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The relationship between a firm's patent quality and its market value — The case of US pharmaceutical industry

Yu-Shan Chen *, Ke-Chiun Chang

Department of Business Administration, National Yunlin University of Science and Technology, 123, Section 3, University Road, Douliu, Yunlin 640, Taiwan

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ABSTRACT

This study examined the relationships between corporate market value and four patent quality indicators – relative patent position (RPP), revealed technology advantage (RTA), Herfindahl–Hirschman Index of patents (HHI of patents), and patent citations – in the US pharmaceutical industry. The results showed that RPP and patent citations were positively associated with corporate market value, but HHI of patents was negatively associated with it, while RTA was not significantly related to it. Thus, if pharmaceutical companies want to enhance their market value, they should increase their leading positions in their most important technological fields, cultivate more diversity of technological capabilities, and raise innovative value of their patents. In addition, this study found that market value of pharmaceutical companies with high patent counts was higher than that of pharmaceutical companies with low patent counts, and suggested that pharmaceutical companies with low patent counts should increase RPP in their most technological fields, decrease HHI of patents, or raise patent citations to further enhance their market value. Furthermore, this study developed a classification for the pharmaceutical companies to divide them into four types, and provided some suggestions to them.

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1. Introduction

In the era of knowledge economy, competitive advantages of firms are less based on the allocation of physical assets, and more on intangible assets, such as patents. Although patents are intangible and their value cannot be accurately measured, companies must develop and increase their corporate value by proactively focusing on patents. The disparity between the book value of publicly traded companies and their market value has increased steadily in recent years [1]. Breitzman and Thomas thought that the substantial value of intangible assets is not accounted for on the financial statements of most companies [2]. Thus, the information provided in annual reports about innovative activities is inadequate and increasing the requirements of annual reports would enhance investors' understanding of the financial statements [3]. Estimating the corporate value based on the patent quality may therefore provide insights into the value of companies' intangible assets. There are some literatures that examine various aspects of the influence of patent performance upon the market value of firms, but there is no literature which explores this influence from four aspects of patent quality — leading position, technological capability, concentration of firms' patents, and innovative value. Therefore, this study explored the relationship between patent quality indicators and market value of firms from the four aspects of patent quality to fill the research gap.

Intellectual property rights became an important strategic weapon for pharmaceutical companies nowadays. The average gross sales margins of United States pharmaceutical companies during the past few years are nearly twice those of the semiconductor companies. Such significant differences in gross margins are primarily attributed to the better records of pharmaceutical companies in protecting their innovation by patents. Therefore, the protection of R&D outcomes is a paramount concern for pharmaceutical companies. Since R&D costs of developing new drugs are very high but the costs of manufacturing pharmaceutical drugs are very low, very few pharmaceutical companies are willing to make huge investments in pharmaceutical R&D without

* Corresponding author. Tel.: +886 5 534 2601x5240; fax: +886 5 531 2074.
E-mail address: dr.chen.ys@gmail.com (Y.-S. Chen).

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patent protection. The owner of the technology can ensure not to lose control of his technology through patents, since he can acquire the monopoly position in the market under patent protection. The patent system can help the owner to exclude others from using his technology during the protection term of the patent.

This study was mainly conducted in the pharmaceutical industry in the United States. There are several characteristics for the pharmaceutical industry. First, it is the highest R&D intensive industry in the United States, and thereby has both the highest R&D to sales ratio among all major industries in the United States. Second, patent protection is very strong in this industry and pharmaceutical companies generally recognize that they are in races with other firms to develop innovative new drugs. Finally, there is sufficient data in the pharmaceutical industry and it is possible to obtain finance and patent information of these pharmaceutical companies easily. In addition, success in the US pharmaceutical industry is dependent upon the ability to continually develop new drugs by investing in R&D. New products are especially important in this industry for two reasons. First, the treatment of diseases is continually changing, which makes old drugs obsolete. Second, patents can allow pharmaceutical companies to make their new drugs have high economic margins [4].

In the pharmaceutical industry, the risk of new drug development is highest in the beginning stage. As the time goes by, the risk would get lower and the value and cash flow of the drug would get higher and higher after obtaining the patent. This study thought that the patent quality would positively impact market value of companies, because patents can protect their innovation outcomes. Previous studies argued that the impact of R&D on market value was significant, and some previous researches discussed the influence of patent indicators upon company's market value already, but this study found that these patent indicators mainly represented the quantitative aspect of patents such as patent counts. There is no study exploring the influence of patent quality upon companies' market value from the four aspects of patent quality — leading position, technological capability, concentration of firms' patents and innovative value. Therefore, this study used four indicators of patent quality – relative patent position (RPP), reveal technology advantage (RTA), Herfindahl–Hirschman Index of patents (HHI of patents), and patent citations – to explore the relationship between patent quality and market value to fill this research gap.

The structure of this paper is as follows: Section 2 would outline the literature review and hypothesis development; Section 3 described the methodology and measurement of this paper; Section 4 would discuss the empirical results; the final section was conclusions and implications of this study.

2. Literature review and hypothesis development

2.1. The patent information and patent indicators

With respect to patent information, Griliches et al. explored whether there was additional information on R&D activities, and found out that patent information can provide more information than R&D expenditure data [5]. Besides, Trajtenberg thought that patent indicators can show the information of firms' R&D capabilities which were scarce in financial statements [6]. Previous researches showed that patent information can provide abundant information to financial data when assessing corporate performance. Patents can support technology management in five areas: support of R&D investment decisions, human resource management in R&D and knowledge management, effective protection of products, identification and assessment of sources for external technology creation, and strategic and operational value maximization of the patent portfolio [7]. Effective patent protection has been identified as an important source of competitive advantage, because it provides two major functions: first, a granted patent protects the inventor, at least for a period of time, from imitation; second, patent protection supports the internal use of technology [8]. Patented technology can be used externally to achieve important operational and strategic benefits [8].

Moreover, patents contain important information for technology management. The value of patent information can be attributed to a variety of reasons: first, patent data are available even for companies that are not required to report R&D data; second, they can be analyzed under several sub-fields (e.g. business units, products, technological fields, or inventors), and this enables a more precise competitor analysis [9,10]. Furthermore, a large amount of technological information is contained in patents, and they are classified according to standardized schemes. In comparison with other information sources, patents are often considered to be the best source for the timely recognition of technological changes [11]. Because the decreasing or increasing of a firm's patent activity in a technological field can be interpreted as changing levels of R&D activity, important patent indicators can be used to analyze companies' patenting strategies [7,10,12]. Hence, patents can provide important information of firms' R&D capabilities and strategies and enable to capture accurate strategic R&D information.

In the past, the number of patent counts is an important indicator to measure the R&D outcomes, but it can't calculate the entire and precise R&D capabilities of companies. For example, Trajtenberg thought that the number of patent counts is a biased indicator to measure the value of innovation activities which varies very much in economic value and scope [6]. Therefore, several scholars proposed other patent quality indicators to measure accurate R&D capabilities of companies. For example, CHI Research, Inc. has built up a database, called Tech Line database, and uses 7 indicators – number of patents, cites per patent, current impact index (CII), technology strength (TS), technology cycle time (TCT), science linkage (SL), and science strength (SS) – to investigate the R&D competence of companies [13]. There are several studies applying CHI Research's Tech Line database to explore the technological capabilities of companies. For example, Hicks and Breitzman used CHI Research's Tech Line database to investigate the shifts of the US innovation system and found out that there was an extraordinarily dynamic innovation in information and health technologies accompanied by a shift in the center of US innovation from the East to the West Coast [13]. Besides, Breitzman applied CHI Research's Tech Line database to introduce a method for identifying technologically similar organizations, industries, or regions by applying the techniques of information science and international patent classification [14]. Furthermore, Breitzman et al. utilized CHI Research's

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