The Impact of Private Equity on Corporate Innovation

Haonan Chen [1, *], Keming Liang [2]

[1] Zhicheng College, Fuzhou University, Fuzhou, China

[2] Faculty of Finance, Henan University of Economics and Law, Zhengzhou, China

* Corresponding author: 02116826@fdzcxy.edu.cn

Abstract. Private equity plays a crucial role in today's economic environment and has a profound impact on corporate innovation. This study aims to explore in depth how private equity investment affects corporate innovation and to reveal the mechanisms behind this impact. By constructing a linear regression model, the study finds that private equity investment has a positive effect on firms' R&D investment and patent output, thus proving that private equity investment promotes corporate innovation. The empirical evidence in this paper reveals the investment logic of private equity investment, provides an analysis of the process of the role of private equity investment in influencing corporate innovation performance, and enriches the research on the factors affecting corporate innovation performance. The findings of this paper are of practical significance in guiding private equity investment to enhance corporate innovation.

Keywords: Private equity; Corporate innovation; R&D investment; Total patents.

1. Introduction

In the context of the new economic normal, innovation is an important driving force for enterprise development. Innovation is not only the inevitable trend of enterprise modernization and development but also the determining factor of the enterprise's new prosperity. The wheel of the times rolls forward but also brings new challenges to enterprises, therefore, in-depth thinking about how to realize enterprise innovation is a top priority. In this process, the capital market continues to develop, and the gradual rise of private capital, which brings new opportunities for enterprise development. On the one hand, private equity investment provides capital support to enterprises, and on the other hand, private equity provides enterprises with various value-added services such as financial counseling, strategic planning, and internal management. For enterprises, technological innovation is a high-risk and high-return enterprise activity while private equity pursues high-risk and high-return. So private capital can provide support to enterprise innovation. Based on this, this paper studies the impact of private equity on enterprise innovation, mainly using the literature induction method and econometric method to sort out and empirically analyze the existing theoretical research results. The research significance of this paper is to supplement the existing theory of private equity investment as a kind of enterprise financing and governance mode, its impact on innovation can provide new empirical evidence for the existing theory, and further improve the financing theory and governance theory. In terms of practical significance, private equity investment is not only the injection of funds, but also may bring strategic cooperation, technology transfer, and other aspects of support to promote cooperation and communication between different enterprises and promote industrial innovation and cross-border integration and development. Therefore, studying the impact of private equity investment on enterprise innovation not only helps academics to deeply understand the mechanism and influencing factors of enterprise innovation activities, but also has important policy guidance significance, which can provide reference for enterprises, investors, governments, and all parties in the society.

2. Literature Review

2.1. Private Equity Overview

Private equity is a form of capital market financing that is raised on a private basis and invested through the purchase of equity in unlisted companies [1]. Private equity, which focuses on unlisted companies, is directed to attract a limited number of specific investors and stealthily raise capital. It aims to enhance the market value of investee companies by making equity investments in selected investment targets. Once a company goes public, private equity realizes its equity holdings in cash through equity issuance, merger and acquisition activities, or repurchase of equity by the company's management, realizing a high return on its investment and exiting its holding in the portfolio company [2]. The main mode of operation of private equity investment is the fund, which is organized in the form of a limited partnership, trust, and company, depending on the rights and obligations, the sharing of benefits, and the arrangement of shared risks between the contributors and managers.

2.2. Key Features of Private Equity

According to Cheng Jiuyan and Lin Zhiqin, private equity is a form of equity financing that is traded through the non-public market, usually by private investors who provide funds to unlisted companies in exchange for a certain percentage of equity. Its main features include the fact that private equity raises funds through non-public means. This is not done through public markets or stock exchanges, but rather, funds are selectively raised for specific investors [3]. Private equity investment institutions become shareholders of an enterprise by purchasing equity in the enterprise. Qiao Zhaorong believes that private equity is different from debt financing, private equity investors do not borrow from the enterprise, but share the future earnings of the enterprise, investment institutions are usually willing to hold a longer period, investors need to patiently wait for the development and maturity of the enterprise in anticipation of the enterprise in the future to achieve good performance and realize the return on investment [4]. Typically, firms that demonstrate a level of excellence in technological innovation tend to be more attractive to private equity investors. While these firms may have achieved significant technological success, their lack of experience and capabilities may be a risk to their growth. By bringing in private equity, Joan Zhao's research suggests that investment organizations can provide more sophisticated and improved management support to firms. Private equity investment institutions usually have rich management experience and professional knowledge and can provide strategic guidance at key stages of enterprise development [5]. The investment objects of private equity investment are usually unlisted enterprises, and private equity investors may face the problem of information asymmetry due to the relatively limited information disclosure of unlisted enterprises. It is difficult for investors to obtain accurate corporate information, which increases the uncertainty of investment decisions and carries high business and market risks, as well as the internal systems and management of most invested enterprises are not perfect, and internal development is not balanced, which carries high risks. As the investment object usually involves the growth or entrepreneurial stage enterprises, which are expected to achieve significant value-added in the process of development, private equity investment through capital injection to help enterprises expand the scale of the development of new markets, promote technological innovation, and have a positive impact on the innovation activities of the enterprise, so that the investment performance is far more than the market average, to obtain a higher return [6].

2.3. Impact of Innovation on Business

The world is currently experiencing a new round of scientific and technological revolution and industrial change, which has brought about profound changes in the global innovation pattern and economic structure. Against this background, seizing the commanding heights of science and technology innovation has become the key to occupying the first opportunity and winning the initiative. China is at an important strategic opportunity for development and needs to focus on activating the momentum of high-quality development, strengthening the status of enterprises as the

mainstay of technological innovation, improving the transformation of achievements and incentive mechanisms, and upgrading the capability of independent innovation. Meanwhile, in the face of fierce international competition, enterprises need to enhance their position in the global value chain through transformation and upgrading, and better meet the domestic market demand through technological innovation [7]. The importance of innovation for business development is indisputable, and it is a key driver of long-term business success. In addition, factors affecting innovation cover a wide range of aspects, including internal management, resource inputs, and the size of the organization. Private equity investment happens to have a positive role in these aspects, private equity investment can provide financial support for scientific and technological activities, but also help science and technology enterprises to avoid and resolve innovation risks, which is an important influence on enterprise innovation [8].

3. Mechanisms and Theoretical Hypotheses of Private Equity Influencing Corporate Innovation

3.1. Capital Injection and Investment in Innovation

Private equity facilitates enterprises to increase their investment in innovation by injecting capital. Enterprises provide an impetus for innovation and development mainly through the investment of resources such as capital, personnel, and technology. In terms of capital, private equity provides an additional source of funding for enterprises. Innovation often requires a large amount of capital for research and development, technological improvement, market promotion, etc., while private equity can provide enterprises with relatively flexible financial support to help them better implement their innovation strategies.

3.2. Introduction of Management Experience

Private equity can provide companies with management experience and planning for corporate management, such as strategic planning and corporate management. The impact of internal management on innovation capacity is mainly related to strategic choices, leadership qualities, and corporate culture management. Marketization, such as the adoption of an autonomous innovation strategy in the later stages of growth and maturity, can stimulate firms to invest in innovation. In terms of leader characteristics, leaders' strategic ability, organizational management ability, innovation ability, learning ability, and relationship ability have a subtle impact on corporate innovation. In terms of corporate culture management, corporate culture can have an impact on corporate innovation through its influence on employees, management mode, and organizational learning ability.

3.3. Incentive Mechanisms and Employee Innovation Motivation

Private equity investment can have an impact on the internal incentive mechanism of enterprises, such as employee stock ownership plans and other executive incentives that play a key role in corporate innovation. As business operators, executives have a clear understanding of the business situation, hold the right to allocate corporate resources, and are the decision-makers in the formulation of corporate strategic planning, which can directly lead the enterprise to implement the innovation strategy of giving priority to the quantity of innovation or the quality of innovation. It is self-evident that executive incentives promote corporate innovation. Equity incentives, as a long-term incentive, can enhance the risk-bearing ability of the incentive recipients, promote the incentives to focus on long-term interests, strengthen teamwork and supervision to achieve long-term goals, and have obvious advantages for the long-time, high-risk, high-quality innovation activities such as invention patents.

3.4. Expanding the Size of the Enterprise

In existing research, enterprise size is mostly expressed as the size of personnel or capital, and private equity investors may expand the size of enterprises through mergers and acquisitions, integration, and other means during the investment cycle to promote the growth and innovation of enterprises. By integrating resources, private equity investors help firms make better use of external innovation resources and promote innovation. Firm size reflects the breadth and depth of the knowledge base on which a firm's innovation competitiveness depends. Usually the larger the size of the enterprise, the market competition in which it is located is relatively moderate, and it is preferred to occupy a favorable market position, respond to consumer demand on time, create revenue for the enterprise, and make up for the cost of innovation [9].

Enterprise innovation ability is an important basis for determining whether enterprises can maintain market competitiveness and sustainable development ability, and an important indicator of innovation ability is the number of patents [10]. Private equity investment has the ability and motivation to influence the number of invention patents of invested enterprises. Private equity can screen out enterprises with innovation ability and provide innovation "counseling" for the invested enterprises as an active investor, intervene in the operation and management of the invested enterprises, and influence their R&D decision-making to promote innovation activities and their commercialization. Therefore, for private equity, to improve the return on income, accelerate the investment cycle and reduce investment risk, to guide enterprises to increase the number of patents to increase innovation performance, to improve the success rate of listing and pricing, has a stronger operation and value [11].

Based on this, this paper proposes the following hypotheses:

H1: Private equity has a positive effect on enhancing the number of corporate patents.

H2: Private equity has a positive effect on corporate R&D investment.

4. Variable Selection and Model Construction

4.1. Sample Selection

This paper selects 299 companies listed on the Chinese Growth Enterprise Market as the initial sample, and the data are obtained from the database of CSMAR; at the same time, this paper carries out the screening treatment for the sample, first: to exclude the ST and PT type companies, and second: to exclude the financial type companies.

4.2. Research Variables

4.2.1. Explained variables

Enterprise innovation has a significant impact on the development and competitiveness of enterprises, this paper investigates the impact of private equity on enterprise innovation and selects innovation output as a measure of enterprise innovation according to the study of Chen Si et al [12]. Meanwhile, R&D investment is introduced as another measure of corporate innovation.

4.2.2. Explanatory variables

Borrowing from Wen Jun and Feng Genfu et al, this paper sets dummy variables with whether there is private investment or not, with 1 for having private participation and 0 for not [13].

4.2.3. Control variables

This paper chooses gearing ratio (total liabilities/total assets), and return on assets (net profit/average net assets at the beginning and end of the year) as control variables. Detailed descriptions and calculations of the research variables are shown in Table 1.

Table 1. Types and definitions of variables

Variable type	Variable symbol	Meaning	Calculation method
Explained Variables	PATENE_T	Innovation outputs	Total number of company patents granted
	R_INPUT	Research input	Research/Revenue
Explanatory variables	PE	Whether private equity is involved	Whether there is private investment or not, with 1 for having private participation and 0 for not
Control variables	ALR	Gearing ratio	Total liabilities/total assets
	ROA	Return on assets	Net profit/average net assets at the beginning and end of the year
	SIZE	Company size	Logarithm of total assets
	YEARS	Age of company	From the creation of the enterprise until 2019

4.3. Model design

Inspired by the study of Wenjing Lai and Manny Zheng, this paper constructs a multiple linear regression model to analyze the impact of private equity on corporate innovation [14]; the specific model expression is shown as follows:

$$PATENE\_T=\beta_0+\alpha_1 PE+\alpha_2 controls+\varepsilon \quad (1)$$

$$R\_INPUT=\beta_0+\alpha_1 PE+\alpha_2 controls+\varepsilon \quad (2)$$

PATENE_T and R_INPUT are the innovation output and R&D input respectively used to measure the innovation level of the firms.PE is a dummy variable, which is 1 if there is private equity participation and 0 if there is not. Controls represent the control variables, which include the asset-liability ratio (ALR), the return on assets (ROA), the size of the firm (SIZE), and the age of the firm (YEARS).

5. Results and Discussion

5.1. Descriptive Statistical Analysis

As can be seen from Table 2, among 279 companies there are 136 companies with private investment and 143 companies without private investment, the mean value of innovation output in companies with private shareholding is 91.84 higher than that of companies without private shareholding, meanwhile, the mean value of R&D investment in companies with private shareholding is 8.1% higher than that of companies without private shareholding and the maximum value of the number of patents in companies with private shareholding is 1232 and the maximum value of R&D investment is 43.5%, which are both higher than the companies without private equity. According to the descriptive analysis of the sample, private placement investment can improve the innovation level of enterprises to a certain extent.

Table 2. Descriptive statistics

Variables	N	Mean	Std.dev	Min	Max
Panel A: PE=0					
PATENE_T	143	50.1	122.116	0	717
R_INPUT	143	0.064	0.548	0.0007	0.4006
ALR	143	0.442	0.357	0.0447	3.5129
ROA	143	-0.0129	0.136	-0.636	0.2224
SIZE	143	21.996	0.847	20.193	24.933
YEARS	143	17.740	3.684	10	28
Panel B: PE=1					
PATENE_T	136	91.840	208.955	0	1232
R_INPUT	136	0.081	2.017	0.0031	0.4351
ALR	136	0．362	0.177	0.050	0.836
ROA	136	-0.021	0.212	-1.919	0.216
SIZE	136	21.810	0.783	20.006	23.850
YEARS	136	18.522	4.361	11	33

Note: Panel A and Panel B are descriptive statistics for PE=0, and PE=1, respectively.

5.2. Correlation Test

As shown in Table 3, the correlation coefficient between whether there is private equity participation in and patent output is 0.122, which is positively correlated; the correlation coefficient between whether there is private equity participation in and R&D investment is 0.128, which is positively correlated. The correlation coefficient between enterprise size and patent quantity is 0.195; the correlation coefficient between gearing ratio and R&D investment is -0.114, which is negatively correlated; the correlation coefficient between the control variable of enterprises' establishment years and R&D investment is 0.033, which is positively correlated but not significant.

Table 3. Correlation test

Correlation	YEARS	SIZE	ROA	R_INPUT	NUM	ALR	PE
YEARS	1.000						
SIZE	-0.102*	1.000					
ROA	0.001	0.129**	1.000				
R_INPUT	0.034	-0.092	-0.074**	1.000			
NUM	-0.003	0.195***	-0.038	0.051	1.000		
ALR	-0.078	0.244***	-0.114**	-0.143**	0.059	1.000	
PE	0.097	-0.108***	-0.024	0.128**	0.122**	-0.138**	1.000

Note: *, *, *** represent significance at 0.1, 0.05, and 0.01 levels of significance respectively

5.3. Regression Analysis

Analyzed by the regression results in Table 4, private equity investment has a positive effect on the company's patent output, the involvement of private equity investment will make the company's innovation output increase by 49 units, and is significant at the 0.05 level of significance. Meanwhile, private equity investment has a positive effect on R&D investment, and the intervention of private equity investment increases the company's R&D investment by 1.4%, which is significant at the 0.01 level of significance. For the regression results of control variables, enterprise size is positively related to the number of patents and is significant at the 0.01 level of significance, which means that the larger the enterprise the better the effect of patent output. The gearing ratio is inversely proportional to R&D investment and is significant at the 0.05 level of significance, which means that the higher the gearing ratio, the more reluctant the company is to increase the cost of R&D

expenditure. The regression results show that private equity has a facilitating effect on both patent output and R&D investment, so the two hypotheses of this paper are valid.

Table 4. Regression result

VARIABLES	PATENE_T	R_INPUT
PE	49.960**	0.014*
	(2.45)	(1.72)
ALR	12.140	-0.028* *
	(0.329)	(-2.04)
ROA	-57.560	-0.029
	(-0.99)	(-1.33)
SIZE	44.650***	-0.002
	(3.47)	(-0.061)
YEARS	0.270	0.0001
	(0.109)	(0.169)
Observations	279	279
R^2	0.063	0.041
F-Statistic	3.67	2.35

6. Conclusion

With the continuous improvement and development of private equity investment, as well as its active involvement in corporate activities, it brings a great impetus to corporate innovation. This paper discusses the impact of private equity investment on corporate innovation using cross-sectional data from the top 300 companies listed on the GEM in 2019. It is found that the involvement of private equity increases the R&D expenditures of enterprises and makes them harvest more innovations, while the enterprises' financial structure also affects the R&D expenditures, which implies that the enterprises have to optimize their financial structure to increase the competitiveness of the enterprises. The larger the enterprise is, the easier it is to obtain the research results, which also indicates that the larger the enterprise, the more willing to work on enterprise innovation, promote its continuous development, and continue to grasp the technology.

This paper finds through empirical analysis that private equity investment has a positive effect on enterprise innovation. It verifies the two hypotheses proposed in this paper. However, this paper does not test the robustness of the regression results in the empirical process due to objective reasons such as the inaccessibility of data resources and the consideration of endogeneity issues. Innovation is a key factor that drives long-term business success. Factors affecting firms' innovation cover a wide range of aspects, including internal management, resource investment, and firm size. Private equity investment happens to have a positive contributing role in these aspects. Private equity investment can provide financial support for scientific and technological activities as well as help science and innovation enterprises avoid and resolve innovation risks. Private equity investment is an important force in the capital market, with the continuous improvement of the financial market, which requires all kinds of private investment institutions to strengthen their professionalism, actively participate in the management of invested enterprises, and promote the innovative activities of invested enterprises, to achieve the continuous improvement of the value of the invested enterprises, to obtain more benefits when exiting. For enterprises, if they want to obtain investment from private equity institutions, they must strengthen their risk control consciousness to reduce financial risks and operational risks. At the same time, enterprises should pay attention to their innovation ability, further strengthen their core competitiveness, and stand firm in the ever-changing market.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

References

[1] Jiang Chen. Discussion on the impact of private equity investment on enterprise innovation. National Circulation Economy,2023,(13):81-84

[2] Xiao Xing, LI Shilin. Discussion on Exit Mechanism of Private Equity Market. China Finance,2023,(02):66-68.

[3] Cheng Jiunyan, Lin Zhiqin. Development and Innovation of Private Equity Secondary Market. China Finance,2023,(02):59-61.

[4] Qiao Zhaorong. Private Equity Funds Actively Introducing Long-Term Capital. China Finance,2023,(02):62-63.

[5] Zhao Qiong. Research on the impact of private equity investment on the value of small and medium-sized enterprises under the perspective o f ESG. Economic Issues,2023,(11):40-47.

[6] Wang Lei, Liu Haixiu, He Xuexue. Private equity investment and corporate mergers and acquisitions - Evidence based on the GEM market. Management Review,2019,31(01):27-38.

[7] Xu Hao, Wan Di Fang, Xu Jin. Who is an effective investor to promote corporate innovation between VC and PE? . Science Research,2015,33(07):1081-1088

[8] Wu Xi, Yue Yang, Zhao Yixin. The impact of capital market participation on corporate innovation strategy - an empirical analysis based on listed companies. Southwest Finance,2023,(07):53-64.

[9] Liu Xuexin, Cao Chengzi, Kong Xiaoxu. Theoretical logic and realization path of new quality productivity formation in the context of great power competition. Journal of Chongqing University (Social Science Edition),2023: 1-12.

[10] Peng Nan. A review of research on factors influencing the innovation ability of enterprises in China. Mall Modernization,2023,(21):76-78.

[11] Liu Guanchen, Li Yuanzhen,LI Meng. Private equity investment, executive incentives and corporate innovation performance - an examination based on the perspective of patent heterogeneity. Economic Management,2022,44(08):116-134

[12] Chen Si, He Wenlong, Zheng Ran. Venture capital and corporate innovation:Impact and potential mechanisms. Management World,2017(01):158-169.

[13] Wen Jun, Feng Genfu. Venture capital and corporate innovation:The trade-off between "value" and "capture". Beijing:Economic Research,2018,(2):185-199.

[14] Lai Wenjin, Zheng Manni. Substantive or Strategic Innovation? -The impact of macro-industrial policy on micro-firm innovation. Economic Research,2016,51(04):60-73.