

Intellectual Property Protection, R&D Investment and Enterprise Value

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Abstract: Taking the A-share listed companies in Shanghai and Shenzhen from 2012 to 2019 as a sample, the relationship and mechanism between intellectual property protection and enterprise value are empirically tested. It is found that intellectual property protection has a significant positive impact on enterprise value, and R&D investment is the mediating variable between intellectual property protection and enterprise value. Further analysis shows that for state-owned enterprises, high-tech enterprises and enterprises with less financing constraints, intellectual property protection has a more significant effect on the enhancement of enterprise value.

Keywords: Intellectual property protection; R&D investment; Enterprise value

1. Introduction

Innovation is the primary driving force for development, and protecting intellectual property rights is protecting innovation. Enterprises are the main body of market economy, but also the main body of various technological innovations. On the one hand, enterprises can improve their resource constraints and improve production and operation efficiency through innovation; On the other hand, enterprises use innovative achievements to develop new products, seize market opportunities, and improve corporate profits. In general, enterprise innovation provides resources and conditions for enterprise value, and enterprise innovation ability has become an important part of enterprise intrinsic value. In the research literature on intellectual property protection and enterprise innovation, most scholars believe that intellectual property protection has a positive effect on enterprise innovation. One of the most obvious characteristics of corporate innovation is the increase in R&D investment, however, the more practical question is whether IP protection can enhance enterprise value, and can it have an impact on enterprise value by increasing R&D investment? At the same time, does the impact of intellectual property protection on enterprise value vary according to the various characteristics of enterprises? The answers to the above questions are expected to provide a theoretical basis for how to further improve intellectual property protection and enhance corporate value. For enterprises, relevant policy suggestions can be put forward according to the different characteristics of enterprises to promote the enhancement of corporate value.

The research on the impact of the existing external environment on enterprise value has achieved certain results. As one of the components of the external environment of an enterprise, intellectual property protection will directly affect the formulation of various financial operation decisions of enterprises^[1], thereby affecting the value of enterprises. Tang Yingkai et al.^[2] found that a sound legal environment can provide good investor protection for corporate investment and effectively enhance the value of family enterprises. Huang Zhihong et al.^[3] found that a good institutional environment can help guide the ability allocation of managers, thereby enhancing enterprise value. Zhang Qifeng et al.^[4] based on the political environment of enterprises show that compared with enterprises without political associations, enterprises with political connections can indirectly enhance corporate value by reducing the encroachment of government interests. In summary, the research on the influence of external environment on enterprise value has certain literature support, which lays a good theoretical foundation for the research of this paper. Taking the A-share listed companies in Shanghai and Shenzhen from 2012 to 2019 as a sample, this paper empirically studies the impact effect of intellectual property protection on enterprise value and its transmission mechanism.

2. Theoretical analysis and research hypotheses

2.1. Intellectual property protection and corporate value

Under the tide of "mass entrepreneurship and innovation", with the help of the "Internet +" entrepreneurial environment, the threshold and cost of entrepreneurship have been continuously reduced, and a large number of enterprises have emerged in the market in recent years to participate in innovation. However, limited by development factors such as capital and operation, the guarantee of survival and development in the fierce market competition is to continuously enhance the value of enterprises. The value of enterprise assets and risk defense capabilities brought by intellectual property protection have become important factors to improve enterprise value.

Core technology is the stepping stone for enterprises to enter the market, and technological innovation also needs financial support. As an important part of an enterprise's intangible assets, intellectual property protection can cope with the financing dilemma of enterprises through pledge financing. Especially for technology-based small and medium-sized enterprises subject to capital factors, intellectual property protection is an important part of enterprise value and a direct embodiment of enterprise value. Strengthening intellectual property protection is conducive to protecting the core technologies and innovation achievements of enterprises, accelerating the speed of new product research and development and expanding the confidence of market share to a certain extent, thereby improving the financial performance of enterprises and increasing corporate value^[5]. At the same time, strengthening intellectual property protection has led to an increase in the cost of infringement by enterprises, thereby reducing infringement between enterprises^[6]. On the one hand, the reduction of infringement acts enhances the enthusiasm of enterprises for innovation, on the other hand, it helps enterprises actively disclose their innovation status, reduce the information asymmetry between external investors and enterprises, and enhance investors' confidence, thereby alleviating the difficulties of R&D financing of enterprises. With the smooth development of enterprise R&D activities, the core competitiveness of enterprises is highlighted, and finally brings about the enhancement of corporate value. In summary, this paper proposes hypothesis H1: that intellectual property protection helps to enhance enterprise value.

2.2. Intellectual property protection and R&D investment

Through the combing of existing literature, it is found that the impact of intellectual property protection on enterprises' R&D investment can be divided into direct effects and indirect effects. First, intellectual property protection directly affects the R&D investment of enterprises. Since R&D investment has the characteristics of both positive externalities and innovation output of public goods, enterprises will be too conservative in making R&D investment decisions and are unwilling to invest too many resources in innovation activities. To a certain extent, the intellectual property protection system can protect the innovation results of enterprises from being stolen, ensure that enterprises obtain expected innovation benefits^[7], thereby increasing enterprises' willingness to invest in R&D. Li Wei et al.^[8] found that enterprises with intellectual property rights can obtain economic benefits and recover investment through the transfer and implementation of production, and enterprises are more willing to continue research and development. Zong Qingqing et al.^[9] believe that intellectual property protection can affect enterprises' R&D investment through the inducing effect of innovation, specifically, intellectual property protection enables enterprises to obtain high monopoly profits and effectively protects the interests of R&D enterprises, which is also the key to motivating enterprises to increase R&D investment. At the same time, a sound intellectual property protection system can further stimulate and guarantee the sustainability of regional technological innovation and coordinate the imbalance of regional economic growth^[10], greatly increasing the determination and confidence of enterprises to innovate and succeed, thereby increasing their investment in R&D. Second, intellectual property protection indirectly affects enterprises' R&D investment, which can affect enterprises' R&D investment by alleviating financing constraints. Due to the limited internal resources, enterprises must have some concerns when carrying out high-risk investment activities such as innovation, and will rely on external financing to a certain extent^[11]. When enterprises face a large degree of financing constraints, considering that corporate management is usually a risk averse^[12], its willingness to innovate must be reduced, resulting in a decline in R&D investment. At the same time, R&D activities require continuous investment and have a low collateral value^[13], which makes it more difficult for enterprises to obtain external financing. Financing constraints are largely due to information asymmetry between firms and external investors. Intellectual property protection can increase the willingness of

enterprises to share information on innovation activities with investors^[7], improve the transparency of information between enterprises and external investors, help alleviate the external financing difficulties of enterprises, and thus play a role in stimulating R&D investment^[14]. In summary, this paper proposes hypothesis H2: intellectual property protection can increase enterprises' R&D investment.

2.3. The mediating role of R&D investment

At present, the research conclusions of domestic and foreign scholars on R&D investment and enterprise value are relatively unified, and it is believed that there is a positive relationship between the two. Xu Xin et al. ^[15] found that participating in R&D activities and increasing R&D expenses can create value for enterprises. Chen Jinyong et al. ^[16] believe that there is a certain mechanism of production and output between R&D investment expenses and enterprise value, which can contribute to enterprise value. Wang Lin et al. ^[17] pointed out that R&D investment can promote enterprises to obtain extraordinary profits, which is also an important factor in the growth of enterprise value. Foreign scholars have also done relevant work on the research of R&D investment and enterprise value. The results of Megna et al. ^[18] show that there is a positive relationship between enterprise R&D expenditure and enterprise value. Chan et al. ^[19] also confirm this view. Based on the previous analysis, on the one hand, intellectual property protection, as an important legal system to combat infringement, can prevent the theft of enterprises' innovation achievements to a certain extent, ensure that enterprises obtain expected benefits, and then enhance corporate value; On the other hand, it promotes the enthusiasm of enterprises to share information on corporate R&D activities with the outside world, helps to reduce external financing costs, and enterprises are willing and able to increase R&D investment, thereby enhancing corporate value. In summary, this paper proposes hypothesis H3: R&D investment is the mediating variable between IP protection and enterprise value.

3. Study design

3.1. Sample selection and data sources

In this paper, A-share listed companies in Shanghai and Shenzhen from 2012 to 2019 were selected as the research sample, and the sample enterprises were screened in accordance with the Industry Analysis Guidelines for Listed Companies (revised in 2012) issued by the China Securities Regulatory Commission. And the data was processed as follows: (1) the financial industry and the real estate industry were excluded; (2) Exclude ST, *ST and PT enterprises; (3) Exclude companies that have been listed for less than one year, have been delisted or have been suspended from listing; (4) Exclude samples with missing data. After the above data collation and screening, 15768 observations from 2927 enterprises were finally obtained. In terms of data acquisition, IP protection data and per capita GDP growth rate of each province are obtained by hand from the China Statistical Yearbook, and other enterprise-level data are derived from the CSMAR database. In order to control the influence of extreme values, this paper uses Winsorize tail reduction at the 1% and 99% levels for all continuous variables in this paper, using the econometric analysis software STATA15.

3.2. Variable definitions

3.2.1. Explanatory variables

Drawing on the research methods of Wang Yu et al. ^[20], the "scale of technology market transfer" is adopted as the proxy variable of intellectual property protection (IPR), and the measurement method is the contract turnover of the technology market in the province divided by the GDP of the region in the year.

3.2.2. The variable being explained

The explanatory variable in this article is enterprise value, expressed by Tobin's Q value (Q), and the specific calculation formula is company market capitalization/total assets. Through reviewing the relevant literature, it is found that most of the existing studies use the growth rate of operating income, return on assets, and Tobin Q value to measure enterprise value. Compared with the previous two measures, Tobin's Q score is a better indicator of a company's ability to create wealth and future profits. Therefore, this paper draws on the research results of Yu Xiaohong et al. ^[21], and selects Tobin's Q value (Q) as the measurement index of enterprise value.

3.2.3. Mediation variables

In this paper, R&D investment (RD) is used as the mediating variable. At present, research on R&D investment mainly measures R&D investment by using R&D expenditure, R&D expenditure as a proportion of total assets and R&D expenditure as a proportion of operating income. Due to the heterogeneity of firm scale, this paper adopts the approach of Wang Jia et al. [22], and takes the ratio of R&D expenditure to operating income as a proxy variable for R&D investment. At the same time, the proportion of R&D expenditure to total assets is selected to measure R&D investment to further verify the robustness of the intermediary effect.

3.2.4. Control variables

Drawing on the research of Wang Jiabin et al. [23], Wang Ping, Wang Kai [24] and other scholars, indicators such as enterprise size, return on total assets, proportion of independent directors, and equity concentration were selected as control variables. Table 1 shows all the variables involved in this article.

Table 1: Variable definitions

Variable type	Variable name	Variable symbol	Variable definitions
The variable being explained	Enterprise value	Q	Company market capitalization/total assets
Explanatory variables	Intellectual Property Protection	IPR	Regional technology market contract turnover divided by the gross regional product for the year
Mediation variables	R&D investment	RD1	R&D expenditure as a percentage of operating income
		RD2	R&D expenditure as a percentage of total assets
Control variables	Enterprise size	SIZE	The total assets are taken as natural logarithms
	Enterprise age	AGE	The number of years of company establishment plus 1 takes the natural logarithm
	Proportion of fixed assets	Fixed	Net fixed assets divided by total assets
	Gearing ratio	LEV	Total liabilities are based on total assets
	Return on total assets	ROA	Net profit divided by total assets
	Proportion of independent directors	Ind	The ratio of the number of independent directors to the number of board members
	Equity concentration	Top1	The shareholding ratio of the largest shareholder
	Two jobs in one	Dual	The chairman and general manager take a value of 1 for the same person, otherwise 0
	GDP per capita growth rate by province	GDP	GDP per capita of each province in the current year / per capita GDP of the previous year -1

3.3. Model building

In order to test the relationship between intellectual property protection and enterprise value, the following model is constructed:

$$Q_{i,t} = \alpha_0 + \alpha_1 IPR_{i,t} + \alpha_2 Controls + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (1)$$

In order to test the relationship between intellectual property protection and R&D investment, the following model is constructed:

$$Q_{i,t} = \alpha_0 + \alpha_1 IPR_{i,t} + \alpha_2 RD_{i,t} + \alpha_3 Controls + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (2)$$

Finally, in order to test the mediating effect of R&D investment, this paper constructs the following model based on model (1) and model (2):

$$Q_{i,t} = \alpha_0 + \alpha_1 IPR_{i,t} + \alpha_2 RD_{i,t} + \alpha_3 Controls + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (3)$$

Among them, the explanatory variables $Q_{i,t}$ represent the enterprise Tobin Q value of enterprise i in the t year, which is used to measure the enterprise value, the explanatory variable $IPR_{i,t}$ represents the intellectual property protection intensity of the province to which the enterprise i belongs in the t year, and $RD_{i,t}$ represent the R&D investment of the enterprise i in the t year. Controls represent the control variable, Year and Ind represent the year dummy variable and the industry dummy variable respectively, and $\varepsilon_{i,t}$ represent the random perturbation term.

4. Empirical analysis

4.1. Descriptive statistics

Table 2 reports the results of descriptive statistics for each variable. It can be observed that the maximum value (Q) of enterprise value is 7.6443 and the minimum value is 0.8768, indicating that the ability of different enterprises to create value is quite different. The maximum value of intellectual property protection (IPR) is 0.1399 and the minimum value is 0.0005, indicating that there is a large gap in the intensity of intellectual property protection in various provinces in China. From the two measurement indicators of enterprise R&D investment, there is also a large gap in R&D expenditure between different enterprises, and most enterprises have low innovation enthusiasm and insufficient R&D investment. The descriptive statistical results of the other control variables were close to the existing literature and were within reasonable ranges.

Table 2: Descriptive statistics for variables

variables	N	mean	sd	min	median	max
Q	15768	2.0397	1.1962	0.8768	1.6564	7.6443
IPR	15768	0.0222	0.0349	0.0005	0.0092	0.1399
RD1	15768	0.0439	0.0433	0	0.035	0.2486
RD2	15768	0.0221	0.0188	0	0.0188	0.1009
SIZE	15768	22.1698	1.2396	20.0674	21.9907	26.1093
AGE	15768	2.8481	0.3216	1.7918	2.8904	3.4657
LEV	15768	0.405	0.1955	0.0534	0.396	0.8598
Fixed	15768	0.2164	0.1461	0.0061	0.1886	0.6601
ROA	15768	0.0384	0.0589	-0.2459	0.0371	0.1902
Ind	15768	0.3758	0.0537	0.3333	0.3571	0.5714
Top1	15768	0.3452	0.1442	0.0848	0.3276	0.7306
Dual	15768	0.2839	0.4509	0	0	1
GDP	15768	0.0806	0.0239	0.0123	0.0790	0.1420

4.2. Benchmark regression

The test results of intellectual property protection and enterprise value are shown in Table 3. Among them, column (1) reports the regression results of the uncontrolled time effect and the industry effect, which show that the intellectual property protection (IPR) coefficient is significantly positive at the level of 1%, and column (2) (3) reports the regression results of the annual effect and the industry effect one by one, showing that the intellectual property protection (IPR) coefficient is 1.930 and 1.025, respectively, and is significant at the level of 1% and 5%, respectively, validating the hypothesis H1. This shows that intellectual property protection can positively affect enterprise value, with the increase of intellectual property protection intensity, enterprises can better use intellectual property rights to reduce product costs, prevent R&D results from being stolen, thereby increasing corporate profits and maximizing enterprise value. From the perspective of control variables: enterprise age (AGE), return on total assets (ROA), proportion of independent directors (Ind), per capita GDP growth rate (GDP) are positively correlated with enterprise value (Q), enterprise size (SIZE), fixed asset ratio (Fixed), dual employment (Dual) and enterprise value (Q) are negatively correlated, other control variables are not significant.

Table 3: Benchmark Regression

variables	(1) Q	(2) Q	(3) Q
IPR	1.691*** (4.10)	1.930*** (4.71)	1.025** (2.53)
SIZE	-0.350*** (-19.91)	-0.371*** (-21.26)	-0.382*** (-21.53)
AGE	0.141*** (3.18)	0.162*** (3.25)	0.147*** (3.20)
LEV	-0.279*** (-2.60)	-0.209** (-1.97)	0.080 (0.79)
Fixed	-0.358*** (-3.95)	-0.426*** (-4.75)	-0.234** (-2.28)
ROA	3.229*** (10.12)	3.321*** (10.69)	3.322*** (11.95)
Ind	0.821*** (3.37)	0.804*** (3.40)	0.626*** (2.84)
Top1	-0.190* (-1.87)	-0.122 (-1.22)	0.021 (0.22)
GDP	-3.041*** (-6.89)	1.752*** (3.38)	1.570*** (3.24)
Dual	-0.059* (-1.90)	-0.044 (-1.47)	-0.062** (-2.19)
Constant	9.440*** (25.46)	8.915*** (24.00)	9.236*** (22.58)
N	15768	15768	15768
Industry	NO	NO	YES
Year	NO	YES	YES
R-squared	0.191	0.338	0.396
Note: *, **, **** indicate that they are significant at the level of 1%, 5%, and 10%, respectively, and the T value in parentheses, the same below			

4.3. Robustness test

4.3.1. Sample selection problem

Table 4: Sample selection questions

variables	(1) PSM	(2) Entropy balance method
	Q	Q
IPR	0.971** (2.28)	
IPR_h		0.080** (2.29)
Constant	9.551*** (21.71)	7.823*** (13.07)
N	13908	15768
Industry	YES	YES
Year	YES	YES
R-squared	0.396	0.415

In order to further verify the robustness of the research conclusions, this paper mainly uses the propensity score matching method (PSM) and entropy balance matching method to solve the possible sample selection bias. Firstly, the propensity score matching method is used to construct a counterfactual framework to generate an approximate randomized trial, that is, the control group is used to observe the consequences when the treatment group is not subject to policy intervention, and the problem of selectivity bias is eliminated by comparing the two results, so as to obtain the real causal relationship. In this paper, the annual intensity of intellectual property protection is grouped by the median, and a dummy variable treat is generated, with a treat assignment of 1 above the median and

a treat assignment of 0 below the median, and the propensity score is matched to the data, and the data after PSM are used for regression. Secondly, drawing on the practice of Zhou Zejiang et al. [25], the entropy balance method is used to eliminate the difference in each covariate between the enterprise group (IPR_h=1) and the enterprise in the control group with a high degree of external intellectual property protection, and if the protection intensity of the intellectual production area in the province where the enterprise is located is in the top 20%, then IPR_h=1, otherwise the assignment is 0. The regression results after the above two methods are shown in Table 4, and column (1) shows the sample regression results after PSM treatment, and the results show that the intellectual property protection (IPR) coefficient is significantly positive; Column (2) shows the regression results after entropy balance matching processing, and it is found that the coefficient of the IP protection dummy variable (IPR_h) is still significantly positive. The above two methods show that intellectual property protection has an enhanced effect on enterprise value, indicating that the research conclusions of this paper have a certain degree of robustness.

4.3.2. Other robustness tests

Drawing on the research methods of Yu Minggui et al. [26], this paper takes the Tobin Q value of listed companies in the next year as a proxy variable for enterprise value, and the larger the value, the higher the company value. There is no significant difference between the regression results and the results are shown in column (1) of Table 5. Secondly, referring to the practice of Song Yan and Xuan Ying [27], ChiNext is different from other companies due to its corporate nature and profitability, so after excluding ChiNext, the regression analysis of the SME board and the main board was carried out, and the regression result of the key variables was positive at the level of 5%, and the specific regression results are shown in column (2) of Table 5. At the same time, in order to further alleviate the endogenous problem, the core explanatory variables and control variables lagged in one period for regression. The regression results are shown in column (3) of Table 5, which further shows that the main conclusions of this paper have a certain robustness.

Table 5: Other robustness tests

variables	(1) Future issue of Tobin Q	(2) Q	(3) Q
IPR	0.799* (1.74)	1.169** (2.43)	
L.IPR			0.860* (1.87)
Constant	9.602*** (21.58)	9.355*** (20.43)	9.539*** (21.33)
N	12325	12307	12325
industry	YES	YES	YES
Year	YES	YES	YES
R-squared	0.398	0.395	0.398

4.4. Mechanism test

The above article verifies that intellectual property protection can positively affect enterprise value, and in this part verifies the mechanism of intellectual property protection affecting enterprise value. According to the theoretical hypothesis in the second part above, the stepwise regression method is used to test whether intellectual property protection can enhance enterprise value by increasing enterprise R&D investment. Table 6 shows the results of testing the intermediary effect of R&D investment. As shown in column (1), IP protection significantly increases enterprise value, as verified in the benchmark regression above. Column (2) (3) shows the impact of IP protection on enterprise R&D investment, and the influence coefficient of variable IPR on the intermediary variable RD is significantly positive at the level of 1%, indicating that intellectual property protection can significantly increase enterprise R&D investment, so the hypothesis of H2 is verified. The regression results in column (4)(5) show that R&D investment plays a mediating role between IP protection and enterprise value, so that the hypothesis of H3 is validated. At the same time, the Z values of the mediating variables RD1 and RD2 obtained by Sobel's test were 8.407 and 6.286, respectively, and both were significant at the 1% level, indicating that the intermediary path of "intellectual property protection-R&D investment-enterprise value" was established.

Table 6: The mediation effect of R&D investment returns to the results

variables	(1) Q	(2) RD1	(3) RD2	(4) Q	(5) Q
IPR	1.025** (2.53)	0.080*** (3.24)	0.025*** (2.60)	0.734* (1.81)	0.825** (2.04)
RD1				3.634*** (6.86)	
RD2					7.881*** (6.72)
Constant	9.236*** (22.58)	0.096*** (6.34)	0.050*** (7.30)	8.888*** (21.51)	8.845*** (21.11)
N	15768	15768	15768	15768	15768
Industry	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES
R-squared	0.396	0.426	0.366	0.406	0.406

4.5. Further analysis

Table 7: Test of heterogeneity of property rights nature and degree of financing constraints

variables	(1) SOEs	(2) non-SOEs	(3) Low degree of financing constraints	(4) High degree of financing constraints
IPR	1.357** (2.07)	0.326 (0.65)	0.898* (1.81)	0.697 (1.03)
Constant	10.422*** (16.60)	9.643*** (16.50)	7.798*** (16.23)	10.606*** (16.51)
N	5192	10576	7885	7883
industry	YES	YES	YES	YES
Year	YES	YES	YES	YES
R-squared	0.464	0.382	0.432	0.383

The above conclusion shows that IP protection enhances enterprise value as a whole, but considering the large differences between SOEs and non-SOEs in terms of business objectives, management methods, capital structure, etc.^[28], the impact of IPR protection on enterprise value may be different. Based on this, this paper divides the sample into state-owned enterprises and non-state-owned enterprises according to the nature of property rights, and examines the impact of intellectual property protection on enterprise value respectively. In addition, this paper further examines enterprises according to the degree of financing constraints, and examines the difference in the influence of financing constraints on intellectual property protection and enterprise value. In this paper, the SA index is selected to measure the degree of financing constraint of enterprises (the smaller the SA index, the higher the degree of financing constraint on enterprises), and grouped according to the median, with the group with low financing constraint above the median and the group with high financing constraint below the median. Table 7 reports the results of the heterogeneity test on the nature of property rights and the degree of financing constraints. Columns (1) and (2) show the impact of the nature of property rights on the relationship between IP protection and enterprise value; Columns (3) and (4) show the impact of the degree of financing constraints on the relationship between IP protection and enterprise value. It can be seen from column (1) that in the sample of state-owned enterprises, the regression coefficient of intellectual property protection (IPR) and enterprise value (Q) is 1.357, which is significant at the level of 5%, indicating that intellectual property protection is conducive to the value of state-owned enterprises. It can be seen from column (2) that the regression coefficient of intellectual property protection (IPR) and enterprise value (Q) is 0.326, but it is not significant, which indicates that the value enhancement effect of intellectual property protection on non-state-owned enterprises is not obvious. The reason for this result may be that non-state-owned enterprises face a greater degree of financing constraints, and state-owned enterprises may have easier access to economic resources due to their political attributes, thereby reducing the degree of financing constraints to a certain extent, so state-owned enterprises invest more in R&D, which is more conducive to the enhancement of enterprise value. It can be seen from column (3) that the regression coefficients of intellectual property protection (IPR) and enterprise value (Q) were 0.898 in the group with low financing constraints, respectively, and were significant at the level of 10%, while in the group with high financing

constraints, The intellectual property protection (IPR) coefficient is 0.697, but it is not significant, indicating that intellectual property protection is more conducive to improving the value of enterprises with less financing constraints, which also explains to a certain extent why intellectual property protection can bring significant improvement in the value level of state-owned enterprises.

With the development of China, intellectual property rights are changing from a general market tool to an important competition tool. The key to the development of high-tech enterprises lies in innovation, intellectual property protection provides an important guarantee for technological innovation achievements, this paper speculates that the impact of intellectual property protection on enterprise value may be affected by the scientific and technological attributes of enterprises. Based on this, this paper draws on the research of Peng Hongxing and Mao Xinshu ^[29] to determine the industry of high-tech listed companies, divides the sample into high-tech enterprises and non-high-tech enterprises, and examines the difference in the influence of enterprises' scientific and technological attributes on intellectual property protection and enterprise value. Table 8 shows the impact of intellectual property protection on enterprise value under different scientific and technological attributes. Section (1) shows that in the sample of high-tech enterprises, the regression coefficient of intellectual property protection (IPR) and enterprise value (Q) is 1.303, which is significant at the level of 1%, indicating that intellectual property protection is conducive to enhancing the value of high-tech enterprises; (2) shows that in the sample of non-high-tech enterprises, the regression coefficient of intellectual property protection (IPR) and enterprise value (Q) is 0.210, but it is not significant, which indicates that compared with non-high-tech enterprises, intellectual property protection can promote the improvement of the value level of high-tech enterprises to a greater extent. This may be due to the nature of high-tech enterprises, which have more R&D activities and R&D capital investment than non-high-tech enterprises, so the impact of intellectual property protection on them is more significant.

Table 8: Heterogeneity test of enterprise technology attributes

variables	(1) High-tech enterprises	(2) Non-high-tech enterprises
IPR	1.303** (2.20)	0.210 (0.49)
Constant	10.241*** (19.99)	7.566*** (13.10)
N	10628	5140
Industry	YES	YES
Year	YES	YES
R-squared	0.386	0.421

5. Conclusions

Based on the previous research conclusions, this paper mainly puts forward relevant policy recommendations from the perspectives of enterprises and the government:

First, the functional departments of the state should strengthen the enforcement of intellectual property protection and effectively protect the legitimate rights and interests of enterprises. In addition, the intensity of intellectual property protection in various provinces in China has a large gap, and the functional departments of the state should take into account the overall situation and promote the coordinated development of intellectual property undertakings in various regions.

Second, the government should attach importance to the development of private enterprises. There are a large number of private enterprises in China, but because the financing constraints of non-state-owned enterprises are greater than those of state-owned enterprises, enterprises lack the economic resources to participate in research and development activities. Therefore, the government can give non-state-owned enterprises certain R&D subsidies or preferential financing policies to encourage them to create corporate value and promote the high-quality development of China's economy.

Third, enterprises should take advantage of a good institutional environment to enhance corporate value. Under the legal guarantee of intellectual property protection, enterprises' core technologies and innovation achievements can be effectively protected, and enterprises should increase R&D investment to actively participate in innovation activities, enhance their core competitiveness, and continuously

enhance their value.

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