

Chinese Firms' Overseas M&A and Innovation Activities: Empirical Analysis Using Patent Data (*)

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In this research, by using a patent database we conducted an empirical analysis to focus on inventors who transferred to Haier, and the change of transferred inventors' performance. From the results of this study, it was found that rather than young inventors who are active in the front line, veteran researchers transferred to Haier. Furthermore, we also found that the inventors' performance tends to decrease after transfer to Haier. Based on these empirical results, we reveal that Haier are mainly to acquire experienced veteran inventors to teach abundant experience rather than let them to do active innovation activities.

I. Introduction

Until now, prior studies on foreign M&A conducted by China can be categorized into studies on reasons and background for M&A, and research on effects after M&A. Regarding the reasons and backgrounds, studies are mainly conducted from the aspects of market elements and corporate elements, while the effects are mainly related to the effects of Chinese companies on their own business performance, and to their target company. This study focuses on the impact on the researchers of target companies.

Recently, M&A cases of Japanese enterprises by Chinese and Taiwanese companies are rapidly increasing, and attention is being paid to the acquisition of Sharp by Foxconn, the acquisition of Toshiba's Home Appliances Business by Midea Group, and the transfer of Fujitsu's PC business under Lenovo as major topics. As a background to this, the entire electronics industry is facing a decline in profitability, and Japanese major electronics companies, which have been leading industries to date, have been forced to select and concentrate their business.

On the other hand, when these companies sell a business, especially when the acquisition company is a Chinese company, there are concerns about technology leakage, the impact of Japanese researchers' activities, etc. There are company-level analysis and researcher-level analysis on the influence of Chinese companies' M&A on target companies. In this study, we will analyze at the inventor-level using the case of Sanyo Electric's acquisition by Haier. Specifically, we analyze changes in research results using data on patent applications of Japanese inventors before and after M&A. Large-scale M&A deals with Japanese companies by Chinese or Taiwanese companies in the

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electronics industry are increasing. Concerning Sharp's acquisition by Foxconn, which is becoming a hot topic, it is too early in terms of data to conduct analysis on the influence after the M&A. Hence, we study the case of Haier's acquisition of Sanyo Electric, because the amount of money is much larger among the acquisition of Japanese companies by Chinese companies, a certain number of years have elapsed since the acquisition, and there is useable data.

In recent years, the number of foreign M&As by Chinese enterprises has been rapidly increasing. Figure 1 which is limited to listed companies, shows that the number of M&As is increasing. Especially since 2006, it is increasing rapidly.

Figure 2 shows the change in the target industry of Chinese companies' external M&A. The upper pie chart is the average of 2005-2010, and the lower pie chart is the one-year data of 2015.3-2016.4. In the graph of 2005-2010, the energy accounts for 53%, but in the graph of 2015.3-2016.4, the energy has been reduced to 10%. On the other hand, the share of industry has increased from 26% to 52%, and for TMT it has increased rapidly from 1% to 19%. These changes indicate that M&A to companies with a high technology level is increasing.

Next, we will look at the status of application for inventions of Chinese companies that did overseas M&A in 1998-2016. As shown in Figure ?, the number of enterprises with applications is 54%, which is more than half of the total, but when looking at the total of Chinese industrial companies (Chart ?), companies with applications are less than 1%. Therefore, it can be said that companies conducting overseas M&A are aggressive companies in innovative activities such as inventions.

Thus, we can summarize the trend of foreign M&A of Chinese enterprises into 3 points. First, the number of Chinese M&A transactions by Chinese companies is increasing. Second, in recent years, the target industry of M&A of Chinese enterprises has been centered on industrial enterprises and the IT communication industry. Third, innovative companies are mainly engaged in external M&A.

On the other hand, it is also true that Japanese companies have a strong sense of resistance to M&A by Chinese companies, due to concerns of technology and researchers' leakage. For Japanese companies, M&A by Chinese companies has positive aspects such as easier access to the Chinese market and diversification of funds, while they cannot wipe out any negative concerns such as leakage of technology and brands as a source of competitiveness. Therefore, it is a very important to analyze what the effects on the Japanese researchers are if their companies are acquired by Chinese companies. In this research, we will analyze the case of Sanyo Electric's acquisition by Haier in 2012.

II. Previous Studies and Hypothesis

1. Previous studies

Access to external knowledge and technology has become one important objective of M&A, but there are some studies that show negative effects of M&A. For example, more than 60% of M&A projects fail (Market and Mirvis, 2001), and acquisition of technology brings lots of losses to the acquiring side (Betrand and Zitouna 2008, Moeller and Schlingemann 2005).

Ornaghi (2009) analyzed 27 M&As of pharmaceutical manufacturers between 1988 and 2004 using the PSM method. It was confirmed that in terms of the number of registered US patents and the number of important patents with many citations, the M&A companies were lower than companies without implementing M&A. Joel Stiebale (2012, 2014) analyzed European companies' cross-border M&A and innovation activities, and they show that M&As have a positive effect on patent applications in the country where the acquiring company is located, and a negative effect on patent applications in the country where the acquired company is located.

There are many studies that analyze the effect of M&A from the perspective of characteristics of companies. Yamanouchi and Nagaoka (2010) conducted an empirical analysis on M&As of Japanese firms in 1984-2002 and found that after M&As the number of patent applications decreased. In addition, Yamauchi and Nagaoka (2010) showed that most of the reduction effect was due to a decline in market share and a decrease in business assets. Cassiman et al. (2005) pointed out that M&As between companies with complementary relationships in the technology sector will promote R&D, but that would have been less effective if they were competitors.

Empirical studies on the leakage of technology by Japanese inventors are also a hot topic. Ingram (2000) points out that transferring technology by M&A mainly goes through researchers. Also, Alnuaimi et al. (2012) and Hoisl (2007) show that acquisition of human capital is very important for technology transfer of M&A.

In recent years, there are also many studies on overseas M&A of Chinese companies. These studies show that overseas M&A by Chinese enterprises has acquired brand, technology and management know-how, and unlike developed countries, has unique characteristics. Specifically, these prior studies can be divided into four main types. Here we make a brief summary of previous studies from the following five aspects.

First, there is a study on the purpose of Chinese M&A by Chinese companies and whether they acquired strategic assets. Some studies show that the acquisition of strategic assets such as market expansion and technical know-how are the purposes of Chinese M&A by using cases and aggregated data (Boateng et al. 2008; Deng 2009; Sun et al. 2012). Indeed, acquisition of strategic assets is also too difficult for industrialized countries. So, it is considered to be very difficult for Chinese companies because they have relatively little experience. Ramasamy et al. (2010) and Ramasamy et al. (2012) found that Chinese companies gained strategic assets by overseas M&A such as resources

and markets. On the other hand, Rugman and Li (2007) point out that absorption capacity is necessary to obtain strategic assets.

Second, there are some studies that focus on whether Chinese enterprises can absorb the obtained strategic assets or realize win-win relationships with overseas enterprises. By using event study, Anderson et al. (2016) show that the innovation performance of Chinese companies is improved after the M&A, but the acquired foreign companies' innovation performance did not change. Wu and Su (2014) analyzed Chinese companies' overseas M&A using seven cases, and they suggest that Chinese companies realized technology catch-up by overseas M&As. There are also studies that point out that it also affects the innovation activities and performance of companies acquired in developed countries. Buckley et al. (2014) pointed out that companies in developed countries that are acquired by Chinese companies, can access the Chinese market and the obtained profits can be turned into innovation activities of companies acquired in developed countries. In other words, it is conceivable that the acquired companies in developed countries are utilizing the superiority of the Chinese companies' market, etc.

Third, there is a study that pointed out that overseas M&As by Chinese companies have unique characteristics. It has been shown that it is difficult for Chinese companies to utilize innovation assets of acquired companies after acquisition, due to the large technical gap. Recent studies show that Chinese companies have recognized weaknesses such as technology gaps with acquired companies in developed countries, and give autonomy to acquired companies after acquisition. So, Chinese companies try to minimize acquired companies' confusion (Estrin and Meyer 2011, Liu and Woywode 2013). For example, most Chinese companies will retain the manager of the acquired company, and give autonomy to their management. Chinese companies are inactively involved in business management of acquired companies. It is greatly different from acquiring companies from developed countries. Schuler-Zhou and Schuller (2013) point out that the role of autonomy has recently been great for knowledge transfer from acquired companies to acquired companies in China.

Fourth, there are some studies focusing on the role of the Chinese government and differences between state-owned enterprises and private enterprises. Most of them analyze how state-owned ownership and the involvement of government effect companies' overseas M&A. Xu and Meyer (2012), Cui and Jiang (2012), show that relative to private enterprises, the Chinese government is more willing to safeguard the interests of state-owned enterprises. At the same time, the Chinese government has a great influence on the strategic decisions of state-owned enterprises. In addition, Li et al (2014), Wang et al. (2012) point out that the Chinese government uses a large amount of resources to support state-owned companies from various aspects (capital raising and rationalization of administrative procedures).

Fifth, increasing the domestic market share is also the main reason for Chinese companies' overseas M&A. According to a report of the World Bank, the most important reason for the government to support foreign direct investment by Chinese companies is to raise their productivity. Chinese companies aim to raise the competitiveness in the domestic market rather than to enhance the competitiveness in the international market. Companies in developed countries are concerned about losing intellectual property and they are reluctant to introduce advanced technologies and products into emerging markets. Therefore, companies in developing countries have to go abroad and acquire such technologies and assets in foreign markets. Maintenance and acquisition of domestic markets is a major factor of M&A by companies from developing countries like China. Chinese companies acquire technologies in developed countries and use them in the domestic market. Ramamurti (2012) points out that Chinese companies have no interests in competition in international markets and cutting-edge technology development.

2. Hypothesis

As explained in the previous section, M&A of Japanese companies by Chinese companies has been rapidly increasing since the 2000s, and it is considered that the main purpose of such M&A is to expand overseas markets and to develop strategic assets such as technology and know-how. Meanwhile, with regard to the acquisition of Japanese companies by Chinese companies and other overseas companies, there is a concern of technology leakage by the movement of Japanese inventors and engineers. In addition, more than half of the foreign direct investment in the manufacturing industry is attributed to state-owned companies, and the influence of the Chinese government is considered to be significant. Therefore, it is very important to analyze how M&A by Chinese enterprises affects Japanese companies' inventors.

As mention earlier, prior studies indicate the purpose of foreign overseas M&A by Chinese companies is acquiring strategic assets, especially for know-how and technology. Based on these earlier studies, we made the following two hypotheses to investigate in this study.

Hypothesis IA: Chinese companies have acquired veteran inventors from Japanese companies by M&A.

Hypothesis IB: Chinese companies have acquired inventors who have many research achievements from Japanese companies by M&A.

It is pointed out by Cohen and Levinthal (1990) that the effective utilization of strategic assets and the transfer of technology depend on the capabilities of the acquired company's innovation. For

this reason, it is generally considered that it is difficult for Chinese companies with inferior innovation ability to make effective use of strategic assets. However, recent studies (Tan and Mathews, 2014) on overseas M&A by Chinese companies have shown that knowledge transfer is going smoothly, technology catch-up has been realized, and Chinese companies have the ability to integrate with the acquired company. In a word, these studies suggest that Chinese companies make effective use of strategic assets. Also, acquired companies in developed countries have easier to access the huge Chinese market, and they can reinvests earned profits into innovative activities, so it is considered that the achievements of inventors may increase. In a word, there may be a positive influence on the innovation activities of inventors from acquired companies. Therefore, based on these earlier studies, we will set up another hypothesis to investigate in this study.

Hypothesis II: After the acquisition, the achievement of inventors of Japanese companies tends to increase.

As mentioned earlier, previous studies show that overseas M&As of Chinese companies are aimed at acquiring strategic assets and they make effective use of the foreign acquired companies. In addition, studies also show that innovation of acquired companies has become more active. However, accumulation of prior studies is not enough in terms of the effect on Japanese companies, especially the effect on the innovative activities of Japanese inventors. In this study, we will analyze what kind of Japanese inventors were acquired by Chinese companies, and the change of the innovative achievement of the Japanese inventors by using inventor level data.

III. Data

We will quickly look at the history of Sanyo Electric's acquisition by Haier. Sanyo celebrated its 50th anniversary in 2000, and in 2002, two years later, Sanyo had a comprehensive alliance with Haier in a wide range of fields. Thereafter, due to the management crisis, in December 2008, the acquisition by Panasonic began, and in March 2011 Panasonic held all shares of Sanyo and it was delisted. In 2010, Sanyo Electric became a wholly owned subsidiary of Panasonic and transferred the semiconductor division to On Semiconductor that is the US company. Subsequently, as part of Panasonic's business reorganization in 2012, Panasonic transferred the white goods business such as Sanyo's refrigerator and washing machine businesses to Haier. This study will focus on the acquisition of Sanyo Electric's white goods division by Haier, that is, the acquisition of the refrigerator washing machine division. In order to highlight its features, as a comparison, we also

analyzed the acquisition by On Semiconductor Co., Ltd. Details of ON Semiconductor are described in the Appendix.

This research uses the IIP patent database (up to FY 2013) provided by the Intellectual Property Research and Education Foundation. First, we extract the name of the inventor who filed at Sanyo Electric from the IIP patent database. Then, using the extracted inventor's name, we picked up all patent applications of these inventors from the IIP patent database. Utilizing the change of the applicant that we picked up, we confirmed the inventor's transfer situation. The achievement greatly depends on the technology field. Therefore, for example, inventor's achievements with regard to refrigerators cannot be compared in the same framework as the achievements of inventors in the battery field. Thus, in this study, we limited the sample to the inventors of the refrigerator or washing machine sector.

IV. Empirical Model

1. What kind of inventor will transfer to Haier?

First, we analyze what kind of Sanyo researchers moved to Haier by using the logit model. The dependent variable is a dummy variable of whether or not the researcher was transferred to Haier.

The main explanatory variables are the invention age, the number of patent applications in the previous year, the average number of claims in the previous year, the average percentage in the previous year's other fields and the average number of citations in the previous year.

The actual age data of the researchers does not exist. Instead of using the age, we use the invention age. The age of invention is the first patent application year since the year of patent application. In this paper, it shows the age as inventor.

As indicators for measuring the performance of researchers, four indicators are used: number of patent applications, average number of claims, percentage of other field citations, and average cited number. The number of patent applications is the number of patent applications per person per year. The average number of claims is the number of average claims per person per year. Average other field quotation percentage is the number of cited documents with different IPC codes among cited documents. The average cited number is the cited number of the patent applied for.

The control variable is a technical field dummy of the researcher and an annual dummy. In addition, due to the robustness of the results, we analyzed using the average of the above three major variables over the previous 3 years.

2. How did the transfer influence inventor's performance?

(1) Regression Analysis

Next, we analyze the effect of transfer to Haier on the performance of inventors. The dependent variables are the number of applications, the average number of claims, and the average quotation ratio of other fields. The explanatory variable is a dummy variable as to whether or not the person moved to Haier. To compare the effect of transfer to Haier, dummy variables of transfer to other companies in Japan were also added to the estimation. Control variables are invention age, researcher's skill and annual dummy. In this analysis, the variables that I want to pay attention to most are the dummy variable of transfer to Haier and dummy variable transfer to other companies in Japan.

(2) Propensity score matching

In addition to the method of regression analysis, the PSM method (propensity score matching) is also used in this research to make the analysis results robust.

Since transfer to Haier is not chosen in a random manner (for example, inventors with better performance are likely to transfer to Haier), selection bias will occur when we estimate the effect of transfer to Haier on the innovation activities. Therefore, it is necessary to use a propensity score matching method (propensity score matching).

In this study, first we estimate the probability of transfer to Haier, and then analyze the average treatment effect of the transfer to Haier by Kernel matching.

V. Empirical Results

From Figure?, we found that the invention age of inventors transferred to Haier is higher than other inventors. Before transfer to Haier, the number of patent applications is a bit larger than inventors who transferred to Panasonic or other Japanese companies. Meanwhile, in terms of the number of claims, the percentage of other citations quoted and the number of citations, inventors who transferred to Haier are lower than the inventor who transferred to Panasonic and other companies in Japan.

Figure? shows that the inventors who transferred to Haier tend to decrease the number of patent applications after transfer, but the average number of claims and the proportion of citations in other fields increase slightly.

Next, Figure? shows the results of logit analysis on which factors affect the change of the affiliation. Regarding the invention age, there is a significant positive effect in the transfer to Haier. Regarding

the number of applications, although it is not significant for the change to Haier, there is a negative effect. The average number of citations and average number of claims are significantly negative. To summarize the above analysis results, it can be seen that inventors with low average citations, average number of claims and inventors with higher age of invention tend to transfer to Haier.

Because of robustness, we also use the average values of key explanatory variables over the past three years to analyze. The results are similar to the above results, showing that inventors with a lower average number of citations and inventors with a higher age tend to move to Haier. In other words, it turned out that veteran inventors tended to transfer to Haier rather than those who invented abundantly.

Next, Figure? shows the analysis result for the effect of transfer on the inventors' achievement. Here, the number of applications, the number of claims, and the quotation ratio of other fields are used as indices of invention achievement. Regarding transfer to other companies in Japan, the number of applications and the number of claims increased significantly, but the transfer to Haier was not significant, and the results tended to decline. In order to make this result robust, we analyzed FE and RE besides OLS, and we got similar results.

In order to obtain robust results, we also analyzed the effect of transfer to Haier on the inventors' performance by using PSM, and the results are shown in Figure?. Regarding transfer to Haier, there is significant negative effect on the number of applications and the average number of claims.

Indeed, it is necessary to see the long-term effect of transfer. In other words, it is better to analyze changes in the number of applications in the 3rd and 4th periods after transfer, but due to data constraints, this study could only analyze up to the second year after transfer. However, from the results of the above analysis, it shows that at least in the short term, the Japanese inventor's achievements declined after transfer.

Here, we summarize the results of empirical analysis so far. First of all, as to what kind of inventor transferred to Haier, it was found that inventors' achievements in the previous term were not so excellent and inventors with a high age of invention tended to transfer to Haier. In other words, rather than inventors who are active in the front line, veteran inventors separated from the front line transferred to Haier. This result supports the hypothesis Ia.

Next, we analyzed whether the transfer to Haier affected the inventor's research achievements. There was negative effect on inventors in the transfer to Haier in terms of the number of applications and the number of claims. These results are in agreement with the analysis results of regression analysis and the PSM method. Therefore, the second hypothesis is not supported.

VI. Conclusion

Recently, overseas M&A by Chinese companies aiming to acquire strategic assets such as know-how and technology are becoming active. Regarding the influence of M&A on employees of Japanese companies, studies at the company level have been mainly conducted so far, but analysis at the employee level is very small. In addition, until now very few studies have focused on the impacts of M&A on the performance of Japanese inventors, especially the impact of M&A by Chinese companies.

In this research, by using a patent database we conducted an empirical analysis to focus on inventors who transferred to Haier, and the change of transferred inventors' performance. From the results of this study, it was found that rather than young inventors who are active in the front line, veteran researchers transferred to Haier. Furthermore, we also found that the inventors' performance tended to decrease after transfer to Haier. Based on these empirical results, we reveal that Haier *are mainly to acquire experienced veteran inventors to teach abundant experience rather than let them to do active innovation activities*

Furthermore, the common point between Japanese inventors who moved to Haier and inventors who transferred to US company On-Semiconductor at the same time is that it is difficult to acquire inventors with excellent achievement results, and achievements of transferred inventors declined. This result is consistent with "destruction of trust" proposed by Shleifer and Summers (1988). On the other hand, regarding the differences, inventors who transferred to Haier are relatively experienced veteran inventors, and inventors who transferred to ON-Semiconductor are relatively young inventors.

Today, the electronics industry in Japan is facing a decline in profits, and Japanese major electronic companies that have been leading the industries so far are also being forced to select and concentrate their business. On the other hand, when these companies sell the business, especially when the acquisition company is a company from an emerging country, concern is raised on technical outflow, the impacts on research activities of Japanese researchers, etc. This study shows that the aim of Chinese consumer electronics companies is for rapid catch-up and introduction of value added products in the short term, rather than the cutting-edge technology development in the long term. In other words, because Chinese enterprises are still in the process of catch-up, they want the Japanese inventors to teach from their abundant experience rather than conducting active innovation activities. Therefore, we think that the possibility of cutting-edge technology leakage is low at present.

However, acquiring know-how should be a source of future catch-up of companies from emerging countries in the future. In order to avoid price competition with Chinese electronics manufacturers in the future, Japanese companies need to focus on cutting-edge technology development at all times. At the same time, it is necessary to delay the speed of catching up by competitors. Specifically, for example, it is necessary to prevent the leakage of inventor's know-how, which was formed by the

inventor, due to M&A inventor's transfer. In addition, after companies from emerging countries catch up to a certain level, they will not only put effort into rapid catch-up and introduction of value added products in the short term, but also cutting-edge technology development in the long term. Then, in order to prepare for the possibility of cutting-edge technology leakage, it is necessary to develop a system related to industrial property rights such as improvement of laws related to M&A and improvement of treatment of Japanese inventors.

There are some problems which were not solved in this study. For example, it is necessary to look at the long-term effect of inventor's transfer, but due to data constraints, this study analyzed until the second year of transfer. In addition, although this study focused on the acquisition of Sanyo Electric Co., Ltd. By Haier, which is a representative M&A by Chinese home electronics manufacturers, it is necessary to analyze many more cases of acquisitions of Japanese companies by Chinese companies to acquire robust results. I would like to make this point a future issue.