RESEARCH ON THE RELEVANCE BETWEEN CORPORATE VALUE AND PATENT POWER ——BASED ON THE EMPIRICAL TEST OF LISTED COMPANIES ON GEM IN CHINA

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ABSTRACT

Patent power is not only the embodiment of enterprise R&D capability, but also reflects the core competitiveness of enterprises. This paper analyzes the value relevance of different aspects of patent power. The results show that the patent quality and patent complexity in small and medium-sized enterprises have a positive impact on the corporate value, and the relationship between patent strength, patent content richness, patent comprehensibility and corporate value is not significant.

Keywords: small and medium sized enterprises; patent power; value relevance

I. Introduction

In a time of knowledge economy, with the deepening of economic globalization and the heating up of competition among enterprises, an enterprise's competitive edges lies more on the intangible assets, especially the patent power, than the material assets or tangible assets. Patent, as a very example of knowledge capital, is now surpassing the fixed assets and financial capital in significance. The technical innovation brought through R&D and patent application will sharpen enterprises' comprehensive competitive edge to realize sustainable development. Though, as a typical kind of intangible assets, the real value of patent is hard to be measured, enterprises are required to increase their value with patent application which is based on achieving core technology and standards along the way of research and development.

Recent research have found that the gap between the account value and market value of listed enterprises are keep widening, a trend due to the absent of numerous intangible value in the financial statement. In other words, the R&D and innovation information revealed in the current financial statement is not accurate enough. The information users, especially investors, however, are eagerly to be accessible to enterprises' such information of intangible assets to make more accurate assessment to the whole entity and obtain more investment returns. Therefore, assessing an enterprise's value by measuring its patent power can provide a new method of intangible assets evaluation.

Theoretically, the value of patent comes from the certain domination it can bring to its owner in product market or technical market, which will further influence the demand of products and thus obtain excess earnings by changing the fixed price of products. We found from the previous research which explores the relationship between the patent power and corporate market value from various perspectives that patent power has a certain impact on corporate value. Yet no documents had ever done research about the impact different respects of the patent have on corporate value and the impact is now uncertain. Therefore, to find out the impact, the paper dissects patent power, chooses five respects (including patent strength, patent quality, patent content richness, patent complexity and patent comprehensibility), and selects corresponding indicators from each respect as a variable to carry on system research.

The breakthroughs of the paper is in the following parts: Firstly, the paper analyzes the previous research, dissects the patent power into several respects including patent strength, patent quality, patent content richness, patent complexity and patent comprehensibility that extends the current research. Secondly, from the research perspective, the paper applies structural equation model to do empirical

research on the relationship between the patent power and corporate market value. Thirdly, with its research from the different respects of patent power, the paper may enrich the relevant documents concerning value relevance of patent power.

II. Documents Review and Theoretical Analysis

A. Documents Review on Patent Power and Patent Information

Patent power refers to the overall patent capacity that supports the development of economic society. To an enterprise, patent power is a critical part of its core competitiveness and the engine of its long-term development. Current research on patent power largely centres on the assessment of patent power and the regional compare of it. For instance, Li Li and Chen Xiuyi and Jiang Xuelin and He Jianjia used different methods to construct the overall patent power assessment system respectively, and applied their own method to assess and verify the patent power.

Patent information refers to the content of information in the disclosed patent documents. Griliches et al. （1991）studied enterprises' R&D activities to find if they contain richer information and discovered that apart from providing statistics about R&D costs, the patent information can also provide more information pertaining the R&D of enterprises. What's more, Trajtenberg(1990)held that patent influence factors could reveal information of a company's R&D capacity, the capacity which is scarcely reflected in finical reports. From these previous research, it can be concluded that patent information can provide more valuable materials to the valuation of corporate value, remedying the vacant of R&D information in financial reports.

To information users, the information contained in the patent is of great significance: First, if patent information is available to the public, even for enterprises having no need to disclose their R&D information, the public can have access to their data of patent application and authorization; Next, patent information can be useful in many ways, especially in fields like business units, productions, technology and R&D, like helping enterprises to analyze the condition of the adversaries. Patent not only contains a large amount of technical information of enterprises, but is also considered as the best source of information to identify technical innovation timely. The increase or reduction of patent development activities can reveal the change in development policy and the patent indicators can be used to analyze the patent strategy of an enterprise. As a consequence, patent activities can inform vital messages about a company's R&D capacity and patent

strategy and with which information users can tell the strategic development facts of the company.

B. Document Review on the Impact Patent Have to Corporate Value

Research on patent activity and corporate values. Researchers usually apply Tobin's q to measure corporate value while studying it. In this process, corporate value reflects investors' prediction about future return and interests which is determined by the condition of tangible and intangible assets of the invested company, especially the condition of innovative knowledge and patent development. Blundell et al.（1999）found in his research on the factors influencing corporate market value that enterprises' innovative proxy variables set based on the fully consideration of enterprises' patent activities have a significant positive impact on its market value. Enterprises' market value is often regarded as foresightedness indicators that demonstrate the future performance of an enterprises, and reveals their sum total of future dividend present value which is quite intimate with the discount of future return of patent achievements. The previous research believes that enterprises' innovative activities and patent performance have a positive impact to market value. Toivanen et al.（2012）found that putting D&D costs into the model which calculates corporate value, the impact the percentage of patent to total assets have to corporate market value will become negative.

Research on patent combination and corporate values. Lin et al. （2006）held that diversity of patent combination could be used to measure the diversity of enterprises' technology and core areas, and could form synergy effects to increase the value of enterprises' market value. Parchomovsky and Wagner（2005）believed that patent combination can help an enterprise to achieve a higher market rank in a certain area, innovators thus prefer to fuse creations with patent combination to enhance the enterprises' capacity of relevant technologies. Previous research also held that the value of R&D activities are by no means unchangeable, but depends on an enterprise's reasonable R&D investment and capacity.

Research on patent significance and corporate values. Hall et al.（2005）found while applying patent citation as the proxy variable of knowledge importance contained in patent that there is a positive correlation between the average citation frequency and enterprises' market value. Research in the past had also realized the weight of patent and the great significance of business value to the valuation of an enterprise's market value. Through empirical study, Nagaoka（2005）analyzed how the two patent indicators--patent citation and scientific relation--effect enterprises' market value, and they discovered that the two patent indicators have notable

impacts on it. Deng et al.（1999）used a set of patent indicators, such as patent quantity, patent citation, to predict an enterprise's performance and find out a positive correlation between patent indicators and corporate future market/account value. Li Shi et al. found through studying the listed enterprises in china that enterprises' market value will have massive increase as a patent is added per time and that the stock market of china has the capacity of patent pricing. Li Zhongfei and Yang TingTing (2015) believed that patent quality boosts the increase in the value of enterprises' investment and has even much promoting effect to high-tech and listed enterprises. Wang Yan and Bao Xinzhong found that the height of enterprises' patent strength indicator is related to their stocks' market performance.

C. Theoretical Analysis on Value Relevance of corporate Patent Strength

Corporate patent power is a comprehensive assessment of the performance it brings to enterprises and symbols the significance of patent in market. In a complete competitive market, corporate market value has a close relation to their patent power. This is because stronger patent power can improve business performance and thus increase market value. In terms of the relationship between corporate innovation and finical performance, some research center on the impact an enterprise's R&D have to production efficiency and market value, and especially the impact of patent rights and trademark rights have to market value. Previous research attached the impact of patent to corporate market value. Study had shown the positive correlation between enterprises' R&D and Profiting condition and that the addition of R&D activities in certain period would increase market value correspondingly. These all demonstrate that theories of patent value relevance have been tested in some mature foreign capital markets. In our capital market, however, a consensus has yet reached in the studies on the above questions and the value relevance of different respects of patent power is still uncertain.

Corporate patent power is an overall reflect on enterprises' patent situation and can be measured from various respects. For instance, patent strength, patent quality, patent complexity, patent content richness, patent comprehensibility, etc. Generally speaking, different respects of patent power all have certain impacts on corporate value. Patent strength, an embodiment of an enterprise's R&D power, reflects an enterprise's capacity to develop technology and innovative products. To some extent, patent strength can represent an enterprise's competitiveness of its products and technology and has a certain positive impact on its value. Patent quality refers to the actual legitimate force of patent which guarantee the maximum interest of an enterprise. Patent complexity, a patent's complexity lies mainly on its right requirements, one of the major purposes of applying the patent ,a critical part to determine the protection scale of the patent and effecting the overall value of an

enterprise. Patent content richness and patent comprehensibility refer to the content richness and comprehensibility of the public patent application which will influence information users' judgment on corporate value.

III. Research Sample and Research Design

A. Sample Selection and Variable Definition

The 100 samples selected here are mostly from high-tech listed companies on GEM of Shenzhen Stock Exchange and center on high-tech enterprises constantly investing, producing and growing during 2010-2015, including 10 companies receiving patent pledge financing from financial institutions. Data of enterprises' patent strength, patent quality, patent content richness and patent comprehensibility are mostly from database of State Intellectual Property Office and are achieved through manual search and sorting. Data of corporate value indicators are from CSMAR database.

Variables here consist of latent variables and measurement variables, and 6 of them are latent variables including patent strength, patent quality, patent content richness, patent complexity, patent comprehensibility and corporate value. Every latent variable contains its corresponding measurement variable.

B. Model Construction

This paper uses structural equation model to analyze value relevance of SMEs' patent power. The reason is that, compared to the traditional multiple regression analysis which cannot be used where several variables exist simultaneously and is unable to obtain the impact latent variables have to dependent variables, the model has certain edges. Recognizing the requirements of research in the paper and the subsequent research, a structural equation model is thus constructed: Chart 1 shows the latent variables and the corresponding measurement variables as well as the error terms; Picture 1 is the impact path of the structural equation where the rectangle denotes a measurement variable, the oval denotes a latent variable and the relations between variables are denoted by lines and arrows. If there's no line between two variables, that means they have no relation; a one-way arrow denotes effective relation and a two-way denotes mutual relation.

Chart 1 Structural Equation Model of SMEs' Patent Value Relevance

Latent Variables	Measurement Variables	Error Terms
Patent Strength	Number of invention publication patents in the period（a_1）	e_1
	Number of invention authorization patents in the period（a_2）	e_2
	Number of practical new-type patents in the period（a_3）	e_3
	Number of image design patents in the period（a_4）	e_4
Patent Quality	Sum of invention publication IPC numbers in the period（a_5）	e_5
	Sum of invention authorization IPC numbers in the period（a_6）	e_6
	Sum of practical new-type IPC numbers in the period（a_7）	e_7
Patent Content Richness	Sum of invention publication pages in the period（a_8）	e_8
	Sum of invention authorization pages in the period（a_9）	e_9
	Sum of practical new-type patents' pages in the period（a_{10}）	e_{10}
Patent Complexity	Total right requirements of invention publication in the period（a_{11}）	e_{11}
	Total right requirements of invention authorization in the period（a_{12}）	e_{12}
	Total right requirements of practical new-types in the period（a_{13}）	e_{13}
Patent Comprehensibility	Number of invention publication appendixes in the period（a_{14}）	e_{14}
	Number of invention authorization appendixes in the period（a_{15}）	e_{15}
	Number of practical new-type appendixes in the period（a_{16}）	e_{16}
Corporate value	Tobin'Q（a_{17}）	e_{17}
	Price-earning ratio（a_{18}）	e_{18}
	Rate of return on common stockholders' equity（a_{19}）	e_{19}
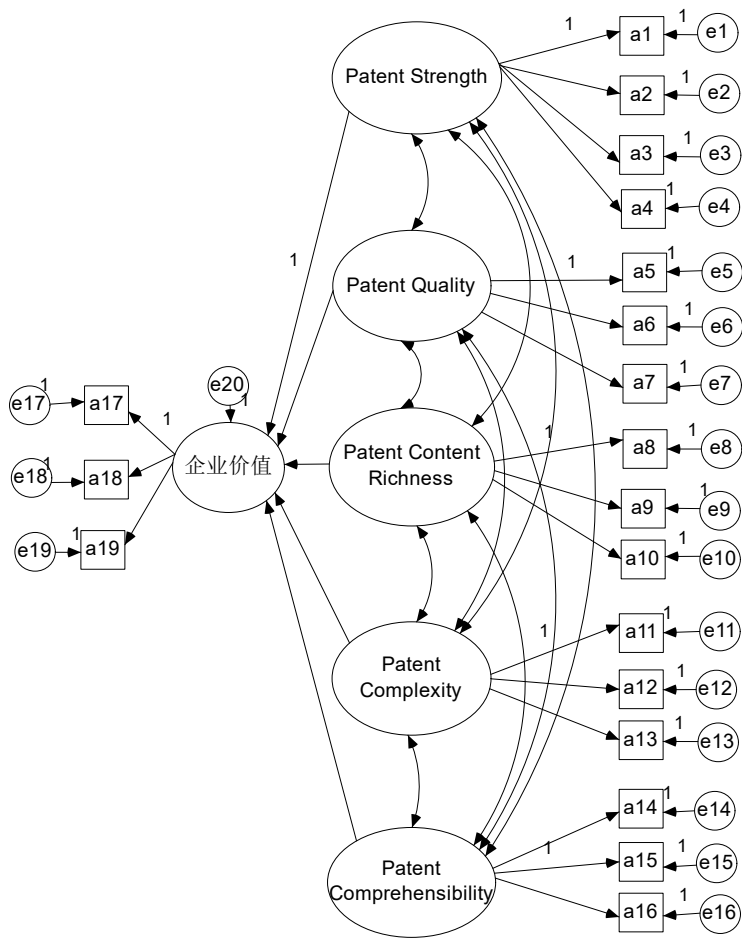
Pic1 Structural Equation Path of SMEs' Patent Value Relevance

IV. Empirical Result

A. Statistics Analysis

Chart 2 shows the descriptive statistic result of all measurement variables. It can be seen from the statistic result of mean value and median that among four types of patents (invention publication, invention authorization, practical new-type and image design), the number of practical new-type patents is the most, the number of invention publication and invention authorization patents is the least and more than half of the enterprises having no invention authorization and image design patent at all；from the statistic result of patent quality, it can be seen that the mean value of sum of invention authorization IPC numbers owned by enterprises is higher than the sum of invention publication and practical new-typed IPC numbers together, and the gap between maximum and minimum of the sum of IPC numbers of all types is relatively huge; from the statistic result of patent content richness, half of the enterprises' applications are within 20 pages and of all three types of patents, the pages of practical new-typed patent is the most and its mean value reaches 33.791; from the patent complexity and mean value statistics of total right requirements, the sum of invention authorization is the least and that of practical new-type is the most; from the proxy variables of patent comprehensibility and application's appendixes, the mean value of practical new-type is the largest and that of invention authorization is the least; in terms of corporate value, the mean value of Tobin'Q variables is 2.27. The low standard deviation of the variable means the differences of Tobin'Q among sample enterprises are small. The mean value of price-earning ratio is 43.36 and that of rate of return on common stockholders' equity is 0.05.

Chart 2 Descriptive Statistic Result of Main variables of SMEs' Patent Value Relevance

Statistic	N	Mean Value	Standard Deviation	Minimum	Maximum	1/4 Quartile value	Median	3/4 Quartile value
a1	100	2.11	3.528	0	17	0	1	3
a2	100	1.19	2.328	0	11	0	0	1.75
a3	100	4.53	6.153	0	30	1	2.5	6

Statistic	N	Mean Value	Standard Deviation	Minimum	Maximum	1/4 Quartile value	Median	3/4 Quartile value
a4	100	2.61	8.065	0	48	0	0	2
a5	100	3.19	5.253	0	25	0	1.5	4
a6	100	1.92	3.459	0	16	0	0	2
a7	100	7.92	10.497	0	48	1	5	11.75
a8	100	18.03	26.73	0	117	0	11	23.75
a9	100	11.22	20.208	0	79	0	0	14
a10	100	30.28	33.791	0	138	7	19	49
a11	100	13.03	18.519	0	81	0	9	17
a12	100	6.92	11.879	0	47	0	0	10
a13	100	21.53	24.928	0	107	5.25	14	33
a14	100	5.83	7.584	0	32	0	4	8
a15	100	3.67	6.033	0	27	0	0	5.75
a16	100	13.81	14.658	0	59	2.25	11.5	24
a17	100	2.72	1.089	1	5	1.97	2.44	3.53
a18	100	43.36	37.394	18	168	37.64	51.65	79.78
a19	100	0.05	0.029	0.02	0.12	0.03	0.04	0.07

B. Model Fitness Test

A structural equation model is required to be assessed on its fitness, namely how fit it is to statistics. The fitness indicators used here are GFI, AGFI, PGFI, RMR and P, and the fitness value is shown in Chart 3. According to the assessment

indicators, the structural equation model constructed in the paper is fit and acceptable in statistics.

Chart 3   Fitness Assessment Indicators of the Study Model

Indicators	Fitness value of the model
GFI	0.901
RMR	0.496
NFI	0.903
TLI	0.917
P	0.000

C. Test Result of the Structural Equation Model

By analyzing the coefficients, it can be told if the parameters pass significance test and if the relation between two variables is significant. The path coefficients are showed in Chart 4. The standardized path coefficient of the proxy variable of patent quality is 1.131, which means the higher the patent quality is, the higher the corporate value will be. And the standardized path coefficient of the proxy variable of patent complexity is 2.217, which means the significant positive relationship between patent complexity and patent value relevance, while the relationship between proxy variables of patent strength, patent content richness and patent comprehensibility is not significant.

Chart 4 Path Coefficients without Standardizing and standardized Path Coefficients of SMEs' Patent Value Relevance

Impact path	Path Coefficients without standardizing	P	Standardized path coefficients
Corporate value<---Patent quality	0.525	***	1.131
Corporate value<---Patent complexity	0.677	***	2.217
Corporate value<---Patent Strength	1		3.603
Corporate value<---Patent content richness	0.009	0.652	0.248
Corporate value<---Patent comprehensibility	0.12	0.102	0.993
a4<---Patent Strength	0.066	0.763	0.025
a3<---Patent Strength	1.643	***	0.808
a2<---Patent Strength	0.266	0.002	0.346
a1<---Patent Strength	1		0.865
a13<---Patent Complexity	3.335	0.002	0.889
a10<---Patent content richness	1.019	***	0.708
a9<---Patent content richness	0.22	0.006	0.256
a8<---Patent content richness	1		0.885
a7<---Patent Quality	1.667	***	0.669
a6<---Patent Quality	0.345	***	0.421
a5<---Patent Quality	1		0.802

Impact path	Path Coefficients without standardizing	P	Standardized path coefficients
a15<---Patent Comprehensibility	1		0.468
a14<---Patent Comprehensibility	2.354	***	0.902
a16<---Patent Comprehensibility	2.406	0.004	0.477
a11<---Patent Complexity	1		0.411
a12<---Patent Complexity	3.58	0.003	0.709
a19<---Corporate value	0.005	0.469	0.139
a18<---Corporate value	35.028	***	0.774
a17<---Corporate value	1		0.735

V. Conclusion

By selecting the data of listed high-tech SMEs on GEM, the paper analyzes the value relevance of corporate patent power. The study shows that: (1) there is significant positive relation between SMEs' patent quality and patent complexity; (2) there is positive relation between patent complexity and patent value relevance; (3) the relationship between patent strength, patent content richness, patent comprehensibility and corporate value is not significant. In a summary, the impact different respects of SMEs' patent power have to corporate value is different, among which the impacts of patent quality and patent complexity are the largest.

Through the research, we find that during the innovative development of SMEs through patent power, the patent quality and patent complexity should be paid more attention to increase corporate value.

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