.				

Table 5. Regression results of the impact of internationalization on R&D investment by domestic actual controllers

Variable	RD_density		RD_intensity	
	(1)	(2)	(3)	(4)
OE	-0.0029 (-0.69)		-0.0781*** (-5.91)	
ER		-0.0087*** (-3.72)		-0.0404*** (-5.40)
ROE	0.0139** (2.15)	0.0117* (1.82)	-0.0993*** (-4.86)	-0.1060*** (-5.17)
NASS	-0.0003 (-1.58)	-0.0004* (-1.82)	0.0011* (1.71)	0.0012* (1.89)
EPS	1.27e-7 (0.57)	1.03e-7 (0.46)	5.04e-7 (0.71)	5.13e-7 (0.72)
SEI	0.0056* (1.90)	0.0044 (1.51)	0.0138 (1.48)	0.0129 (1.38)
CEOage	-0.0011 (-0.27)	-0.0012 (-0.35)	-0.0224* (-1.79)	-0.0219* (-1.76)
H5	-0.0051 (-1.13)	-0.0039 (-0.86)	-0.0527*** (-3.68)	-0.0559*** (-3.90)
OS	-0.0013 (-0.47)	0.00004 (0.01)	0.0077 (0.90)	0.0100 (1.16)
Ncf	0.0252*** (2.95)	0.0272*** (3.21)	0.0225 (0.83)	0.0185 (0.68)
Lev	-0.0113*** (-2.98)	-0.0110*** (-2.94)	-0.0947*** (-7.86)	-0.1030*** (-8.62)
Industry	Control	Control	Control	Control

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Year	Control	Control	Control	Control
cons	0.0229 (1.40)	0.0254 (1.56)	0.1980*** (3.81)	0.1950*** (3.75)
F	9.86***	10.46***	11.29***	11.03***
Adj-R2	19.01%	20.04%	21.43%	21.00%
Prob>F	0.0000	0.0000	0.0000	0.0000
N	1058	1058	1058	1058
Remark：***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.				

According to table 4 and table 5, R & D density (RD_density) is significantly positively correlated with overseas sales intensity (OE) and overseas sales proportion (ER) at the level of 1% for the internationalization and R & D investment under the actual foreign controllers. R & D intensity (RD_intensity) has a positive and significant relationship with overseas sales intensity (OE) and overseas sales proportion (ER) at the significance levels of 10% and 5%. This fully shows that when the actual controller is a foreign natural person (foreign organization), it can make the organizational learning ability play a positive effect, and its positive effect is greater than the negative impact of the principal agent on the R & D investment, so that the internationalization of the enterprise has greatly promoted the progress of technological innovation. On the other hand, the international with R & D investment, R & D density (RD_density) with overseas sales intensity (OE), R & D intensity (RD_intensity) with overseas sales intensity (OE) and the proportion of overseas sales (ER) are negatively correlated in the 1% significant level. This also fully shows that when the controller is a domestic natural person (domestic organization), because it does not have the international experience of the former, it is more difficult to supervise, so the negative effect of the agency on R&D investment is greater than the positive effect of organizational learning. As a result, the internationalization of domestic controllers is negatively related to the technological innovation of enterprises.

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Internationalization and Total Number of Patents

Table 6. Regression results of the impact of internationalization on the total number of patents

Variable	(1)	(2)
OE	-1.1780* (-1.91)	
OE2	1.3690 (1.20)	
ER		-1.2540*** (-2.73)
ER2		1.3090** (2.19)
ROE	0.5630 (1.50)	0.5280 (1.41)
NASS	0.0533*** (3.98)	0.0541*** (4.05)
EPS	-1.29e-5 (-0.79)	-1.32e-5 (-0.81)
SEI	1.1590*** (5.72)	1.2090*** (5.91)
CEOage	-0.4440 (-1.61)	-0.3940 (-1.42)
H5	-0.2580 (-0.84)	-0.2640 (-0.86)
OS	0.6130*** (3.25)	0.5920*** (3.11)
Ncf	-0.3040 (-0.52)	-0.3310 (-0.57)
Lev	-0.0118 (-0.05)	-0.0866 (-0.34)
Industry	Control	Control
Year	Control	Control
cons	1.401 (1.22)	1.235 (1.08)
F	12.84***	13.01***
Adj-R2	22.39%	22.64%
Prob>F	0.0000	0.0000
N	1191	1191
Remark : ***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.		

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From the perspective of technological innovation output, the empirical results are in line with expectations. The total number of patents (OE) is significantly related to the overseas sales intensity (OE), the proportion of overseas income (ER) and its squared term (ER2). Significant correlations at 10%, 1%, and 5% indicate that the internationalization of GEM companies is positively U-shaped with the total number of patents. According to the calculation, the four regression positive u-shaped graphs are quadratic function images in the first quadrant. More importantly, in the regression results of enterprise internationalization and total number of patents, it is also found that the average and median values of overseas sales intensity (OE), overseas sales proportion (ER) are lower than those of overseas sales intensity (OE) and overseas sales proportion (ER) corresponding to the lowest point. This shows that in China's GEM enterprises are currently on the left side of the positive U-shaped graph, the internationalization and the total number of patents are negatively correlated, indicating that the technological innovation output of China's GEM companies has not been beneficially affected by the internationalization of enterprises.

From Table 7, we can see that the internationalization of foreign actual controllers has a significant positive correlation with the total number of patents, and is significant at the level of 5% and 10% respectively. On the contrary, the internationalization and total number of patents under actual controllers in China showed a significant negative correlation at the level of 5% and 10%.

Table 7. Regression results of the impact of internationalization on the total number of patents by actual controllers at home and abroad

Variable	Panel A：Foreign actual controller		Panel B：Domestic actual controller	
	(1)	(2)	(3)	(4)
OE	2.4380** (2.27)		-0.6040** (-2.00)	
ER		1.0410* (1.71)		-0.3030* (-1.77)
ROE	5.1690** (2.03)	5.2040* (1.95)	0.5610 (1.45)	0.5160 (1.33)
NASS	0.2200*** (4.01)	0.2160*** (3.79)	0.0459*** (3.29)	0.0467*** (3.35)
EPS	0.0010* (1.85)	0.0011* (1.95)	-1.51e-5 (-0.91)	-1.49e-5 (-0.90)
SEI	-0.3330 (-0.60)	-0.2460 (-0.43)	1.1740*** (5.42)	1.1690*** (5.38)
CEOage	0.8200 (0.71)	0.7610 (0.65)	-0.4270 (-1.49)	-0.4230 (-1.47)
H5	0.5110 (0.50)	0.4030 (0.38)	-0.0895 (-0.27)	-0.118 (-0.36)

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OS	-2.9120*** (-4.55)	-3.0560*** (-4.56)	0.6940*** (3.49)	0.7090*** (3.54)
Ncf	-1.6620 (-0.68)	-1.6190 (-0.65)	-0.4630 (-0.77)	-0.4920 (-0.81)
Lev	3.4460*** (3.32)	3.6020*** (3.42)	-0.2800 (-1.03)	-0.3400 (-1.26)
Industry	Control	Control	Control	Control
Year	Control	Control	Control	Control
cons	-2.3020 (-0.50)	-2.0880 (-0.44)	1.3530 (1.14)	1.3340 (1.12)
F	6.63***	6.28***	11.80***	11.76***
Adj-R2	58.79%	57.22%	21.86%	21.80%
Prob>F	0.0000	0.0000	0.0000	0.0000
N	76	76	1082	1082
Remark：***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.				

Combined with the empirical results of the previous internationalization and r&d investment, it can be seen that, on the one hand, due to the immature development of gem enterprises, when carrying out the internationalization strategy, enterprises lack experience in internationalization and strong learning ability, and the positive impact brought by internationalization on the technological innovation of enterprises is still small. On the other hand, due to the opportunistic behavior of senior executives, they deviate from the actual control of people's rights and interests and bring negative effects to the technological innovation of enterprises. At this time, the positive effect of internationalization based on organizational learning theory on enterprises is less than the negative effect of internationalization based on principal-agent theory, so that enterprise internationalization is negatively correlated with technological innovation. With the deepening of internationalization, enterprises gradually accumulate experience in the international market and enhance their learning ability. The positive effect of enterprise internationalization on technological innovation is gradually greater than that of executives due to opportunism. At this time, enterprise internationalization is positively correlated with enterprise technology innovation. Therefore, internationalization and technological innovation present a positive u-shaped relationship. And if the actual controllers of the enterprises are foreign natural persons or foreign organizations, they have already had relevant international experience and experience before managing the Chinese GEM companies, and they are from more developed countries or regions. As a result, in the process of internationalization of GEM enterprises, their organizational learning ability will be stronger, and they have both ability and motivation to promote technological innovation. Therefore, internationalization will play a more significant positive role in technological innovation. If the actual controller is a domestic natural person or domestic organization, they do not have such sufficient international experience, so they do not have strong organizational learning ability in the process of internationalization. In this case, despite their incentive to innovate, executives have greater freedom of action as a result of internationalization, giving them a great opportunity to deviate from the rights of the actual controller. And they can take advantage of the complexity of

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administration and holes, for the sake of his reputation and short-term interests, to reduce the risky and long-term technological innovation investment. The entrusted agency problem has increased the negative impact on technological innovation in internationalized enterprises, and is greater than the positive effect brought by internationalization to enterprise technological innovation based on organizational learning theory. The negative influence of the principal-agent is dominant, so the reverse effect of enterprise internationalization on technological innovation will be significant. So we can prove hypothesis 1, hypothesis 2 and hypothesis 3.

Internationalization with Patent of Invention, Utility Model Patent and Appearance Design Patent.

Table 8. Regression results of internationalization on the impact of patent of invention, utility model patent and appearance design patent

Variable	POI		UM		AD	
	(1)	(2)	(3)	(4)	(5)	(6)
OE	-1.4150** (-2.49)		-0.3030 (-0.50)		0.3500 (0.82)	
OE2	1.2070 (1.14)		-0.0441 (-0.04)		0.2170 (0.28)	
ER		-1.2740*** (-3.01)		-0.0118 (-0.03)		0.0678 (0.21)
ER2		0.9790* (1.77)		-0.1930 (-0.33)		0.33300 (0.81)
ROE	0.5750* (1.65)	0.5060 (1.46)	0.5780 (1.56)	0.5570 (1.51)	-0.1510 (-0.58)	-0.1080 (-0.42)
NASS	0.0740*** (5.98)	0.0744*** (6.04)	0.0222* (1.68)	0.0226* (1.71)	0.0053 (0.57)	0.0054 (0.58)
EPS	-6.07e-6 (-0.40)	-6.60e-6 (-0.44)	-6.34e-6 (-0.39)	-6.20e-6 (-0.38)	-9.70e-6 (-0.86)	-9.59e-6 (-0.85)
SEI	1.0100*** (5.40)	1.0320*** (5.47)	0.8220*** (4.12)	0.8120*** (4.03)	0.0849 (0.61)	0.1120 (0.79)
CEOage	-0.2650 (-1.04)	-0.2330 (-0.91)	-0.9360*** (-3.44)	-0.9420*** (-3.44)	-0.00914 (-0.05)	0.0077 (0.04)
H5	-0.6930** (-2.44)	-0.6820** (-2.42)	0.6230** (2.06)	0.6110** (2.03)	-0.1880 (-0.89)	-0.1960 (-0.93)
OS	0.1110 (0.64)	0.1260 (0.72)	0.5620*** (3.02)	0.5740*** (3.06)	1.1370*** (8.74)	1.1000*** (8.38)
Ncf	-0.1780 (-0.33)	-0.2110 (-0.40)	-0.5810 (-1.02)	-0.6040 (-1.06)	0.2920 (0.73)	0.3060 (0.77)
Lev	0.0682 (0.29)	-0.0283 (-0.12)	0.0480 (0.19)	0.0210 (0.08)	-0.3140* (-1.79)	-0.2780 (-1.60)

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Industry	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
cons	0.6880 (0.65)	0.6030 (0.57)	2.6940** (2.39)	2.7110** (2.40)	0.2310 (0.29)	0.1640 (0.21)
F	11.52***	11.82***	7.68***	7.67***	4.49***	4.61***
Adj-R2	20.41%	20.86%	14.01%	13.98%	7.83%	8.08%
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N	1191	1191	1191	1191	1191	1191
Remark：***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.						

The empirical results in table 8 show that the patent of invention (POI) has a significant relationship with the secondary term (OE2) of the overseas sales intensity , the proportion of the overseas income (ER) and its squared term (ER2), and is significantly correlated with 5%, 1% and 10% respectively. Similarly, the constant term is positive, first indicating that the internationalization of the GEM and the patent of invention (POI) have a positive-negative relationship in the first quadrant. Second, through further calculation, the lowest point of the positive u-shape of the four regression results is greater than 0, which indicates that the positive u-shape graphs produced by the four regression results are all quadratic function images in the first quadrant with the minimum value greater than 0. Similarly, the average overseas sales intensity (OE) and overseas sales ratio (ER) of the GEM companies are lower than the minimum overseas sales intensity (OE) and overseas sales (ER). This shows that in China's GEM companies are currently on the left side of the positive U-shaped graphics, internationalization and patent of invention (POI) are negatively correlated.

Table 9. Regression results of the impact of internationalization under foreign controllers on patent of invention, utility model patent and appearance design patent

Variable	POI		UM		AD	
	(1)	(2)	(3)	(4)	(5)	(6)
OE	2.0190* (1.78)		-0.2270 (-0.20)		1.3690** (2.16)	
ER		0.9650 (1.52)		-0.8370 (-1.31)		0.6270* (1.75)
ROE	5.3180* (1.98)	5.5060* (1.98)	0.2850 (0.10)	-0.8580 (-0.31)	2.3670 (1.58)	2.4520 (1.57)
NASS	0.1360** (2.35)	0.1360** (2.29)	0.2410*** (4.06)	0.2180*** (3.66)	0.0581* (1.79)	0.0570* (1.71)
EPS	0.0002 (0.57)	0.0004 (0.65)	0.0009 (1.61)	0.0010* (1.80)	-2e-6 (-0.01)	3.24e-5 (0.10)
SEI	-0.6020 (-1.02)	-0.5660 (-0.95)	0.4660 (0.77)	0.7220 (1.20)	0.1070 (0.32)	0.1410 (0.42)

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CEOage	1.4630 (1.20)	1.4310 (1.17)	-0.9550 (-0.77)	-1.0730 (-0.87)	-1.0800 (-1.58)	-1.1060 (-1.60)
H5	-0.6370 (-0.60)	-0.7680 (-0.70)	1.2600 (1.15)	1.5700 (1.43)	-1.1810* (-1.98)	-1.2590** (-2.04)
OS	- 3.3260*** (-4.93)	- 3.4730*** (-4.97)	-0.9700 (-1.40)	-0.7520 (-1.08)	-0.1300 (-0.34)	-0.2220 (-0.56)
Ncf	-0.7500 (-0.29)	-0.7430 (-0.28)	-1.5080 (-0.57)	-1.3030 (-0.50)	-0.3090 (-0.21)	-0.2970 (-0.20)
Lev	3.7810*** (3.45)	3.8980*** (3.55)	2.2340* (1.99)	2.3050** (2.10)	-0.4140 (-0.68)	-0.3310 (-0.54)
Industry	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
cons	-2.8190 (-0.58)	-2.6730 (-0.54)	1.0970 (0.22)	1.3070 (0.26)	4.6320* (1.69)	4.7400* (1.71)
F	4.83***	4.72***	3.33***	3.52	1.10	0.99
Adj-R2	49.28%	48.51%	37.13%	0.01%	2.38%	0.29%
Prob>F	0.0000	0.0000	0.0002	0.3896	0.3795	0.4871
N	76	76	76	76	76	76
Remark：***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.						

Table 10. Regression results of the impact of internationalization under domestic controllers on patent of invention, utility model patent and appearance design patent

Variable	POI		UM		AD	
	(1)	(2)	(3)	(4)	(5)	(6)
OE	- 0.9620*** (-3.49)		-0.3240 (-1.09)		0.4420** (2.09)	
ER		- 0.6180*** (-3.97)		-0.0811 (-0.48)		0.3200*** (2.68)
ROE	0.5360 (1.52)	0.4510 (1.28)	0.6850* (1.80)	0.6680* (1.75)	-0.1030 (-0.38)	-0.0604 (-0.22)
NASS	0.0716*** (5.61)	0.0720*** (5.67)	0.0087 (0.63)	0.0096 (0.70)	0.0034 (0.35)	0.0035 (0.36)
EPS	-6.81e-6 (-0.45)	-7.09e-6 (-0.47)	-8.89e-6 (-0.55)	-8.55e-6 (-0.52)	-1.08e-5 (-0.93)	-1.05e-5 (-0.91)
SEI	1.0650*** (5.38)	1.0360*** (5.23)	0.7590*** (3.55)	0.7690*** (3.58)	0.06040 (0.40)	0.07940 (0.52)
CEOage	-0.3210	-0.3220	- 0.8890***	- 0.8830***	0.1310	0.1340

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	(-1.22)	(-1.23)	(-3.13)	(-3.11)	(0.65)	(0.66)
H5	-0.5160* (-1.71)	-0.5350* (-1.78)	0.7810** (2.40)	0.7500** (2.31)	-0.1160 (-0.50)	-0.1150 (-0.50)
OS	0.2190 (1.21)	0.2680 (1.47)	0.5040** (2.57)	0.4990** (2.52)	1.1780*** (8.46)	1.1490*** (8.21)
Ncf	-0.3000 (-0.54)	-0.3220 (-0.58)	-0.6490 (-1.09)	-0.6790 (-1.14)	0.2410 (0.57)	0.2440 (0.58)
Lev	-0.1430 (-0.57)	-0.2320 (-0.94)	-0.2110 (-0.79)	-0.2470 (-0.93)	-0.3040 (-1.60)	-0.2650 (-1.40)
Industry	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
cons	0.8480 (0.78)	0.8720 (0.80)	2.5940** (2.21)	2.5510** (2.17)	-0.2650 (-0.32)	-0.2910 (-0.35)
F	10.86***	11.02***	7.28***	7.24***	4.44***	4.55***
Adj-R2	20.35%	20.61%	14.00%	13.92%	8.17%	8.42%
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N	1082	1082	1082	1082	1082	1082
Remark：***, ** and * indicate significant levels at 1%, 5%, and 10%, respectively.						

For the group of foreign actual controllers, the results show that the overseas sales intensity (OE) and patent of invention (POI) are significantly positively correlated at 10%, while for the group of domestic actual controllers, the patent of invention (POI) and the overseas sales intensity(OE), the proportion of overseas income (ER) are significantly negatively correlated at 1%.

The results of patent of invention (POI) are basically consistent with the empirical results in table 6 and table 7. However, in addition to patent of invention (POI), the empirical results of utility model patent (UM) and appearance design patent (AD) are not significant and do not support the original hypothesis. Therefore, this not only proves that from the perspective of enterprise technology innovation output, enterprise internationalization and technological innovation show a positive U-shaped relationship. The internationalization of foreign real holding people is positively related to technological innovation, and the internationalization of domestic actual holding persons is negatively related to technological innovation. And further studies carried out from the categories of the total number of patents show the relationship between international and patents of invention (POI) is significant, utility model patent(UM) and appearance design patent(AD) are not significant. This shows that internationalization has a significant relationship with the total number of patents, and that the significant relationship between invention patents and enterprise internationalization plays a major role.

In addition, each of the above regression groups passed the test of variance inflation factor (vif), and the detection value is less than 10, which further indicates that there is no collinearity relationship between variables, and also indicates the robustness of the empirical results.

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Robustness Test

R&D personnel and technicians are important human resources for technological innovation, and one of the ways for enterprises to invest in research and development. Since the annual report of the GEM is only from 2015, the number of R&D personnel is generally disclosed. Therefore, considering the integrity and accessibility of the data, this paper selects the proportion of technicians as the explanatory variable for robustness test.

The empirical results show that the ratio of technicians (TOR) is significantly related to the overseas sales intensity (OE), its squared item (OE2) and the proportion of overseas income (ER), and they are significantly correlated with 10%, 1% and 5% respectively, which indicates that the internationalization of GEM companies and the proportion of technical personnel are positive U-shaped. For the group of foreign natural persons (foreign organizations), the results show that the proportion of technical personnel (TOR) is positively correlated with the proportion of overseas sales intensity (OE) and overseas income (ER) at 5% and 1% respectively. While for the actual controller foreign natural person (domestic organization) group, the results show that the proportion of technical personnel (TOR) is negatively correlated with the proportion of overseas sales intensity (OE) and overseas income (ER) at 1% both. In addition, after the test of the variance expansion factor (vif), the verification is within 3. Therefore, the above empirical results and related calculations and tests verify the robustness of the empirical results of the internationalization and technological innovation of GEM companies.

CONCLUSIONS AND IMPLICATION

Under the policy background of internationalization and technological innovation, this paper studies the relationship between enterprise internationalization and technological innovation from the microcosmic perspective of the actual control person's domestic and foreign attributes by taking the data of GEM enterprises from 2009 to 2016 as a sample. First, the empirical results show that the internationalization and technological innovation of China's GEM companies have a significant positive U-shaped relationship. Moreover, China's GEM enterprises are currently on the left side of the positive U-shaped figure, and internationalization and technological innovation are negatively correlated, indicating that the technological innovation output of China's GEM enterprises has not been beneficially affected by the internationalization of enterprises. Secondly, the internationalization under the actual controllers of foreign countries has a positive correlation with the technological innovation of enterprises. The internationalization under the actual controllers in China has a negative correlation with the technological innovation of enterprises. t is verified that as the actual controlling person is a foreign natural person (foreign organization), they have already had international experience before managing Chinese companies in the process of internationalization. In the process of internationalization, their organizational learning ability will be stronger. Both the ability and the motivation to promote technological innovation, the positive effect of internationalization on technological innovation will be more significant. On

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the contrary, the actual controlling shareholder is a domestic natural person (domestic organization), who does not have such sufficient international experience. Therefore, in the process of internationalization, their organizational learning ability is not strong, leading to the negative correlation between internationalization and technological innovation. Thirdly, when further studying the influence relationship between internationalization and patent of invention, utility model patent and appearance design patent, it is found that only the relationship between internationalization and patent of invention conforms to the original hypothesis, while the relationship between internationalization and utility model patent and appearance design patent are not consistent with the original hypothesis, and it is not significant and has no explanatory significance. Therefore, this shows that internationalization has a significant relationship with the total number of patents, and the significant relationship between invention patents and enterprise internationalization plays a major role, indicating that patent of invention is the patent category that best reflects the ability of patent research and development. Finally, using the technical personnel number is accounted for as the explained variable robustness test, the empirical result is the same as the original hypothesis, further illustrates the GEM enterprises internationalization and the empirical results of the robustness of the technology innovation, as well as the robustness of different linear relationships between enterprise internationalization and technological innovation under different attributes of actual controllers at home and abroad.

Therefore, in the face of such a situation, this paper proposes the following policy implications:

First of all, from the perspective of enterprises, on the one hand, before undertaking international activities, GEM enterprises should make adequate preparations for the early stage of internationalization, such as market selection, targeted product sales, marketing plans, good corporate image and sufficient research. On the other hand, from the perspective of corporate governance, it can be seen from the positive adjustment effect of foreign actual controllers on enterprise internationalization and technological innovation that the importance of shareholders with international experience is obvious. In this paper, through empirical tests, it is verified that the actual controller is a foreign natural person or a foreign organization, and the internationalization of the enterprise will have a positive effect on technological innovation. On the contrary, the actual controller is a domestic natural person or a domestic organization, and the internationalization of the enterprise will have a negative inhibitory effect on technological innovation. Therefore, in the actual business process of the enterprise, it is difficult for the actual controller to make changes or choices, and the shareholders are relatively easy to introduce. Moreover, compared with the executives, the shareholders tend to be in line with the interests of the actual controllers. Therefore, they will safeguard the ultimate interests of the company and consider the long-term development of the company, which will further enhance the technological innovation of the enterprise.

Finally, whether in the academic or in the actual operation of the enterprise, the measurement of the innovation output of the enterprise should not only focus on the total number of patents, but should also focus on invention patents. Because invention patents are the most representative of all patent categories, the most representative of the company's ability to

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innovate output. In this way, it is conducive to our understanding of the technological innovation output of enterprises and the correct evaluation of enterprises' innovation output capability.

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