



A Dual-Perspective Study on the Impact of Mergers and Acquisitions Companies on their Innovation Performance – Taking Company J as an Example

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Abstract

Objective To explore the impact of mergers and acquisitions (M&A) on the innovation performance of the companies from both a patent perspective and a financial perspective by taking the case of M&A Company J as an example. **Methods** The literature research method, patent data analysis method, and financial data analysis method were used. **Results and Conclusion** The M&A has a positive impact on the innovation performance of Company J, and the results from the patent perspective and the financial perspective are consistent. The literature research method, patent data analysis method, and financial data analysis method were used. The M&A has a positive impact on the innovation performance of Company J, and the results from the patent perspective and the financial perspective are consistent.

Keywords: mergers and acquisitions (M&A); innovation performance; patent perspective; financial perspective; Company J

Innovation is an important topic in today's era. The development of the new technological revolution and industrial transformation has increasingly highlighted the urgency of accelerating our national technological innovation capability^[1]. Constantly improving innovation capability is critical for the survival and development of enterprises.

In recent years, with the development of China's pharmaceutical industry, the number of pharmaceutical companies has increased year by year, but few companies have independent research and innovation capabilities. The long drug development cycle, the high cost of research and development and

short patent protection time are the factors that hinder the R&D innovation of biopharmaceutical companies. A large number of pharmaceutical companies realize that it is difficult to develop new products only by their effort. Therefore, it is inevitable for pharmaceutical companies to reorganize and integrate resources within the industry if they want to develop^[1]. Mergers and acquisitions are an important mechanism for companies to realize organizational restructuring adjustment and resource reallocation^[2]. Moreover, M&A is an active behavior for both parties, meaning both the acquirer and the acquired party will reallocate resources.

Although pharmaceutical companies have started to make M&A, they still need to reorganize and integrate their resources. To test whether the M&A has

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exerted a tremendous positive impact, it is necessary to measure the technological capability of the companies. In recent years, innovation performance has become an important indicator to measure firms' technological capability. And firms' innovation performance can be calculated from multiple dimensions. Patent perspective and financial perspective are often used by domestic scholars to measure innovation performance in recent years. This paper selects the acquired party rather than the acquirer to explore the firm's innovation performance from both the patent and the financial perspectives.

1 Introduction to related theories

1.1 M&A synergies

A synergistic effect was initially a biological concept proposed by Harken in Germany. In the middle of last century, Igor Ansoff, an American scholar, proposed the economic concept of synergy. After the completion of M&A, the overall effect of the enterprise is greater than the sum of the effects of each independent enterprise, which means " $2 + 2 > 5$ ". The overall benefits of the M&A are greater than the sum of the economic benefits of the two parties prior to the M&A^[3]. Financial synergy is one of the core components of M&A, which refers to the various financial benefits brought by the M&A. However, it is not necessarily all the effects are positive. Only positive financial synergy can bring positive benefits^[4]. Financial synergies are usually expressed in financial performance indicators, specifically in terms of improved return on capital, reduced costs, improved debt servicing capacity, and financing capacity.

1.2 Enterprise innovation performance

Since the China's government implemented the innovation-driven development strategy, there has been an "innovation boom" across the country. Various industries started to innovate, and the

academic debate on innovation has continued for a long time^[5]. The most frequently mentioned concept is innovation performance, which, as the name implies, refers to the corporate revenue generated by a company's innovation activities^[6]. Most studies tried to measure corporate innovation performance by patent indicators in the current literature on innovation performance in China. However, patents and innovation are two distinct and related concepts. On the one hand, patents are the knowledge input for innovation, and an organization's innovation activities are largely determined by its patent portfolio. On the other hand, the commercialization success from patents to products is a complex process of knowledge integration^[7].

However, if we deconstruct the technological innovation performance of firms into quantity of innovation and economic value^[5], the innovation performance of companies should also be expressed by financial indicators. Financial data is the most intuitive reflection of the economic value of companies, such as operating income, R&D expenditure, etc.

This paper explores the impact of M&A on the innovation performance of the acquired party through the analysis of patent data and financial data before and after corporate M&A. To draw corresponding conclusions, a domestically listed pharmaceutical company is selected to study the factors affecting innovation performance by analyzing its patent quantity, patent quality, patent field, operating income, R&D expenditure, and other indicators.

2 Case selection and data sources

2.1 Case selection

Company J is a listed pharmaceutical company in China, mainly producing healthcare drugs and focusing on traditional Chinese medicine. Its main business is the production, R&D, and sales of over-the-counter drugs and healthcare products. Company J was acquired by another large biopharmaceutical company in China, Company H, in 2019. With



Company J as its base, Company H is committed to becoming a leading domestic integrated pharmaceutical group.

This merger and acquisition began planning in 2018. In 2019, the merger and acquisition were completed. The offer price was 17.56 yuan/share, and 239 million shares were offered. Therefore, the total funds were close to 4.202 billion yuan. After the completion of this merger and acquisition, Company H had 51% of the equity of Company J, becoming its controlling shareholder.

2.2 Data sources

The patent data was obtained from Wisdom Buds, and the search time was February 15, 2023. The keywords for search were Jiangzhong Pharmaceutical Co., Ltd. The patent application time was controlled from 2017 to 2022. A total of 267 patents were retrieved, including 60 patents for invention applications, 25 patents for utility models, 158 patents for designs, and 24 patents granted for inventions.

Financial data was obtained from the official annual reports of Company J, including annual report data from 2017 to 2021.

3 Analysis of patent data before and after the merger of Company J

3.1 Changes in the number of patents

The change in the number of patents is an important index in patent analysis, including the change in the number of applications, the change in the number of licenses and the Length of time from application to authorization.

3.1.1 Changes in the number of applications

The number of patents is an important indicator of the value of patents. The number of patent applications is the patents applied for in a year, which includes the entitled patents, the pending ones and non-entitled patents. As shown in Fig. 1, 2020 is the peak year for patent applications. In 2020, Company J completed its M&A. The number of patent applications from 2017 to 2020 shows an upward trend. The greatest increase happens from 2019 to 2020. It shows a large decrease in 2021 and returns to an upward trend in 2022, though not exceeding the peak year of 2020.

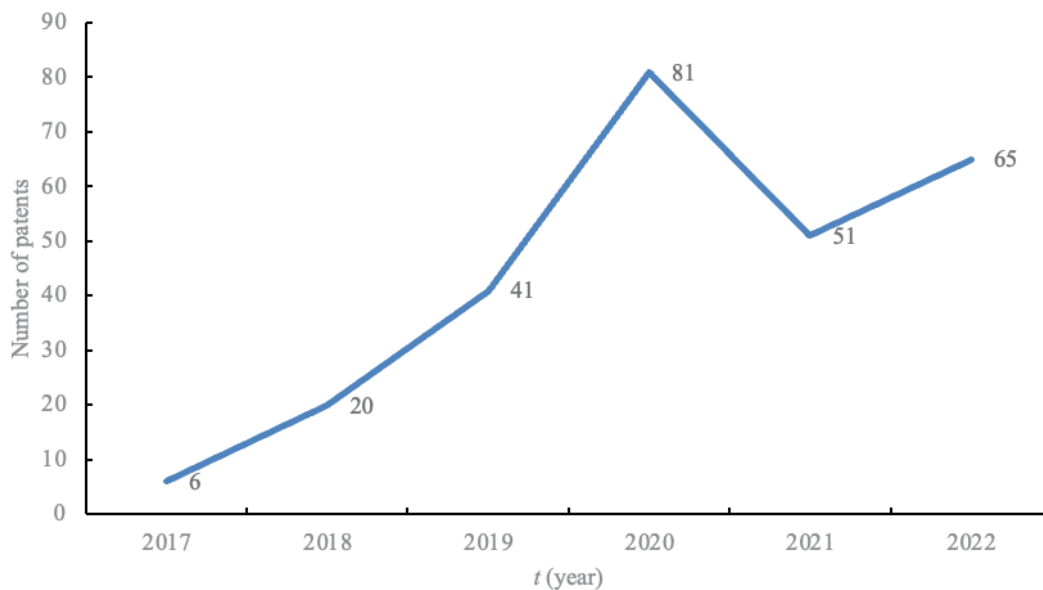


Fig. 1 Changes in the number of patent applications by Company J from 2017 to 2022



3.1.2 Change in the number of licenses

The number of patents granted is the number of entitled patents, excluding patents under trial and unentitled patents. The number of patents granted can better represent the technological capability of the company. As shown in the Fig. 2, it can be

seen that 2020 is the peak year for the number of patents granted to Company J, with 70 entitled patents, and the trend is up from 2017 to 2020. Then, it starts to decline in 2021, and resumes an upward trend in 2022. It is consistent with the trend of the number of patent applications of Company J.

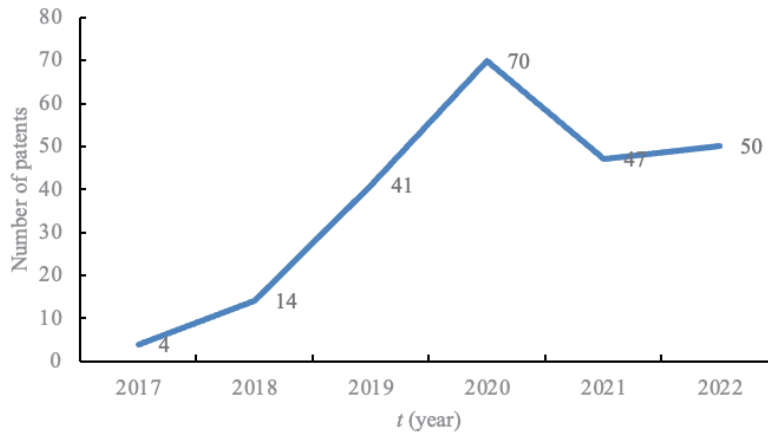


Fig. 2 Changes in the number of patents granted by Company J from 2017 to 2022

The formula for calculating the ratio of patents granted is entitled patents/applied patents. As shown in the Table 1, the ratio of patents granted from the company is over 50% from 2017 to 2022, and the highest ratio is in 2019, when the grant ratio

reaches 100%. In 2019, the M&A occurs. And the authorization ratio is on an upward trend in 2020 and 2021. It should be noted that the authorization rate will gradually increase in the following years due to the delayed time limit after 2022.

Table 1 Proportion of patents granted by Company J from 2017 to 2022

Year	Authorization ratio (%)
2017	66.66
2018	70.00
2019	100.00
2020	86.42
2021	87.04
2022	76.92

3.1.3 Length of time from application to authorization

According to the survey results on the number of patents of Company J from 2017 to 2022, more than 95% of the licensing period are below six months, and the largest proportion of the licensing period is from 3 to 6 months. The change in the authorization period before and after 2019 is not obvious, which means the

change of the authorization period before and after M&A is not obvious.

3.2 Changes in patent quality

If patents are used as indicators to measure the technological capability of enterprises, it is necessary to consider all dimensions of patent indicators.



Therefore, patent quality indicators are no less important than patent quantity indicators in recent years.

3.2.1 Legal status

As shown in the Fig. 3, the legal status of patents can help measure the degree of patent activity. Patent

legal status of Company J has three classifications from 2017 to 2022, including 226 valid patents, 34 under review patents, and 7 invalid patents. The percentage of entitled patents is 85%, which shows that the patent granted rate of Company J is reasonable. The proportion of patents under trial is not very large, indicating that the company's patent innovation vitality is average.

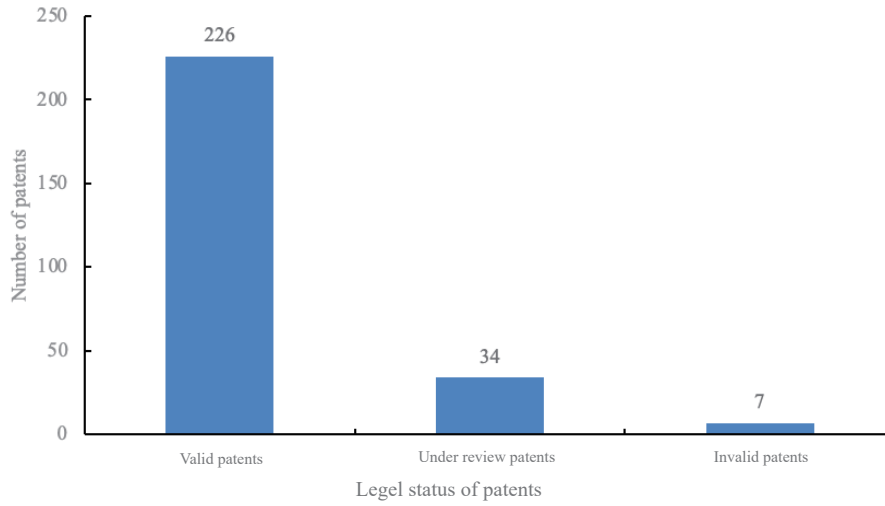


Fig. 3 Legal Status of Company J Patents

3.2.2 Number of citations

The number of citations directly proves the gold content of the patent in the field to which it belongs. It is an important reflection of the quality of the patent, and the total number of patent citations for Company J from 2017 to 2022 is 40. As shown in

the Fig. 4, the peak of patent citations for Company J was in 2018, the year before the M&A, while the number of patent citations decreased gradually after 2019. However, it should be noted that the maximum patent disclosure period is 18 months, so the number of patent citations in 2021 and 2022 will be seriously underestimated.

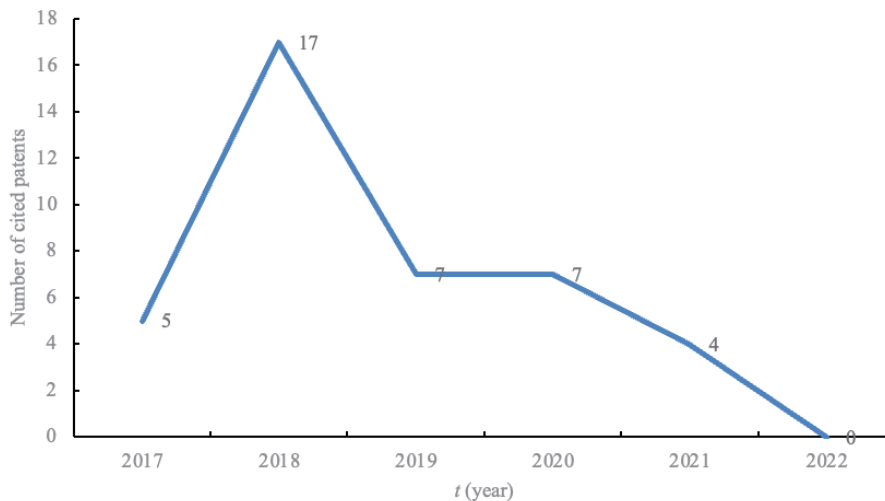


Fig. 4 Change in patent citations of Company J from 2017 to 2022



3.2.3 Number of patents granted with a protection period of over 8 years

Since patent citations are characterized by a time lag, the indicator of patent quality can be chosen as the protection period, which is 20 years for invention patents and ten years for utility model and design patents.

Therefore, this paper selects eight years as the dividing value. As shown in the Table 2, we can see that the total number of patents granted after 2019 with a protection period of 8 years or more is continuously rising. However, in terms of the number of new patents, 2019 is the peak year and it will decline in the following years.

Table 2 The number of patents with a protection period of more than 8 years in Company J

Year	Number of patents	New additions during the year
2017	152	
2018	144	-8
2019	183	39
2020	249	66
2021	278	29
2022	293	15

3.3 Changes in patent field

The international patent classification (IPC) is now a standard tool for internationally classifying technologies in the patent literature and is often used to observe changes in the patent field.

Company J has a total of 26 invention and utility model patents prior to the M&A in 2019. The MIPC subcategories of the IPC main classification number focus on A61K (preparations for medical, dental or grooming purposes), G05B (general control or regulation systems), A61J (containers dedicated to medical or pharmaceutical purposes), A61P (specific therapeutic activity of compounds or pharmaceutical preparations), B08B (general cleaning), C12N (microorganisms or enzymes), E04H (buildings or similar structures for specialized uses), H04L (transmission of digital information), A23L (food, edibles or non-alcoholic beverages not included in subcategories A21D or A23B to A23J), B01J (chemical or physical methods), B02C (chemical or physical methods), F26B (drying for eliminating liquids from solid materials or products), F28D (heat exchange

equipment not included in other subcategories where the heat exchange medium is not in direct contact), G01N (testing or analyzing materials with the aid of determining their chemical or physical properties), and G06Q (data processing systems or methods specially adapted for administrative, commercial, financial, regulatory, supervisory, or forecasting purposes). As shown in the Fig. 5.

Moreover, the number of inventions and utility model patents of Company J after the merger, i.e., from 2020 to 2022, is 84, of which the IPC classifications are A61K, A23L, B02C, B01D (separation), F24F (air conditioning), G01N, B01J, A61J, A61L (general method or apparatus for material or sterilization), B30B (general press), C08B (polysaccharides), F23D (burners), F26B, A23K (feeding feed specifically for animals), B04B (centrifuges), B08B, C07D (heterocyclic compounds), C07H (sugars), C11B (production), F16K (valves), G01D (not dedicated to the measurement of specific variables), G02B (optical components), H02H (emergency protection circuit device), and H04J (multiplexed communication). As shown in Fig. 6.

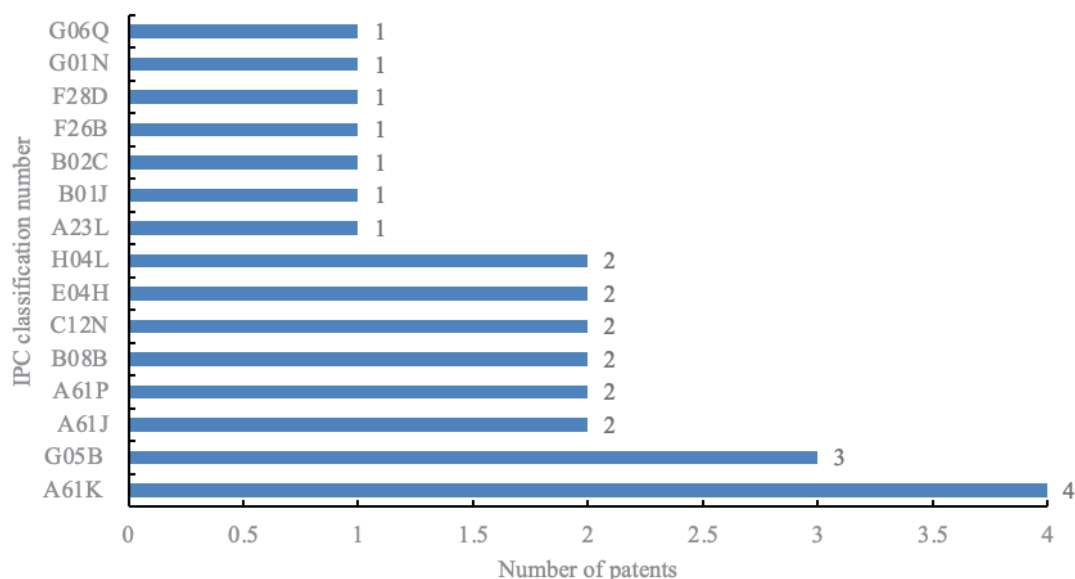


Fig. 5 Changes in IPC main classification numbers of invention and utility model patents of Company J before the merger and acquisition

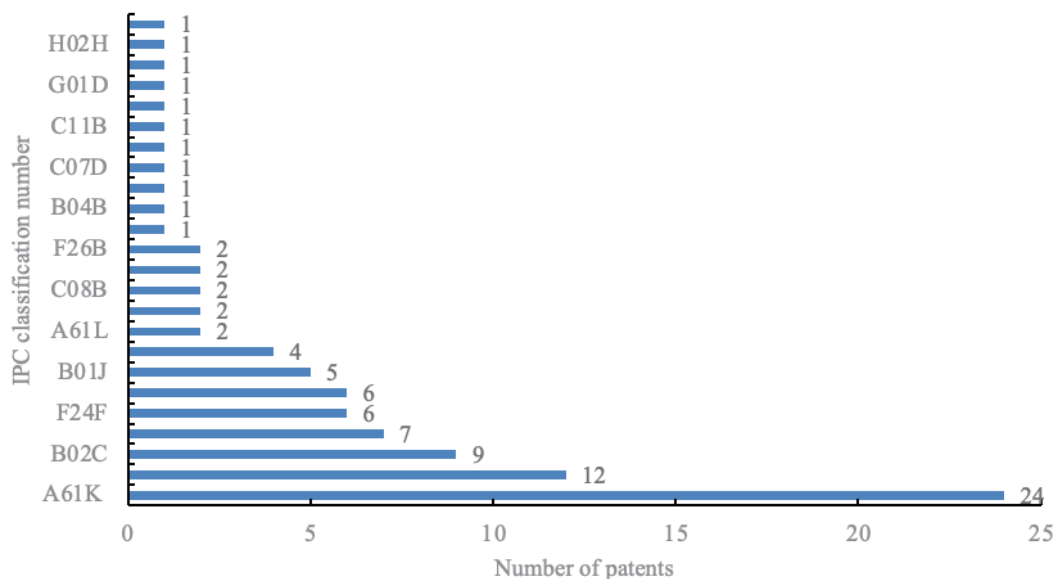


Fig. 6 Changes in IPC main classification numbers of invention and utility model patents of Company J after M&A

It can be seen that Company J covers 14 sub-categories before the merger and 24 sub-categories after the merger. Therefore, the number of patent categories has increased significantly. However, instead of adding to the 14 categories, the original six sub-categories are reduced, and 16 new sub-categories are added. The six reduced categories are G05B, A61P, C12N, E04H, F28D, and G06Q. The 16 new categories are B01D, F24F, A61L, B30B, C08B,

F23D, A23K, B04B, C07D, C07H, C11B, F16K, G01D, G02B, H02H, and H04J.

3.4 Changes in patent invention lineup

The change of the patent invention lineup is shown by the change of the lineup of main inventors and the change of the number of patent applications.



As shown in Table 3, the main invention lineup of Company J after M&A did not change a lot, and the key inventors stayed around the main invention lineup. However, they varied much from year to year, and the number of invention patents of key inventors was continuously rising. 2018 was the year with the

largest percentage of invention patents of key inventors, reaching 80%. After the M&A occurred in 2019, the percentage continued to decline. This indicates that although Company J did not change their invention lineups after M&A, they were gradually expanding their invention lineups, which means it has more inventors.

Table 3 Changes in the main invention lineup of Company J

Year	Top three principal inventors (Sorted by number of inventions)	Number of invention patents	Number of key inventor applications	Percentage of the number of applications by key inventors (%)
2017	Le Yuning, Liu Xuhai, Zhou Youhua, Zhu Minghui, Xiong Jing, Wang Guihua, Wang Guhong	3	3	50
2018	Lu Xiaoqing, Liu Xuhai, Le Yuning, Zhang Xiaohe, Yang Honglin, Zhong Li, Chen Level, Gao Siyuan	15, 6, 4	15	80
2019	Lu Xiaoqing, Liu Xuhai, Zhu Minghui, Wang Guhong	26, 9, 9	26	63
2020	Lu Xiaoqing, Liu Wenjun, Li Yiguang	47, 16, 13	47	58
2021	Lu Xiaoqing, Liu Xuhai, Zhang Xiaohe	32, 8, 8	32	59
2022	Liu Weiquan, Liu Wenjun, Li Yiguang, Lu Xiaoqing, Xiong Yanxia	22, 18, 13	22	34

4 Analysis of financial data before and after the merger of Company J

4.1 Debt service capacity analysis

Debt service capacity analysis includes two aspects: current ratio and owner's equity ratio.

4.1.1 Current ratio

As shown in Table 4, current ratio = current assets/current liabilities. The current ratios of Company J from 2017 to 2022 are 5.96, 5.06, 4.09, 5.45, 3.09, and 2.43, which means that the current ratio is decreasing year by year. The current ratio represents the short-term solvency of the company. The current ratio between 1.5 and 2.0 is the best interval, the current ratio of Company J is not in this interval. But the current ratio of Company J in the year of the merger significantly decreased, which represents that the M&A increased the short-term solvency of the company.

4.1.2 Owner's equity ratio

As shown in the Table 4, owner's equity ratio = owner's equity/assets. The lower the owner's equity ratio is, the better without considering the effect of the leverage factor. The owner's equity ratios of Company J from 2017 to 2022 are 0.87, 0.85, 0.83, 0.86, 0.76 and 0.72, respectively, which shows that the owner's equity ratio is continuously decreasing after the completion of the M&A, indicating a good sign.

4.2 Analysis of financing capacity

As shown in Table 4, assert liability ratio = liabilities/assets. The Assert liability ratios of Company J from 2017 to 2022 are 0.13, 0.15, 0.18, 0.14, 0.24, and 0.28, respectively. Besides, the Assert liability ratio represents the long-term solvency of the company. The Assert liability ratio of Company J is less than 0.2 until 2021, which means that the financing ability of Company J is not good. The Assert liability ratio



of Company J in 2020 decreases significantly, which indicates that the M&A has an impact on the financing ability of the company. However, the Asset liability

ratio of Company J in 2021 and 2022 has a significant increase and exceeds 0.2.

Table 4 Selected financial data for company J from 2017 to 2022 (Unit: yuan)

Financial index	Year					
	2017	2018	2019	2020	2021	2022
Current assets	1 968 045 400	2 293 747 100	3 061 726 400	3 275 216 100	4 064 479 200	4 022 075 300
Total assets	3 364 102 129.40	3 816 971 960.48	4 759 193 757.25	4 923 573 835.05	5 997 600 248.38	6 243 659 100
Current liabilities	330 070 700	453 731 000	748 912 800	6014 87 600	1 316 560 400	1 657 669 300
Total liabilities	448 738 400	563 530 700	834 837 100	672 274 000	1 415 111 600	1 748 281 700
Total owner's equity	2 915 363 700	3 253 441 300	3 924 356 600	4 251 299 800	4 582 488 600	4 495 377 400
Main business income	1 746 642 528.67	1 755 229 022.31	2 449 404 442.61	2 441 451 789.23	2 873 974 462.18	3 811 641 511
R&D expenses	22 779 828	29 621 000	47 509 700	55 553 200	87 824 600	99 970 600
Net profit after tax	417 719 567.19	470 232 546.77	479 436 535.81	490 323 230.45	530 949 126.86	644 211 400

4.3 Innovation capacity analysis

The analysis of innovation capability includes three aspects: Main business income, return on assets and R&D expenditure.

4.3.1 Main business income

As can be seen from Table 4, the main business income of Company J gradually increases from 2017 to 2019 and decreases in 2020, but it resumes rising in 2021. 2020 is the first year when the merger and acquisition of Company J are completed, meanwhile, the COVID-19 breaks out in China, so the decrease in main business revenue is affected by various factors.

4.3.2 Return on assets

As seen from Table 4, the return on assets of

Company J is gradually decreasing. The formula for the return on assets is the return on assets = net profit after tax/total assets, and the return on assets is better at 10% or more. The return on assets of Company J from 2017 to 2022 are 12.42%, 12.32%, 10.07%, 9.96%, 8.85%, and 10.31%, which shows that Company J's asset utilization rate is on a downward trend after the M&A, but it starts to rebound again in 2022. The use of assets needs to consider the time lag.

4.3.3 Research and development expenses

From Table 4, it can be seen that the R&D expenses of Company J are increasing year by year with a large increment, with the largest increase from 2020 to 2021, followed by 2018 to 2019. The overall R&D expenses are increasing, which means that Company J is investing more in R&D. Therefore, it pays more attention to R&D after the M&A.



5 Conclusion

By analyzing the patent data of Company J, we can conclude that the M&A positively impacts the patent effectiveness. Regarding patent quantity, the number of patent applications and the patent granted rate are both the highest in the year when the M&A is completed. In terms of patent quality, the peak of patent citations is in the year of preparation for the M&A, and Company J has the largest proportion of entitled patents, and the number of patents granted with a protection period of more than eight years also increases after the M&A. As to patent field, the M&A has a significant impact on the field of invention and utility model patents of Company J, which is reflected in the expansion of many IPC subcategories and the number of patents. Therefore, Company J will expand its patent field after the completion of the M&A. As for the invention lineup, after the M&A, the original major inventor lineup still retains. The invention lineup is expanding, which means that Company J strengthens its competitive advantage in its field after the M&A.

By analyzing the financial data of Company J, we can also conclude that this M&A has a positive impact on the patent effectiveness of Company J. Firstly, the solvency has improved, which can be reflected by the decrease in the current ratio and the owner's equity category.. Secondly, increasing the Asset liability ratio represents improving the company's financing ability. Regarding the analysis of the innovation capacity of the company, the overall trend of operating income is gradually increasing. However, there is a decline in 2020 due to the possibility of being affected by the pandemic. And the upward trend resumed in 2021. The return on assets is decreasing year by year, implying that assets are generating less revenue. But this does not imply a decline in innovation performance because the return on assets is characterized by a time lag and the increase of more assets in recent years may be reflected in the

performance of later years. Besides, the indicator of R&D expenses also verifies this situation. The R&D expenses of Company J is increasing each year, which means that it attaches importance to R&D innovation. Thus, it is clear that the financial data of Company J in the post-merger period are positive in general.

M&A can both increase the acquirer's performance and the acquired party's performance, which is a win-win situation.

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