

The Impact of Patent Characteristics and Patent Strategic Value on Innovation Performance

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Abstract. To explore the impact of corporate patent characteristics and patent strategic value on innovation performance, this study provides an empirical analysis of 339 automobile companies in China. The results show that the patent characteristics have a positive impact on the patent strategic value and innovation performance, and the impact of patent characteristics on innovation performance depends on the patent strategic value. This study also shows that when the corporate leadership supports innovation and have strong patent management capability, the patent characteristics and patent strategic value will have a stronger effect on innovation performance.

Introduction

From the perspective of the resource-based theory, patents can bring competitive advantages to companies because they are valuable, scarce, and difficult to be imitated or replaced^[1]. In particular, high-quality patents are conducive to the improvement of companies' innovation performance. For instance, patents with high citations can help boost companies' market value^[2]. However, the positive impact of high-quality patents on corporate performance may lag behind, and it also varies according to different industries and firm sizes^[3-5]: the number of citations of a company's patents and the company's market value show a significant U-shaped correlation^[4]. The number of citations of patents for invention is significantly conducive to corporate performance, but the patents that have been sustaining for many years are not significantly conducive to corporate performance^[5].

Patent characteristics refer to indicators that characterize the quality of patents, including offensive, defensive, and influence characteristics^[6]. Innovation performance is the result at organizational level that measures a company's innovation output. The correlation between patent characteristics and innovation performance might be complex. Therefore, it is necessary to conduct further research on the impact of relevant mediating variables or moderator variables, such as patent strategic value, innovation support from the leadership, and patent management capability. Among them, patent strategic value refers to the competitive advantages and commercial interests created by enterprises in the broader time (long-term) and space (industrial chain) dimensions through using patents as they are driven by strategic motives. This study explores the impact of patents on innovation performance from two aspects, namely, patent characteristics and patent strategic value, constructs a research model that innovation performance is affected by patent characteristics and patent strategic value, analyzes the moderating effects of two variables, i.e. innovation support from the leadership and patent management capability, on patent characteristics & innovation performance, and patent strategic value & innovation performance, and finally conducts an empirical analysis of the automobile industry.

Literature Review and Research Hypotheses

Patent Characteristics and Innovation Performance

The patent offensive characteristics are shown as the scope of patent license, frequency and patent claim^[6]. The wider the scope of patent license, the more frequent the application, and the wider scope of patent claim, the more it can be applied and transferred^[7]. The defensive characteristics are

shown as the number of independent claims and the rate of application^[6]. The greater number of independent claims would mean more technological innovations, better protection, and the greater product competitiveness. The faster rate in patent application would indicate a company's strong capability in continuous innovation and high R&D input-output ratio. The patent influence characteristics are demonstrated as the number of citations and the number of patent families^[6]. More citations and greater number of patent families would indicate a company's apparent technological superiority, better recognized products, and better market performance^[8].

Hypothesis 1: Patent characteristics are positively correlated with innovation performance.

Patent Characteristics and Patent Strategic Value

Among the patent offensive characteristics, if the scope of patent license is wide, the frequency is high, and the patent claim is wide, the company would pose a bigger challenge to its competitors^[1]. Among the patent defensive characteristics, the fast rate of patent application and the strong technical defense capability would be conducive to the strategic orientation of a company's products. Among the patent influence characteristics, if a patent is cited many times and the number of patent families is large, the corporate image and bargaining position could be enhanced^[9], thus receiving more government support and external investment.

Hypothesis 2: Patent characteristics are positively correlated with patent strategic value.

Patent Strategic Value and Innovation Performance

The impact of patent strategic value on innovation performance is shown as follows: by building technical barriers, patents could help limit and keep out competitors, reduce the chance of patent infringement, attract foreign investment, and enhance leverage in their negotiations and talks with partners^[10], so as to maintain companies' strategic advantages and product competitiveness, and ultimately guarantee companies' long-term business strategy and market returns.

Hypothesis 3: Patent characteristics improve innovation performance through patent strategic value as part of the mediator.

The Moderating Effect of Innovation Support from the Leadership and Patent Management Capability

The impact of patent characteristics on innovation performance also depends on corporate leadership's support for innovation and efficient management of corporate patents. The leadership's respect and support for employees' innovation ability would create a good atmosphere for innovation so that more innovations can be patented and generate benefits^[11]. Companies with strong patent management capability tend to have defined management processes so that they could lay more emphasis on patenting research findings and patent operation, as well as the application of patents in corporate strategy-making, R&D, and market development. Under these circumstances, the role of patents can be maximized and companies' interests could be protected to the greatest extent.

Hypothesis 4: Innovation support from the leadership can positively moderate the correlation between patent characteristics and innovation performance.

Hypothesis 5: Patent management capability can positively moderate the correlation between patent characteristics and innovation performance.

Hypothesis 6: Innovation support from the leadership can positively moderate the correlation between patent strategic value and innovation performance.

Hypothesis 7: Patent management capability can positively moderate the correlation between patent strategic value and innovation performance.

Research Design

Research Sample

This study is an empirical analysis of automobile companies. Questionnaires were distributed and collected during the period from July 2018 to December 2018 mainly among the company

management as well as personnel from R&D department, intellectual property department and marketing department .A total number of 400 questionnaires were distributed, and 398 were collected, of which 339 were valid ones. The number of collected valid questionnaires accounted for 84.8% of the total.

Variables and Measurements

(1) Measurement of dependent variable. The dependent variable of this study is innovation performance. According to the study of Qian Xihong^[12] and Bell^[13], five items are adopted to measure the innovation performance.

(2) Measurement of mediating variable. The mediating variable of this study is the patent strategic value. According to the study of Grimaldi ^[14], four items are adopted to measure the patent strategic value.

(3) Measurement of independent variable. The independent variable of this study is the patent characteristics. According to the study of Ma Tianqi^[6], 10 items are adopted to measure the patent characteristics.

(4) Control variables. The control variables of this study are the firm size and firm age. The difference between the year of 2018 and the year of the establishment of the company is calculated as the firm age. According to the number of employees, the firm size is categorized into 4 levels, i.e. 1 standing for less than 100, 2 for 100-499, 3 for 500-1000, and 4 for more than 1,000.

(5) Moderator variables. The moderator variables of this study are innovation support from the leadership and patent management capability. According to the study of Zhang^[15], six items are adopted to measure the innovation support from the leadership. According to the study of Wang Jing^[16], five items are adopted to measure patent management capability.

Reliability of Measurement Model

In this study, the coefficients of internal consistency of the five scales, i.e. patent characteristics, patent strategic value, innovation performance, innovation support from the leadership, and patent management capability, range from 0.715 to 0.940 (significance level greater than 0.7), which means the reliability level is high.

Empirical Results

Measurement Model

The following table below shows the mean value, standard deviation, and correlation coefficient of the main variables in this study.

Table 1. Descriptive Statistics and Correlation Coefficients of Variables

Name of Variables	Mean Value	Standard Deviation	1	2	3	4	5	6
Firm Age	2.345	1.387						
Firm Size	3.009	0.982	-0.542**					
Patent Strategic Value	4.261	0.638	-0.208**	0.118*				
Patent Characteristics	3.889	0.858	-0.303**	0.101	0.638**			
Innovation Support from the Leadership	4.292	0.654	-0.229**	0.201**	0.375**	0.463**		
Patent Management Capability	4.188	0.709	-0.331**	0.192**	0.501**	0.614**	0.552**	
Corporate Innovation Performance	4.256	0.645	-0.274**	0.143**	0.459**	0.515**	0.469**	0.665**

Note: N=339; ** means $p < 0.01$, * means $p < 0.05$, two-tailed test. It is sorted according to correlation matrix.

Mediating Effect Test

In the mediating effect regression model and results of this study, Model 4 proves that patent characteristics have a significant positive impact on innovation performance ($\beta = 0.362$, $p < 0.001$), supporting Hypothesis 1; Model 2 proves that patent characteristics have a significant positive

impact on patent strategic value ($\beta=0.476$, $p<0.001$), supporting Hypothesis 2; comparing Model 4 with Model 5, one can find that although the regression coefficient of patent characteristics is positive, it falls from ($\beta=0.362$, $p<0.001$) to ($\beta = 0.263$, $p < 0.001$), which means the regression coefficient and the significance decreases, supporting Hypothesis 3.

Table 2. Mediating Effect Test of Patent Strategic Value

Type of Variables					Patent Strategic Value	Innovation Performance
		M1	M2	M3	M4	M5
Control Variables	Firm Age	-0.097**	0.005	-0.136***	-0.058*	-0.059*
	Firm Size	0.003	0.039	0.010	0.017	0.009
Independent Variables	Patent Characteristics		0.476***		0.362***	0.263***
Mediating Variables	Patent Strategic Value					0.207**
F		7.845***	78.551***	14.605***	45.486***	38.230***
R ²		0.045	0.414	0.080	0.290	0.315
ΔR^2		--	0.369***	0.080***	0.210***	0.025**

Note: *** means $p<0.001$, ** means $p<0.01$, and * means $p<0.05$.

Regression Analysis of Moderating Effect

In the regression results shown in Table 3 below, Model 8 proves that after the introduction of the variable of the innovation support from the leadership, the model's explanatory power significantly increases ($\Delta R^2=0.059$, $p<0.001$), and patent characteristics have a significant impact on innovation performance ($\beta=0.269$, $p<0.001$). Model 9 shows that after the introduction of the interaction between the innovation support from the leadership and patent characteristics, the model's explanatory power increases significantly ($\Delta R^2=0.024$, $p<0.001$), and the innovation support from the leadership significantly moderates (in a positive way) the correlation between patent characteristics and innovation performance ($\beta=0.258$, $p < 0.001$). Therefore, Hypothesis 4 is supported. Model 10 proves that after the introduction of the variable of the patent management capability, the explanatory power of the model significantly increases ($\Delta R^2=0.178$, $p<0.001$), and patent characteristics have a significant impact on innovation performance ($\beta=0.127$, $p<0.01$). Model 11 shows that after the introduction of the interaction between patent management capability and patent characteristics, the explanatory power of the model increases significantly ($\Delta R^2=0.032$, $p<0.001$), and the patent management capability significantly moderates (in a positive way) the correlation between patent characteristics and companies' innovation performance ($\beta=0.114$, $p<0.01$). Therefore Hypothesis 5 is supported.

Model 14 proves that after the introduction of the variable of the innovation support from the leadership, the model's explanatory power significantly increases ($\Delta R^2=0.087$, $p<0.001$), and patent strategic value has a significant impact on innovation performance ($\beta=0.309$, $p<0.001$). Model 15 shows that after the introduction of the interaction between the innovation support from the leadership and patent strategic value, the model's explanatory power increases significantly ($\Delta R^2=0.053$, $p<0.001$), and the innovation support from the leadership significantly moderates (in a positive way) the correlation between patent strategic value and companies' innovation performance ($\beta=0.355$, $p<0.001$). Therefore, Hypothesis 6 is supported. Model 16 proves that after the introduction of the variable of the patent management capability, the explanatory power of the model significantly increases ($\Delta R^2=0.224$, $p<0.001$), and patent strategic value has a significant impact on innovation performance ($\beta=0.162$, $p<0.01$). Model 17 shows that after the introduction of the interaction between patent management capability and patent strategic value, the explanatory power of the model increases significantly ($\Delta R^2=0.013$, $p<0.001$), and the patent management capability significantly moderates (in a positive way) the correlation between patent strategic value and companies' innovation performance ($\beta=0.195$, $p<0.01$). Therefore Hypothesis 7 is supported.

Table 3. Moderating Effect of Innovation Support from the Leadership and Patent Management Capability

Patent Characteristics & Innovation						
Moderating Effect of Innovation Support from the Leadership				Moderating Effect of Patent Management Capability		
	M6	M7	M8	M9	M10	M11
Firm Age	-0.136***	-0.058*	-0.056*	-0.040	-0.026	-0.012
Firm Size	-0.010	0.017	-0.009	0.005	-0.006	0.002
Patent Characteristics		0.362***	0.269***	0.258***	0.127**	0.114**
Innovation Support from the Leadership			0.273***	0.416***		
Patent Characteristics*Innovation Support from the Leadership				0.100***		
Patent Management Capability					0.496***	0.646***
Patent Characteristics* Patent Management Capability						0.121***
F	14.605***	45.486***	44.572***	39.446***	73.220***	66.496***
R ²	0.080	0.290	0.349	0.373	0.468	0.500
ΔR ²	--	0.210***	0.059***	0.024***	0.178***	0.032***
Patent Strategic Value & Innovation Performance						
Moderating Effect of Innovation Support from the Leadership				Moderating Effect of Patent Management Capability		
	M12	M13	M14	M15	M16	M17
Firm Age	-0.136***	-0.095***	-0.079**	-0.071**	-0.035	-0.032
Firm Size	-0.010	-0.011	-0.034	-0.020	-0.017	-0.010
Patent Strategic Value		0.421***	0.309***	0.355***	0.162**	0.195***
Innovation Support from the Leadership			0.320***	0.428***		
Patent Strategic Value * Innovation Support from the Leadership				0.096***		
Patent Management Capability					0.515***	0.550***
Patent Strategic Value * Patent Management Capability						0.050**
F	14.605***	36.404***	41.730***	41.946***	73.830***	62.052***
R ²	0.080	0.246	0.334	0.387	0.470	0.483
ΔR ²	--	0.166***	0.087***	0.053***	0.224***	0.013***

Note: *** means $p < 0.001$, ** means $p < 0.01$, and * means $p < 0.05$.

Conclusions and Application

Focusing on automobile companies, this study discusses the impact of patent characteristics on innovation performance, and constructs a research model that patent characteristics affect innovation performance through the patent strategic value as the mediator. Through an empirical analysis of 339 automobile companies in China, it is found that patent characteristics have a positive impact on both patent strategic value and innovation performance. The impact of patent characteristics on innovation performance also depends on patent strategic value. When corporate leadership provides strong support for innovation and has strong patent management capability, the patent characteristics and patent strategic value have a stronger impact on innovation performance. The results of this study can be potentially applied by companies in the following areas: as patent characteristics have a positive impact on innovation performance, companies can provide motivations and guarantees for innovation by improving patent quality and making rational arrangements concerning patent. Since patent strategic value is an important factor in the improvement of corporate innovation performance, it is necessary to maximize the role of patent strategic value in the operation of a company. Companies should also improve patent management capability, make better use of patents in the business strategy-making, research and development, and market development so that companies have the incentives to constantly improve their innovation performance.

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