ATLANTIS PRESS
Advances in Economics, Business and Management Research, volume 94
4th International Conference on Economy, Judicature, Administration and Humanitarian Projects (JAHP 2019)

R&D Investment, Intellectual Property Protection and Corporate Performance

An Empirical Study Based on 190 Listed Companies in China

Rongjian Yu
School of Business Administration
Zhejiang Gongshang University
Hangzhou, China

Lu Cheng
School of Business Administration
Zhejiang Gongshang University
Hangzhou, China

***Abstract*—Based on the knowledge-based theory, this study uses multiple regression methods to study the performance mechanism of R&D investment by using data from 190 GEM listed companies in China from 2011 to 2015. The main conclusions obtained include: first, R&D investment promotes long-term performance better than short-term performance; second, the intellectual property protection positively regulates the relationship between R&D investment and long-term and short-term performance of enterprises and in areas with strong intellectual property protection, and R&D investment can improve long-term and short-term performance of enterprises. The government should increase the protection of intellectual property rights and protect corporate profits. Enterprises should actively carry out R&D to maintain the competitive advantage of enterprises, thus bringing more profits to enterprises.**

Keywords—R&D investment; long-term and short-term performance of enterprises; intellectual property protection

I. INTRODUCTION

Chinese companies in the global innovation landscape are in the midst of a key step toward high-end R&D. Independent innovation is the fundamental way for companies to seek strategic advantage. Enterprises can reduce the cost of original products or develop new products through innovation to create a steady stream of customer needs, thereby improving the company's comprehensive competitiveness and improving corporate performance. Enterprise innovation is an important opportunity to broaden market share, and form competitive advantages, enhance the comprehensive competitiveness of enterprises, and maintain sustainable and stable development. At the same time, the ability to innovate directly affects the country's economic development process and its competitive strength on the international stage. R&D investment as the source and foundation of innovation and knowledge creation is an important way for enterprises to acquire and maintain competitive advantage. R&D activities play an important role in the development of enterprises. R&D activities play an important role in the development of enterprises. For enterprises and governments, only comprehensive and accurate grasp of the characteristics and laws of R&D activities on enterprise development, the R&D decisions of enterprises and the corresponding policies of the government can be targeted. However, at present, no scholars have given affirmative answers to the question of whether R&D investment can promote the improvement of corporate performance. Therefore, in the context of the new era, it is of great practical and theoretical significance to continue to examine the impact of R&D investment on corporate performance deeply.

Scholars focus on the relationship between R&D investment and corporate performance, and conduct research from different angles. In general, there are mainly two aspects of research. First, the relationship between R&D investment and corporate performance is tested. Garcia Manjon et al. (2012) and Morby (1988) respectively found that R&D investment is positively correlated with productivity growth and corporate sales growth [1] [2]. Falk (2012) used Australia's corporate data test to show that R&D investment intensity has a significant positive impact on the number of employees' lags behind the two periods and the growth rate of sales revenue [3]. Sharma (2012) uses Indian pharmaceutical industry data to calculate that the impact of R&D investment on total factor productivity is 15% [4]. Li Lu et al. (2013) took China's manufacturing enterprises as a sample, and concluded that R&D investment (including capital investment and personnel input) has a significant effect on the current performance of the company, and the contribution of R&D funds is significantly higher than that of R&D personnel [5]. Qi Xiuhui et al. (2016) used a sample study of Chinese listed companies and found that R&D investment has a significant effect on corporate performance [6]. Li Sihai and Zou Ping (2016) used the panel data of China's high-tech listed companies from 2007 to 2012 to test the relationship between R&D investment and corporate performance, and also reached a conclusion consistent with the above scholars [7]. Some scholars believe that R&D investment is not or even negatively correlated with corporate performance. Liu Zhen (2014) used Chinese A-share listed companies as a sample to study the relationship between R&D investment intensity and corporate financial performance. It was found that R&D investment intensity had a certain negative impact on performance [8]. Chen Jianli et al. (2015) used data from companies listed in the computer, communications and other electronic equipment manufacturing industries for 3 years. Research shows that R&D investment intensity has a significant negative impact on current corporate performance [9]. Jiang Weiping and Liu Yudi (2016) used the 2010-2014 data of GEM listed companies as the target,

empirically analyzed the relationship between R&D investment and corporate performance. The results show that R&D investment intensity has a significant negative impact on the current performance level of GEM listed companies[10].Lin (2006) used panel data from 258 companies in the United States to find that there is no significant relationship between R&D investment and firm performance [11]. Chen et al. (2015) analyzed the panel data of 78 high-tech listed companies from 2007 to 2013 and found that there is no statistical correlation between R&D investment and performance when the company is in a recession [12]. Some scholars have also drawn a nonlinear relationship between R&D investment and corporate performance. Hartmann et al. (2006) believe that there must be a critical value; R&D investment beyond this threshold will not produce an equal proportion of return on investment [13]. Wang (2011) and Yeh (2010) also reached the same conclusion [14] [15]. Gong Limin and Jiang Shisong's research on Zhejiang Yongkang manufacturing industry shows that R&D investment and corporate profits have an inverted U-shaped nonlinear relationship, that is, R&D investment performance has a critical value. When R&D investment is below the critical value, it shows Positive correlation effects to corporate profits, when R&D investment exceeds the critical value, it has a negative correlation to corporate profits [16]. Li Jing et al. (2013) found that R&D investment can significantly promote total factor productivity only when the company's R&D density is within a certain range [17]. Han Xianfeng and Dong Mingfang (2018) based on data from listed companies in China's smart cities, the results show that the impact of R&D investment on corporate performance is significantly "inverted U" [18]. The second are research on the contextual factors of R&D investment and corporate performance and research on the situational factors of corporate size and government subsidies [19] [20].

In summary, the current relationship between R&D investment and corporate performance has not yet formed a more consistent conclusion. The strategic effect of R&D investment in the construction of competitive advantage of enterprises has a high degree of context dependence. Some companies seek innovation based on R&D, but some companies still seek a push for market expansion. In what context, can R&D investment improve business performance? What is the difference between R&D investment and long-term performance? These issues need to be further explored in order to provide a theoretical reference for effectively promoting corporate performance and competitiveness by focusing on R&D investment in the new normal context.

Based on the above-mentioned realistic propositions and theoretical dilemmas, this study is based on the knowledge-based theory, using multiple regression techniques, using the data of 190 GEM listed companies in China from 2011 to 2015, to study the performance mechanism of R&D investment: (1) R&D investment to enterprises Impact of performance: independent effect; (2) Situational dependence mechanism of R&D investment affecting corporate performance: regulation effect.

II. Theoretical Basis and Hypothesis

A. *Relationship Between R&D Investment and Long-term and Short-term Performance of the Company*

In 1912, Schumpeter first proposed the theory of innovation, which holds that the key to the constant renewal of capitalism lies in technological innovation. In 1986, Romer proposed a model of incremental income growth, arguing that the accumulation of knowledge and advances in technology can promote the rapid growth of returns of other factors, including capital and labor. The resource-based theory believes that when a company has heterogeneous and scarce resources, it will occupy a favorable position in the market and gain a competitive advantage, and research and development innovation is the main way to obtain key resources. Both technical innovation theory and resource-based theory show that R&D innovation plays an important role in promoting enterprise development and helping enterprises to obtain excess profits. Therefore, in the era of knowledge economy, if enterprises want to maintain core competitiveness in the market, they need to continuously innovate. Knowledge-based innovation becomes the basis of sustainable development and the source of competitive advantage. R&D investment as the base and source of enterprise knowledge creation and innovation, the increase in R&D investment can enhance the core competitiveness of the company. In the era of knowledge economy, if enterprises want to maintain core competitiveness in the market, they need to continuously innovate, and knowledge-based innovation becomes the basis of sustainable development and the source of competitive advantage. R&D investment is the basis and source of enterprise knowledge creation and innovation. Increasing enterprise R&D investment can improve the core competitiveness of enterprises. The increase in R&D investment of enterprises can reduce the cost of enterprises and realize product differentiation, so that enterprises have a strong competitive advantage in the market. Increasing the R&D investment of enterprises can enable enterprises to concentrate on all aspects of production activities, improve the efficiency of the use of existing resources, thereby reducing the production costs of enterprises and improving the adaptability of enterprises to different environments [21]. Technological innovation can improve the quality of products, improve the performance of products, create new products, attract customers, increase market share, and increase sales. Some scholars believe that the increase in R&D investment will help improving corporate performance [11] [20] [22]. R&D investment is not a simple cost, but a value-added investment activity that generates excess profits [23]. It takes time for R&D activities to be transformed into R&D results, and it takes time for R&D results to be translated into actual final products. It will not significantly promote short-term performance of the company and may affect the long-term performance of the company [24]. Therefore, the following assumption is made:

H1: Compared with the short-term performance of enterprises, enterprise R&D investment can improve the long-term performance of enterprises.

B. The Role of Intellectual Property Protection in the Regulation of R&D Investment and Long-term and Short-term Performance of Enterprises

The results of enterprise R&D and technological innovation are easily replicated by other companies in the process of application. Once copied, such excess returns will be difficult to lock into R&D investment investors, and enterprises cannot receive expected related benefits. The interests of innovators will be undermined, which will greatly reduce the enthusiasm of enterprise technology innovation. Therefore, a good legal protection environment or a mechanism to reduce the risk of research and disclosure of information is needed to protect the rights of innovative subjects [25]. The protection of intellectual property rights through the obligation of legal means guarantees the flow of relevant economic benefits into the enterprise and provides guarantee for the fairness of the market and the legal environment. It is used more reasonably by authorization and permission. The improvement of legislation and the strictness of the judiciary can effectively reduce disputes, curb infringements, and protect the research and development results of investors. Areas with weak intellectual property protection seem to allow other companies to imitate without compensation, reduce the ability of companies to generate benefits from innovation, and increase the negative impact of R&D spillovers, thereby reducing the incentives for companies to invest in R&D [26]. As an institutional guarantee, intellectual property protection protects the private interests of right holders by giving them legal monopoly rights. It not only helps to compensate the innovator's upfront investment by guaranteeing the monopoly interest in the statutory time, but also reduces the technology transformation pricing caused by the emergence of substitutes, ensures the economic compensation of innovative investment and establishes a long-term stimulus mechanism [27]. At the same time, it can accelerate the dissemination of technical information, greatly reduce duplication of investment, and allow other innovators to stand on the shoulders of giants to develop new technologies and equipment, accelerate technological innovation and strengthen competition in the technology market [28]. With the strengthening of the intellectual property system, the probability of patent infringement of enterprises is low, so the technological monopoly profits and patent licensing fees brought by R&D investment and patent technology will increase [29].Therefore, the following assumptions are made:

H2: Intellectual property protection has a significant positive adjustment effect on the relationship between R&D investment and corporate performance.

H2a: Intellectual property protection has a significant positive adjustment effect on the relationship between R&D investment and long-term performance of the company.

H2b: Intellectual property protection has a significant positive adjustment effect on the relationship between R&D investment and short-term performance of enterprises.

III. RESEARCH METHOD

A. Sample and Data Sources

This study is based on the GEM listed companies listed before December 2015 in China. First, the data is highly reliable. Listed companies are strictly controlled by the government, and their published data is complete and true. Second, research is more valuable. Most of China's listed companies are engaged in high-tech business, and compared with other listed companies; technical factors contribute more to corporate performance and have more research value. From the Wind database, CSMAR database, and iFinD database, data indicators such as the enterprise age, company size, and enterprise asset-liability ratio, Ratio of independent directors, Tobin Q, total net profit margin (ROA), R&D investment and sales revenue of the sample enterprise were downloaded. The number of patent grants and law enforcement cases were obtained from National Intellectual Property Administration of China. It can be selected a sample of R&D investment for five consecutive years, and finally obtained a sample of 190 companies for five consecutive years, with a total of 950 observations. The observation year is 2011-2015.

B. Variable Measurement

1) Dependent variables: long-term performance of enterprise, short-term performance of enterprise:

a) Long-term performance of the company: The Tobin Q model was proposed by American economist James Tobin. Nowadays, the model is widely used internationally to measure company performance, growth of company, performance of mergers and acquisitions, and management effects. Tobin Q reflects the relationship between the company's intrinsic value and market value. It reflects the value judgment of the market on whether the company is successful or not. It is suitable for measuring the value creation in a long period of time and can show the contribution of intangible resources to the value of the enterprise. This study uses the market value indicator Tobin Q as a measure of the long-term performance of the company. The calculation formula is: Tobin Q = enterprise market value / replacement cost of the total capital of the enterprise.

b) Short-term performance of the company: This study uses the total return on assets (ROA) to measure the short-term performance of the company. The calculation formula is: ROA = net profit / average balance of total assets, of which the average balance of total assets = (ending balance of total assets + total assets at the end of the last year)/2.

2) Independent variables:R&D investment: In the existing research on R&D investment, R&D input intensity is the most extensive indicator used to measure R&D investment. Most studies usually reflect the ratio of R&D investment to sales revenue. The advantage of R&D investment intensity compared to absolute indicator is that it has strong comparability among different listed companies. This paper uses R&D input intensity as a measure of R&D investment.

3) Regulatory variables: intellectual property protection: This paper draws on the method of measuring the protection

of intellectual property rights by Dai Zhongqiang (2014) [30]. The specific calculation is as follows:

$$IPP=1+(crime_{i,t}/adpatent_{i,t})/(\Sigma criem_{i,t}/\Sigma adpatent_{i,t})$$

$crime_{i,t}/adpatent_{i,t}$ represents in the i region t year the proportion of IPR enforcement cases to the proportion of patent grants in the region in that year; $\Sigma criem_{i,t}/\Sigma adpatent_{i,t}$ represents the number of IPR enforcement cases in the national t-year accounted for the proportion of patents granted in the current year.

*4) Control variables:*Based on a large number of related literatures, the four core variables are selected as the control variables of this paper. First, the age of the company, the age of the company (age) is subtracted from the year of establishment of the company; second, the size of the company (fsz), the size of the company is represented by the logarithm of the total assets of the enterprise; third, the debt-to-asset ratio (debt), Asset-liability ratio is the ratio of total liabilities to total assets. Fourth, the proportion of independent directors (indepent), according to the research of Zheng and Lv (2009) [31], the proportion of independent directors in the board of directors is used as a measure.

IV. DATA RESULTS

A. Descriptive Statistics

This article uses stata14.0 for empirical analysis. Since the data in this paper is panel data, there may be problems such as heteroscedasticity, sequence correlation and cross-section correlation. Using the usual panel data estimation method will underestimate the standard error, resulting in bias in the model estimation results. Therefore, estimation methods that can simultaneously resolve heteroscedasticity, sequence correlation, and cross-section correlation should be used. The xtscc command from Driscoll & Kraay (1998) solves this series of problems and is suitable for large N small T-type panel data [32]. Therefore, in the subsequent panel data model estimation, this paper uses the xtscc command for processing. At the same time, the Hausman test results show that the fixed effect model is better than the random effect model, so the fixed effect model is chosen. The correlation coefficients between the explanatory variables in Table 1 are all less than 0.5 and the variance expansion factor test is performed on all explanatory variables. The results show that the mean value of the variance expansion factor of each explanatory variable is 1.06, and the variance expansion factors of each explanatory variable are less than 2. Far less than 10, so there is no problem of multiple collinearity. (See "Table I")

TABLE I. DESCRIPTIVE STATISTICS OF VARIABLES AND PEARSON CORRELATION ANALYSIS

	mean	SD	Tonbin Q	ROA	R&D	IPP	Age	fsz	debt	indepent
Tonbin Q	3.1226	2.1746	1							
ROA	0.0518	0.0506	0.2657***	1						
R&D	0.1801	1.1894	-0.0556*	0.0080	1					
IPP	2.0443	1.4161	-0.0425	-0.0140	-0.0094	1				
age	10.8263	4.5198	0.1219***	0.0455	-0.0252	-0.0714**	1			
fsz	21.1797	0.6837	-0.0187	0.1046***	-0.0340	-0.0268	0.0485	1		
debt	0.2422	0.1533	-0.0020	-0.2233***	-0.0405	-0.0028	0.2095***	0.3060***	1	
indepent	0.3778	0.0573	0.0791**	-0.0227	-0.0406	-0.0087	0.0036	-0.0884***	0.0334	1

a. N=950 *** means p<0.01, ** means p<0.05, * means p<0.1

TABLE II. REGRESSION RESULTS OF R&D INVESTMENT AND CORPORATE PERFORMANCE

	Tobin Q				ROA			
	Model1	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**
age	0.7600***	0.7643***	0.7720***	0.7720***	-0.0041***	-0.0042***	-0.0041***	-0.0041***
fsz	0.5099***	0.5109***	0.5099***	0.5064***	0.0061***	0.0060***	0.0060***	0.0060***
debt	-2.6248***	-2.6273***	-2.6343***	-2.6190***	-0.0235	-0.0235	-0.0235	-0.0233
indepent	-3.8527***	-3.8794***	-3.8625***	-3.8692***	0.0442	0.0447	0.0449	0.0448
R&D		0.0391***	0.0416***	0.0489***		-0.0006	-0.0006	-0.0005
IPP			0.0856**	0.0909***			0.0010	0.0011
R&D*IPP				0.0592***				0.0009 **
R2	0.3594	0.3599	0.3613	0.3620	0.0473	0.0476	0.0481	0.0485
ΔR2		0.0005	0.0014	0.0007		0.0003	0.0005	0.0004
F	130.9***	139.43***	138.42***	133.15***	39957.55***	36.85***	35.55***	57.49***

a. N=950 *** means p<0.01, ** means p<0.05, * means p<0.1

B. Hypothesis Testing

Model 2 in "Table II" shows that R&D investment is significantly positively correlated with long-term performance (β=0.0391). In Table 2, Model 6 shows that R&D investment intensity and firm short-term performance are not significant, and the sign is negative (β=-0.0006). Therefore, compared with the short-term performance of enterprises, R&D investment intensity can promote the growth of long-term performance of enterprises, and H1 is established. The results of Model 4 in "Table II" show that intellectual property protection has a significant positive adjustment effect on the relationship between R&D investment and long-term performance of the enterprise (β=0.0592), that is, In the environment of strong intellectual property protection, it will enhance the positive relationship between the intensity of R&D investment and the long-term performance of enterprises, H2a is established; the results of Model 8 in Table 2 show that intellectual property protection has a significant positive adjustment effect on the relationship between R&D investment intensity and short-term performance of enterprises (β=0.0009), that is, In the strong intellectual protection environment, the negative relationship between the intensity of R&D investment and the short-term performance of the company will be weakened, H2b will be established.

V. Conclusion and Enlightenment

A. Conclusion

Based on the panel data of China's GEM listed companies from 2011 to 2015, this paper uses a multilayer regression method to study the relationship between R&D investment and corporate performance, and the role of intellectual property protection in regulating the relationship between the two. The main conclusions obtained include: firstly, R&D investment is more conducive to improving the long-term performance of the company than the short-term performance of the company. Due to the cyclical nature of R&D investment, it may not bring profits to enterprises in the short term. However, in the long run, R&D investment can significantly improve corporate performance. Enterprises should focus on innovation and increase R&D investment. Secondly, Intellectual property protection positively regulates the relationship between R&D investment and long-term and short-term performance of enterprises. Intellectual property protection strengthens the positive relationship between R&D investment and long-term performance of enterprises, and weakens the negative relationship between R&D investment and short-term performance of enterprises. That is to say, in areas with strong intellectual property protection, R&D investment can improve corporate performance. The government should increase the protection of intellectual property rights to ensure the maximum profit of enterprises. At the same time, in areas with strong intellectual property protection, enterprises can obtain more profits and increase investment in research and development.

B. Enlightenment

In the era of knowledge economy, innovation is the source of power for the development and progress of a country and a company. From the business perspective, although R&D investment in the short-term can't bring profits to enterprises, in the long run, R&D investment can significantly improve the long-term performance of enterprises. Enterprises should increase R&D investment, continuously innovate, and maintain enterprise competition advantages to enhance business performance. At the same time, in areas with strong intellectual property protection, enterprises should increase investment in research and development to bring more profits to enterprises.

From the government's point of view, the government should increase the protection of intellectual property rights, strengthen the punishment of infringements, and let the awareness of intellectual property protection be deeply rooted in the hearts of the people. Governments should provide a good legal environment for enterprise innovation, ensure that the innovation income of enterprises is more locked in itself, stimulate the enthusiasm of enterprise innovation, drive supply-side reform with technological innovation, and realize the transformation of regional economic development mode. So it can Improve corporate profits, drive the country's economic development, and thus improve the innovation strength of the entire country.

Acknowledgment

This research was substantially supported by research grants from Key Projects of Philosophy and Social Science Planning in Zhejiang Province (16NDJC029Z) and National Natural Science Foundation of China (71773115).

References

[1] Garcia Manjon, Juan V, Elena RomeroMerino M . "Research,development and firm growth.Empirical evidence from European top R&D spending firms", Research Policy, 41. 6(2012), pp.1084-1092.

[2] Morby S B. "Research on the value relevance of R&D in the computer industry", Academy of Management Journal, 30(1998), pp.51-70.

[3] Falk M. "Quantile estimates of the impact of R&D intensity on firm performance", Small Business Econom ics, 39.1(2012), pp. 19-37.

[4] Sharma C. "R&D and firm performance: evidence from the Indian pharmaceutical industry", Journal of the Asia Pacific Economy, 17.2(2012), pp.332-342.

[5] Li Lu, Zhang Wanting. "Study on the Impact of R&D on The Performance of manufacturing Enterprises in China", Science&Technology Progress and Policy, 30.24(2013), pp.81-85.

[6] Qi Xiuhui,Wang Wei, Wu Zhiyong. "Research on the Relationship Between R&D Investment and Corporate Performance Regulated by Executive Incentive", Science&Technology Progress and Policy, 33.15 (2016), pp.77-82.

[7] Li Sihai, Zou Ping. "A Research on the stickiness of R&D performance — An empirical evidence from high-tech listed enterprises", Science Research Management, 37.2(2016), pp.38-46.

[8] Liu Zhen. "CEO's annual remuneration, intensity of R&D investment and company's financial performance", Science Research Management, 35.12(2014), pp.129 - 136.

[9] Chen Jianli, Meng Lingjie, Wang Qin. "Nonlinear Link between R&D Investment and Performance of Listed Companies", China Science and Technology Forum, 5(2015), pp.67-73.

[10] Jiang Weiping, Liu Daidi. "R&D Intensity,Slack Resources and Firm Performance", The Theory and Practice of Finance and Economics, 37.203(2016), pp.58-62.

[11] Lin B, Lee Y, HUNG S. "R&D intensity and commercialization orientation effects on financial performance" Journal of Business Research, 9(2006), pp. 679-685.

[12] Chen Shou, Zhou Zengmin, Liu Rui. "The impact of technology innovation capability life cycle and R&D investment on firm performance" Science &Technology Progress and Policy, 32.12(2015), pp. 72-78.

[13] Hartmann G C,Myers M B, Rosenbloom R S. "Planning your firm's R&D investment" Research Technology Management, 49.2(2006), pp. 25-36.

[14] Wang C H. "Clarifying the Effects of R&D on Performance evidence from the high technology industries", Asia Pacific Management Review, 16.1(2011), pp. 51-64.

[15] Yeh M L, Chu H P, Sher P J, et al. "R&D intensity,firm performance and the identification of the threshold: fresh evidence from the panel threshold regression model", Applied Economics, 42.3(2010), pp. 389–401.

[16] Gong Limin, Jiang Shisong. "The Impact of R&D Investment on Firm Performance:Evidence from Yongkang's Manufacturing Industry in Zhejiang Province", Zhongda Management Research, 5.3(2010), pp.19-35.

[17] Li Jing,Peng Fei, Mao Defeng. "The Spillover Effect of R&D Input on Firms' TFP: Evidence from Industrial Firms in China" Economic Review, 3(2013), pp. 77-86.

[18] Han Xianfeng, Dong Mingfang. "R&D Investment's Threshold Effect on Firm Performance", Journalof Beijing Institute of Technology (Social Sciences Edition), 20.2(2018), pp. 96–101,116.

[19] Cao Yang, Yi Qiqi. "The Impact of Government Subsidies on R&D Investment and Performance: An Empirical Study Based on Biomedical Manufacturing", Science and Technology Management Research, 1(2018), pp. 41-46.

[20] Wang Xinhong, Lie Yaqian. "Government subsidies, R&D investment and corporate performance", Accounting newsletter, 3(2019), pp. 63-76.

[21] Baruch Lev, Theodore Sougiannis . "The capitalization amortization and value relevance of R&D", Journal of Accounting and Economies, 21(1996), pp.10-13.

[22] Lome O, Heggeseth A G, Moen. "The effect of R＆D on performance: do R＆D intensive firms handle a financial crisis better?", Journal of High Technology Management Research, 27.1(2016), pp. 65-77.

[23] Xie Maohua, Wang Jing, Wang Jin. "Firm Traits, R&D Investment and Firm Value", R&D Mangement, 27.3(2015), pp. 34-44.

[24] Zhou Jiangyan. "A Research on the Relationship between R&D Expenditure and Performance — An Empirical Analysis on Listed Companies of Manufacturing Industry in China", Journal of Industrial Technological Economics,1(2012), pp. 49-57.

[25] Liu Xing, Jiang Shuiquan. "Bank equity connections, intellectual property protection and enterprise innovation — A bank ownership perspective" China Journal of Accounting Research, 9(2016), pp. 207-233.

[26] Joseph P.H, Fan a, Stuart L, Gillan, Xin Yu. "Innovation or imitation? The role of intellectual property rights protections", Journal of Multinational Financial Management, 23(2013), pp. 208-234.

[27] Yi, Z.F., Ye, J.Y., Huang, Y.H., "The protection of intellectual property rights and enterprise innovation: transmission mechanism and its inspection", World Econ, 12(2013), pp. 111-129 (in Chinese).

[28] Moser P. "Innovation without patents: evidence from world fairs" Law Econ, 55.1(2012), pp. 43-74.

[29] Wu Chaopeng, Tang Di. "Innovation and Operating Performance:Evidence from China's Listed Companies", economic Research, 11(2016), pp. 125-139.

[30] Dai Zhongqiang. "Does the intellectual property protection enhance China's export technological sophistication? An empirical study on panel data of provinces", Studies in Science of Science, 32.12(2014), pp. 1847-1858.

[31] Zheng Zhigang, Lu Xiuhua. "The interactive effects of the independence of the board of directors, and an evaluation of the effectiveness of the policies for the system of independent directors in China's capital markets", Management World, 7(2009) pp.133-144, 188.

[32] Driscoll J C, Kraay A C. "Consistent covariance matrix estimation with spatially dependent panel data", The review of economics and Statistics, 80.4(1998), pp.540-560.