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EFFECTS OF PATENT RIGHT AND INNOVATION DIVERSITY ON BUSINESS PERFORMANCE IN BIOMEDICAL INDUSTRY

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Effects of Patent Right and Innovation Diversity on Business Performance in Biomedical Industry

Xiang LI¹

Abstract

Under the impact of business trend and internationalization, the rapid growth of patent applications reveals national emphasis on intellectual property. When biomedical Industry concentrates on core competency and largely outsources parts of production, patents allow biomedical Industry keeping the technological value that biomedical Industry largely applies for patents to manifest the innovative technology. Taking biomedical Industry as the research object, 50 listed biomedical companies in Chinese medicine database are selected for this study. Based on the database and assisted with Market Observation Post System, the business data of such 50 biomedical companies are searched. According to the results, suggestions are further proposed, expecting to help biomedical Industry promote the profitability when devoting to patent application and planning.

Keywords: biomedical industry, patent right, innovation diversity, business performance.

Introduction

The impact of aging and reverse age, rising health awareness, and approach of AI era enhances the world constantly changing the appearance of health care industry through technology. The boom of high-tech industry reveals that the development of health care industry should present prospect. Under the impact of business trend and internationalization, the rapid growth of patent applications reveals national emphasis on intellectual property. A lot of domestic enterprises, after the news of foreign infringement litigation of famous biomedical companies, start to protect the intangible assets and protect the technological rights with patents. A patent is an asset as well as a business tool. Being in the knowledge competition era, the acquisition and management of patent is extremely important in the innovation management of an enterprise. Business managers have to understand that high

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value-added intangible assets, in addition to equipment, labor, and land, has become a critical success factor in the market. A patent protects the technological innovation of an enterprise, which is closely related to the innovation strategy. When investing in research and development, an enterprise has to consider market and technology uncertainties; however, new technology would result in new markets and profit-making opportunities. In this case, an enterprise would face choices of continuously cultivating the technology development of the same type to strengthen the technology power in the field or diversifying research and development types in order not to miss the opportunity for new markets.

When biomedical Industry focuses on core competency and largely outsources parts of production, patents allow biomedical Industry keeping the technological value to make royalty by authorization as well as establish the mainstream design standards by cross-authorization with other companies. The applied strategies are broad that biomedical Industry largely applies for patents to manifest the innovative technology. Actually, both the application and maintenance of patents are territorial that biomedical Industry with more applications and application countries would consume more money and labor. The application and planning of patent is simply a tactic; to enhance various profit goals with patent strategies is indeed the primary objective of patent value. After all, the ultimate predicted value of patents is to make profits and pursue profits. The application of patent strategies is simply the tactic to achieve the goal. It would be a losing business when an owner invests in money and resources to apply for patents, but could not commercialize or authorize such patents. To prevent the technology from being rapidly imitated and weakening the profits, some managers do not show high willingness of application. In this case, the correlation between patent right and business performance is discussed in this study. The effects of patent right and innovation diversity on business performance are therefore discussed in this study, expecting to help biomedical Industry promote the profits when devoting to patent application and planning.

Literature review

Patent right

Chen *et al.* (2016) stated that patent act was formulated to encourage, protect, and utilize the creations of invention to promote industrial development. Kusnadi *et al.* (2016) classified patent into invention, utility model, and design. Invention patent referred to new technology with creativity and practicality; utility model patent referred to new programs of suitable product shape, structure, or the combination; and, design patent referred to the appearance of product shape, pattern, and color suitable for the design of industrial production. Wickham & Grolemond (2016) explained patent right as the right granting the inventor' technology, after going

through the written application and passing the examination. Relevant industries and academics could understand the technology content through public written disclosure, and the invention information allowed others promoting creativity and innovation. On the other hand, the law granted patent protection and exclusion right that the invention could not be commercially produced, used, offered for sale, sold, or imported without the agreement of the patentee. Baumann & Kritikos (2016) pointed out patent as a type of intangible asset being more easily quantified; patent index could be used for evaluating the intangible asset value of an enterprise and further evaluating the strength and value as well as the objective reference for technology transfer. Malik & Makhdoom (2016) mentioned that the statistical indicator of patent was often used for measuring the patent performance of an enterprise. It could be roughly classified into 1.quantitative index, measured with the quantity of patents, e.g. number of patents and patent growth rate, to reflect “the quantity of technology”, and 2.qualitative index, calculated by patent citing, e.g. citation index and technology life cycle, to find out the importance of the technology and reflect the “quality of technology”.

Referring to Lee & Chu (2017), it is further proposed in this study that the number of patents in foreign official patent management authority and the times cited could be the indicators of the patent value of an organization. Unfortunately, domestic intellectual property bureau does not provide the retrieval function of times cited. For this reason, merely the number of patents is used as the indicator of patent performance in this study, which is divided into short-term immediate performance and long-term accumulation.

Innovation diversity

Xu & Jin (2016) defined innovation as a firm adopting new production programs or production methods being able to change the production possibility. Gupta, Banerjee, & Onur (2017) regarded “invention” first and then “innovation” that invention and innovation were considered distinct. Invention was the discovery of new tools or new methods, while innovation was the application of new tools or new methods. Xu, Xia, & Li (2017) defined innovation as the generation, acceptance, and practice of new ideas, new processes, and new products or service. Diversification and specialization were considered the important roles in the creation and expansion of knowledge. A specialized economic system referred to a specialized industry, while a diversified economic system generally appeared in cross departments. In other words, Bouaziz (2016) considered that specialization could assist in the internal knowledge dissemination in the industry. Lome, Heggeseth, & Moen (2016) believed that the spill-over effect of diversification and innovation could offer more varieties of labor division, larger economic capability, and diverse products and service. Neumayer & Plumper (2017) indicated that the future development of an enterprise depended on the current behavior, and current organizational routines, along with time, would affect the evolution of

the enterprise. The advance of technology could be regarded as the evolution process; the advance of technology was formed by the constant improvement of technology and the accumulation of diverse development. Kalelkar (2016) pointed out the same condition in the innovation activity of enterprises. To reinforce the organization, an enterprise had to continuously invest in and master the original technology and constantly develop relevant technology to protect the core technology with patent wall. Nevertheless, in consideration of the replace speed in the market and to avoid the emergence of new technology not being able to immediately respond or invest in the technology development with larger potential in a different market, an enterprise should develop towards diversification. It was the dilemma of innovation.

Referring to the viewpoint of Wang, Wei, & Song (2017), the technology combination and management resource allocation of an enterprise could be realized by the technology standard on the patent combination. Accordingly, innovation concentration and related diversity are used for measuring innovation diversity in this study.

Business performance

Lin *et al.* (2016) mentioned that different performance goals were used in general experimental research, due to different organization structure and goals of industries. Yu & Hong (2016) indicated that research on business management generally focused on business performance; therefore, finding out significant factors in business performance and providing message for managers making strategies were the objectives of business research. Duran *et al.* (2016) pointed out business performance as the performance of business activity, which contained the creation of operating revenue, control of cost and expense, and presentation of profits. Zhong & Gao (2017) indicated that groups and organizations with different needs would have distinct standards for business performance; performance evaluation allowed understanding the resource operation result in the past to guide the future business strategy and resource allocation direction of the organization. Johnston & Nowland (2017) considered that financial performance and marketing performance were generally used for representing the business performance of a company, including rate of return, return on sales, pre-tax income, sales, and sales growth rate in financial performance as well as market share in marketing performance. Orlitzky, Schmidt, & Rynes (2016) further pointed out the measurement of performance with non-financial methods and sliced time for business performance; the short-term goal should take the value of shareholders into account, and the long-term goal aimed to balance the long-term sustainable development and survival.

Referring to Ding *et al.* (2017), two indicators are used for measuring business performance in this study: (1) *Gross profit*: deducting cost of sales from revenue. Cost of sales is the direct cost of product sales or labor provision, but does not cover indirect expenses of rent, utility bill, advertising cost, and R&D expense;

(2) *Operating revenue*: various incomes of an enterprise acquired from product sales or labor provision. Operating revenue is the income before deducting any costs and expenses.

Methodology

Research hypothesis

Wang, Wei, & Song (2016) stated that technological capability was often regarded as the major factor in business performance in biotechnology industry. Rafiq *et al.* (2016) referred technological capability as all activities transferring specific invested resources into production goal and could be developed with unique methods, designed new products and processes, and upgraded knowledge, i.e. transferring knowledge into design and creation to achieve the expected effect. Grimpe *et al.* (2017) pointed out the establishment of technological capability as the accumulation process, through the innovation, accumulation, and utilization of the enterprise to promote the competitiveness and further affect the business performance. Lin *et al.* (2016) evaluated the innovation and technological capability of an enterprise with patent activity and regarded it as a part of core resource. Ruiqi *et al.* (2017) also considered that business performance could be evaluated by patent performance. Ding *et al.* (2017) proposed that common measurement of patent performance contained number of patent and times cited. The following hypothesis is then proposed in this study.

H1: Patent right reveals significant effects on business performance.

Shin *et al.* (2017) proposed that the specialization of technological activity could assist in the promotion and expansion of the technology in the industry. From the literature review, based on the viewpoints of RBV and evolutionary economics, an enterprise could enhance the rich basis of research and development ability or present deep pocket advantage in the accumulation of innovation activity to intertemporally spread the market monopoly. Guldiken & Darendeli (2016) revealed that the core competency (specialized technology) of an enterprise should be constantly accumulated to enhance the competitiveness of the enterprise in the process. Xu, Xia, & Li (2017) regarded the advance of organizational technology as an evolution process; when past technology could be improved or diversely developed, an enterprise could form the future technology through the accumulation of technology. Lee & Chu (2017) considered that an enterprise, when facing broader market opportunities, would research and develop new technology with the viewpoint of investment combination to avoid loss of opportunities. Nonetheless,

an enterprise, in the research and development of investment combination, tended to the development related to current technology, based on niche technology, in order to reinforce and reconstruct core competency. Accordingly, the following hypotheses are proposed in this study.

H2: Innovation diversity appears remarkable effects on business performance.

H3: Patent right and innovation diversity show notable effects on the promotion of business performance.

Research object and research design

The relationship among patent performance, innovation diversity, and business performance is discussed in this study that the selected industry must present certain degree of patent quantity. Apparently, biomedical Industry show outstanding patent applications in past five years. Especially, patents reveal extreme importance on the industry requiring advance advantage. Biomedical Industry therefore is selected as the research object. By searching listed biomedical companies from Chinese medicine database, 50 companies are selected as the research object. Based on the database and assisted with Market Observation Post System, the business data of such companies are searched.

Analysis method

Analysis of variance is applied in this study to discuss the effect of patent right on business performance and the effect of innovation diversity on business performance as well as understand the effect of matching patent right with innovation diversity on business performance.

Results and discussion

Variance analysis of patent right on business performance

According to analysis of variance to discuss the difference of patent right in gross profit and operating revenue, *Table 1*, short-term immediate and long-term accumulation presents remarkable difference in gross profit; long-term accumulation shows higher gross profit than short-term immediate. Short-term immediate and long-term accumulation reveals notable difference in operating revenue; short-term immediate appears higher operating revenue than long-term accumulation. H1 is therefore supported.

Table 1. Variance analysis of patent right

variable		F	P	Scheffe post hoc
patent right	gross profit	12.165	0.000**	long-term>short-term
	operating revenue	17.423	0.000**	short-term>long-term

* stands for $p < 0.05$, ** stands for $p < 0.01$

Variance analysis of innovation diversity on business performance

According to analysis of variance to discuss the difference of innovation diversity in gross profit and operating revenue, Table 2, innovation concentration and related diversity show significant difference in gross profit; related diversity reveals higher gross profit than innovation concentration. Innovation concentration and related diversity appear remarkable difference in operating revenue; innovation concentration presents higher operating revenue than related diversity. Consequently, H2 is supported.

Table 2. Variance analysis of innovation diversity teaching

variable		F	P	Scheffe post hoc
innovation diversity	gross profit	21.836	0.000**	related diversity > innovation concentration
	operating revenue	32.451	0.000**	innovation concentration > related diversity

* stands for $p < 0.05$, ** stands for $p < 0.01$

Effect analysis of patent right and innovation diversity

According to analysis of variance to discuss the difference of patent right act and innovation diversity in business performance, the interaction between patent right and innovation diversity is further discussed with two-way analysis of variance to test the promotion of innovation diversity. Table 3 reveals the highest gross profit of long-term accumulation and related diversity, while the highest operating revenue appears on short-term immediate and innovation concentration. As a result, H3 is supported.

Table 3. Variance analysis of patent right integrated innovation diversity on business performance

variable	gross profit			operating revenue		
	F	P	Scheffe post hoc	F	P	Scheffe post hoc
patent right	12.165	0.000**	long-term> short-term	17.423	0.000**	short-term> long-term
innovation diversity	21.836	0.000**	related diversity> innovation concentration	32.451	0.000**	innovation concentration> related diversity
patent right* innovation diversity	38.462	0.000**	11>12>21>22	43.157	0.000**	22>21>12>11

* stands for $p < 0.05$, ** stands for $p < 0.01$

Conclusion

The research results show that R&D and technological capability are regarded as the core resources of an enterprise in biomedical Industry, which could be accumulated to create the competitive advantage and further promote business performance. Quantity of patent reveals positive effects on business performance of biomedical Industry that quantity of patent could effectively enhance the output value. In this case, biomedical Industry should particularly pay attention to the management and distribution of patents and acquire advance technology for the competitive advantage in the industrial environment with emerging and evolving industrial technology. In regard to the higher effect of long-term accumulation patent than short-term patent, patents should present the characteristic of intertemporal spread. In this case, biomedical Industry might not have immediate effectiveness in short term, but should constantly accumulate core technology to construct competitive advantage. The performance of biomedical businesses pursuing the related diversity development of innovation activity shows better business performance than those without related diversity. For this reason, biomedical Industry, when preceding R&D activity, should focus on specialized technology. However, the specific implementation of the effect of core technology relies on the match of the rest production activity. What is more, although diversification might result in declining business performance due to resource decentralization, when biomedical Industry selecting innovation activity due to market, technology

uncertainties and industrial characteristics, related diversity firms pursuing innovation activity should outperform those without related diversity in long term. As a consequence, biomedical Industry should focus on reinforcing and reconstructing core technology.

Recommendations

According to the research conclusion, the following suggestions are proposed in this study.

- The application of patents should consider the business strategies, distribution resources, product funds, and financial plans of biomedical Industry to make the final decision. In regard to the countries for the application, an innovative enterprise has to consider the resource and patent distribution strategic plan matching the middle- and long-term sales plan.
- Enterprises in biomedical Industry basically would follow the location of industrial chain to apply for patents. Overall speaking, there is not an enterprise completely cover the vertical integration of upstream, mid-stream, and downstream. However, strategic alliances allow biomedical Industry more rapidly distribute the industrial chain.
- Biomedical Industry should synchronize the future planning so as to match the patent application and technological development. That is, when a technology is predicted to boom in the market 10 years later, the technology should be researched now, the market survey is re-examined five years later, and then the patent application is prepared.
- In a company with constant promotion of patent right, the correlation between patent right and the biomedical company should be realized in the organizational structure. In other words, the concept should link internal organization of the biomedical company and the idea of patent right is placed on top of the organization level. In this case, talent search, personnel allocation, technology R&D and product development strategies, estimation of investment in patent right, joint venture and merger with other biomedical companies, authorization activity, and litigation planning could correspond to human resource department, R&D department, product development department, finance department, and legal affairs department of the biomedical company for overall patent right strategic planning.

References

- Baumann, J., & Kritikos, A. S. (2016). The link between R&D, innovation and productivity: Are micro firms different?. *Research Policy*, 45(6), 1263-1274, DOI: 10.1016/j.respol.2016.03.008.
- Bouaziz, Z. (2016). The Impact of R&D Expenses on Firm Performance: Empirical Witness from the Best Technology Index. *Journal of Business Theory and Practice*, 4(1), 51, DOI: 10.22158/JBTP.V4N1P51.
- Chen, P.-C., Chan, W.-C., Hung, S.-W., Hsiang, Y.-J., & Wu, L.-C. (2016). Do R&D expenditures matter more than those of marketing to company performance? The moderating role of industry characteristics and investment density. *Technology Analysis & Strategic Management*, 28(2), 205-216, DOI: 10.1080/09537325.2015.1093107.
- Ding, C.G, Jane, T.D. Wu, C.H., Lin, H.R., & Shen, C.K. (2017). A systematic approach for identifying level-1 error covariance structures in latent growth modeling. *International Journal of Behavioral Development*, 41, 444-455, DOI: 10.1177/0165025416647800.
- Duran, P., Ander, N.K., Van Essen, M., & Zellweger, T. (2016). Doing More With Less: Innovation Input and Output in Family Firms. *Academy of Management Journal*, 59(4), 1224-1264, DOI: 10.5465/amj.2014.0424.
- Grimpe, C., Sofka, W., Bhargava, M., & Chatterjee, R. (2017). R&D, Marketing Innovation, and New Product Performance: A Mixed Methods Study. *Journal of Product Innovation Management*, 34(3), 360-383, DOI: 10.1111/jpim.12366.
- Guldiken, O., & Darendeli, I.S. (2016). Too much of a good thing: Board monitoring and R&D investment. *Journal of Business Research*, 69(8), 2931-2938, DOI: 10.1016/j.jbusres.2015.12.062.
- Gupta, K., Banerjee, R., & Onur, I. (2017). The effects of R&D and competition on firm value: International evidence. *International Review of Economics and Finance*, 51, 391-404, DOI: 10.1016/j.iref.2017.07.003.
- Johnston, J., & J. Nowland. (2017). A research note the informational benefits of CEO attendance by-invitation. *Journal of Contemporary Accounting & Economics*, 13(2), 108-118, DOI: 10.1016/j.jcae.2017.05.006.
- Kalelkar, R. (2016). Audit committee diligence around initial audit engagement. *Advances in Accounting*, 33, 59-67, DOI: 10.1016/j.adiac.2016.04.009.
- Kusnadi, Y., Leong, K.S., Suwardy, T., Wang, J. (2016). Audit committees and financial reporting quality in Singapore. *Journal of Business Ethics*, 139(1), 197-214, DOI: 10.1007/s10551-015-2679-0.
- Lee, T., & Chu, W. (2017). The relationship between entrepreneurial orientation and firm performance: Influence of family governance. *Journal of Family Business Strategy*, 8(4), 213-223, DOI: 10.1016/j.jfbs.2017.09.002.
- Lin, C.L., Lin, H.L., & Lin, E.S. (2016). Is there a complementary relationship between product and process innovation on productivity in Taiwanese manufacturing firms?. *Hitotsubashi Journal of Economics*, 57(2), 139-173, DOI: 10.15057/28221.
- Lome, O., Heggeseth, A. G., & Moen, O. (2016). The effect of R&D on performance: Do R&D-intensive firms handle a financial crisis better? *The Journal of High Technology Management Research*, 27(1), 65-77, DOI: 10.1016/j.hitech.2016.04.006.

- Malik, M.S., & Makhdoom, D.D. (2016). Does corporate governance beget firm performance in fortune global 500 companies? *Corporate Governance*, 16(4), 747-764, DOI: 10.1108/CG-12-2015-0156.
- Neumayer, E., & Plumper, T. (2017). *Robustness Tests for Quantitative Research*. New York, NY: Cambridge University Press, DOI: 10.1017/9781108233590.
- Orlitzky, M., Schmidt, F. L., & Rynes, S. L. (2016). Corporate Social and Financial Performance: A Meta-Analysis. *Organization Studies*, 24(3), 403-441, DOI: 10.1177/0170840603024003910.
- Rafiq, S., Salim, R., & Smyth, R. (2016). The moderating role of firm age in the relationship between R&D expenditure and financial performance: Evidence from Chinese and US mining firms. *Economic Modelling*, 56(C), 122-132, DOI: 10.1016/j.econmod.2016.04.003.
- Ruiqi, W., Wang, F., Xu, L., & Yuan, C. (2017). R&D expenditures, ultimate ownership and future performance: Evidence from China. *Journal of Business Research*, 71, 47-54, DOI: 10.1016/j.jbusres.2016.10.018.
- Shin, N., Kraemer, K.L., & Dedrick, J. (2017). R&D and firm performance in the semiconductor industry. *Industry and Innovation*, 24(3), 280-297, DOI: 10.1080/13662716.2016.1224708.
- Wang, Q., Hang, Y., Sun, L., & Zhao, Z. (2016). Two-stage innovation efficiency of new energy enterprises in China: A non-radial DEA approach. *Technological Forecasting and Social Change*, 112, 254-261, DOI: 10.1016/j.techfore.2016.04.019.
- Wang, Y., Wei, Y., & Song, F.M. (2017). Uncertainty and corporate R&D investment: Evidence from Chinese listed firms. *International Review of Economics & Finance*, 47, 176-200, DOI: 10.1016/j.iref.2016.10.004.
- Wickham, H., & Golemund, G. (2016). *R for Data Science*. Sebastopol, CA: O'Reilly Media, DOI: 10.18637/jss.v077.b01.
- Xu, J., & Jin, Z. (2016). Research on the Impact of R&D Investment on Firm Performance in China's Internet of Things Industry. *Journal of Advanced Management Science*, 4(2), 112-116, DOI: 10.12720/joams.4.2.112-116.
- Xu, X., Xia, Y., & Li, C. (2017). Influence of Chinese entrepreneurial companies' internationalization on independent innovation: Input incentive effect and efficiency improvement effect. *China Journal of Accounting Research*, 10(3), 247-280, DOI: 10.1016/j.cjar.2017.05.001.
- Yu, G.J. & Hong, K. (2016). Patents and R&D expenditure in explaining stock price movements. *Finance Research Letters*, 19, 197-203, DOI: 10.1016/j.frl.2016.07.012.
- Zhong, M., & L. Gao. (2017). Does corporate social responsibility disclosure improve firm investment efficiency?: Evidence from China. *Review of Accounting and Finance*, 16(3), 348-365, DOI: 10.1108/RAF-06-2016-0095.