Impacts of Acquisitions of Japanese Companies by Chinese Companies on Innovation Activities of Japanese Society - Empirical Analysis by Using Patent Data (*)

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In this study, we focus on the impact of acquisitions, human resources movement, spillover and patent transfer by using engineer level data extracted from patent data. We analyze the impact of acquisitions of Japanese companies by Chinese companies on Japanese engineers. This study obtained the following results. First, we find that invention age has an inverse U-shaped relationship with the trend to transfer to Chinese companies. Second, the higher the quality of the application, or the fewer the number of applications, the more likely they are to transfer to the acquisition company from China. Third, engineers who had patents that are transferred to Chinese companies, or engineers who had patents that are forward cited by Chinese engineers prior to the acquisition, are more likely to transfer to the acquisition company from China. Fourth, although the number of patent applications for Japanese engineers transferring to Chinese companies becomes smaller and the quality becomes lower, the number of Japanese engineers' patents cited by Chinese engineers increase. This result shows that the existing innovation achievements of Japanese engineers are better utilized.

I. Introduction

In recent years, Japanese companies have been forced to select and concentrate their business. Even if these companies sell low-profitable businesses or low-competitiveness businesses effectively by utilizing existing technologies, there is a possibility that the research and development capability in that field will decline over the long term. In particular, in the case of an acquiring company from emerging markets, it is worried that technology outflow will impact on innovative activities of Japanese engineers. Therefore, it is an important research issue to analyze the impacts of acquisitions, especially the acquisitions of Japanese companies by overseas companies, in terms of engineers' mobility, technology spillover, the utilization of innovation achievements of Japanese engineers, etc.

It is difficult for M&As among Japanese companies to succeed. It is even more difficult for M&As between companies in various countries to succeed. Marks and Mirvis (2001) point out that failures account for 60% of the total M&A. Bertrand and Zitouna (2008) and Moeller and Schlingemann (2005) argue that acquiring technology in particular brings a lot of losses to the acquiring side. In addition, Hofstede (1991) pointed out that because of differences in cultures, treatment of

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studies, such as Seth et al. (2002) and Bremer et al. (2017), have pointed out that different countries or different cultures have a huge impact on M&A activities.

Recently, M&A of Japanese companies by Chinese companies aiming to acquire strategic assets such as know-how and technology has become active. For example, the acquisition of Sharp by Foxconn, the acquisition of Toshiba Lifestyle by the Midea Group, and so on. Regarding the outflow of Japanese engineers, we wonder that what kind of engineers Chinese companies have acquired through acquisitions. We also wonder if Japanese engineers are effectively used after the acquisition, for example, whether it is the use of Japanese engineers for advanced technology research or the use of Japanese engineers to impart R&D experience; in other words, from the perspective of the use of Japanese engineers, whether the acquisition of a Japanese company has been successful.

The prior literature on the impact of acquisitions on employees basically use firm level data, with very few analyses using employee level data. In addition, few research focuses on the impact of M&A on the achievements of Japanese engineers, especially the impact of M&A by Chinese companies on Japanese engineers. One major reason is that it is necessary to track changes in the company of each engineer, but it is difficult to obtain such data information. However, if our research object is limited to engineers with patent applications, we can use the information of the researchers in patent data for analysis. In the patent data, not only the name and address of the applicant who filed the patent, but also the engineers' address (principally the address of the establishment) is stated. Therefore, if the names of engineers are organized in time series order, we can grasp the state of transfer of engineers affected by acquisitions. Such analyses have been started internationally in recent years.

In previous studies, it is shown that M&A of Chinese companies aimed at acquiring strategic assets, and it is suggested that Chinese companies effectively utilize it, and the innovation activities of acquired companies in industrialized countries are being promoted. However, in the case where the acquired company is a Japanese company, there is little research accumulation other than study by Yuan (2017) on Sanyo Electric Co., Ltd. and Haier. In this research, we focus on the impact of acquisitions, human resources movement, spillover and rights transfer using engineer level data extracted from patent data. Specifically, the following two questions are studied in this paper: (1) what characteristics the engineers who were obtained by a Chinese company have? (2) Has there been any change in the performance of engineers after the acquisition?

II. The basic situation of Chinese companies' M&A of Japanese companies

Table 4 shows the acquisitions of Japanese companies by countries from 1996 to 2016. In terms of the number of acquisitions of Japanese companies, the U.S. companies take the largest share,

followed by England and China. Together with Hong Kong, China is ranked second, which cannot be ignored for Japanese companies.

III. Previous studies and hypothesis

1. Previous studies on M&A and technology acquisition

Most studies on M&A activities of Japanese companies focus on acquisitions of Japanese companies or acquisitions of overseas companies by Japanese companies, and these studies analyze the impact of changes of corporate governance on corporate value (Miyajima, 2007). Except Yamauchi and Nagaoka (2010) and Shinbo and Nagaoka (2009), there is little accumulation of research on the impact of acquisitions on innovation activities of Japanese companies. Yamauchi and Nagaoka (2010) conducted an empirical analysis of M&A between Japanese companies during the period of 1984-2002. They found that the number of patent applications declined after M&A and the decreasing effect become significant after 2 years of M&A. Their findings indicate that the majority of the reduction effect is due to a decline in market share and a decrease in business assets. Shinbo and Nagaoka (2009) have studied Mitsubishi Chemical's M&A and found that the number of patent applications tends to decrease after the M&A.

Acquisition of Japanese companies by overseas companies have been rapidly increasing in recent years, especially acquisitions by companies from developing countries with the aim of acquiring technology. However, studies accumulated in related fields are very small. Studies on acquisition characteristics and technology acquisition of overseas companies compared to domestic companies can be categorized mainly into four as follows, though these studies did not focus on Japanese companies. First, it is a study focusing on cultural differences. Hofstede (1991) pointed out that because of differences in cultures, treatment of uncertainties resulting from different nationalities of companies also differs, and Seth et al. (2002) and Bremer et al. (2017) have pointed out that different countries or different cultures have a huge impact on M&A activities.

Second, many studies argue that it is difficult to acquire technology through acquisitions overseas. For example, Bertrand and Zitouna (2008) and Moeller and Schlingemann (2005) argue that acquisitions aimed at acquiring technology will bring a lot of losses to the acquiring side.

Third, studies indicate the disparity of technology and the relevance of technology have a great influence on acquisition of technology through acquisitions. Zhao (2009) shows that acquirers with inferior innovation performance can improve the performance of innovation by acquiring innovative companies. Cassiman et al. (2005) point out that the technical relevance and the relevance in the market are important factors for determining the results of technology acquisition.

Fourth, many studies have focused on the role of engineers who have a very important role in acquiring technology. Alnuaimi et al. (2012) and Hoisl (2007) argue that engineers are responsible for innovative activities of companies, so how acquirers use these engineers from acquired companies is very important.

As mentioned earlier, mergers and acquisitions of Chinese companies in Japan have increased rapidly since 2000. The main purpose of such M&A is to expand overseas markets and acquire strategic assets such as technology. Based on these circumstances, it is very important to verify Japanese companies' technology transfer to Chinese companies resulting from acquisitions and the impact of acquisitions on Japanese companies' innovative capabilities. Recently, regarding foreign companies, especially Chinese companies, acquiring Japanese companies, Japanese society is very worried about the impact of innovation on engineers and the technical losses caused by these engineers. Therefore, it is necessary to conduct a rigorous empirical analysis; however, there are very few related studies.

Yuan (2017) analyzed the impact of Haier's acquisition of Sanyo Electric, using data from Sanyo engineers. She found that Haier tends to gain R&D experience by acquiring Sanyo veteran inventors. However, Sanyo Electric may not be able to represent all Chinese companies to acquire Japanese companies. Therefore, we need to analyze all Japanese companies acquired by Chinese companies under a unified framework to grasp the impact of acquisitions on innovation.

In addition, recent studies have reported the results of research by controlling selected bias (for example, Alhenawi and Krishnaswami, 2015), but many existing studies did not sufficiently identify the causal relation of the acquisition. In this paper, we analyze research issues after sufficiently identifying the causal relation of the acquisition.

2. Hypothesis

First, this paper analyzes from the perspective of what the aim of Chinese companies is in obtaining Japanese engineers through acquisitions. Previous literature on Chinese companies' overseas acquisitions pointed out that the purpose of Chinese enterprises' acquisition is to obtain resources (Ramasamy et al. (2012)), markets (Boateng et al. (2008), Deng (2009)), know-how and technology etc. (Boateng et al. (2008)).

Although these prior studies point out that the acquisition of strategic assets is the aim of Chinese companies, they have not shown in detail what kinds of purposes the strategic assets are acquired for. This research focuses on the detailed purposes of acquiring Japanese engineers by Chinese companies and sets hypotheses IA and IB.

Hypothesis IA: Chinese companies obtain Japanese engineers aiming for catch-up rather than acquisition of state-of-the-art technology
Hypothesis IB: Chinese companies obtain Japanese engineers to acquire state-of-the-art technology

Next, we analyze whether Japanese engineers are effectively utilized, focusing on changes in the research performance of Japanese engineers before and after acquisition. Cohen and Levinthal (1990) point out that the effective utilization of strategic assets and technology transfer depends on the innovation capacity of the acquiring company. For this reason, it was generally thought that Chinese companies with inferior innovation abilities had difficulty in making effective use of Japanese engineers.

Previous studies on the outcomes of Chinese companies' external M&A have shown that knowledge transfer is going smoothly (Tan and Mathews (2014)), technological catch-up has been realized (Wu, Su (2014)), and Chinese companies have the ability to integrate with the acquired company (Deng (2010)). In other words, there are many studies that make an argument that Chinese companies use strategic assets effectively.

Regarding the impact on the acquired developed countries' companies, it is considered that developed countries' companies can access the growth market of China more easily, reinvesting the profits obtained from the Chinese market into innovative activities, so the innovative performance of acquired companies of developed countries tends to increase. In other words, some studies point out that there is a positive impact on the innovative activities of engineers from acquired companies in developed countries. Therefore, this research focuses on changes in the innovative performance of Japanese engineers after the acquisition, and sets hypothesis II.

Hypothesis II: After acquisition, Chinese companies effectively utilize engineers from former Japanese companies

IV. Data and observations

In this study, we use the following databases: IIP Patent Database (Period: 1990-2016), State Intellectual Property Office (SIPO) Patent Transfer Database (Period: 1990-2016), the SIPO Citation Database (Period: 1990-2016), and the RECOF M&A Database (Period: 1996-2017).

First of all, we will use the RECOF M&A database to extract Japanese companies acquired by Chinese companies and pick up the application status of these Japanese companies from the IIP patent database. Specifically, the analysis target is extracted based on the following three conditions.

Condition 1: Japanese company bought by a Chinese company

Condition 2: Acquired companies are located in Japan (Acquisition of overseas subsidiaries of Japanese companies is not subject to this paper.)

Condition 3: Acquired companies have patent applications

In the end, there were 35 companies that will be studied. We first extract the names of the engineers of the former 35 Japanese companies. Then, we make a database by using the extracted names of the engineers of the former Japanese company, and by picking up the application status from the IIP patent database and confirming the affiliation change from the address of the applicants and inventors. Furthermore, we connect the patent transfer data of SIPO and patent cited data of SIPO with this database.

V. Empirical Analysis

1. What kind of characteristic Japanese engineer will transfer to a Chinese company?

First, we will analyze what kind of characteristics Japanese engineers who transferred to a Chinese company have by using a Logit model. The explained variable is a dummy variable of whether he/she has transferred to the Chinese company of the acquiring side or not. Then, we use invention age and the square of invention age, which are indicators showing the career period as an engineer. There is no data on the actual age of the engineers, so we use the data of invention age instead of actual age in this paper. The age of invention is the filing year of his/her first invention subtracted from the filing year of an invention.

Then, we use quantitative indicators and qualitative indicators as indicators to measure the performance of engineers. As the quantitative index, the number of patent applications in the previous year, the number of patent applications in the previous year (partial), and the number of head applications in the previous year are used. As qualitative indicators, the number of claims per application in the previous year, the number of back citations per application in the previous year, the number of forward citations per application in the previous year, and the number of forward citations as reason for refusal per application in the previous year are used.

In addition, in order to analyze whether the engineers are in the technical fields needed by Chinese companies, we use variables that indicate technology spillover effects. One is a patent transfer virtual product, and the other is a forward citation by a Chinese engineer.

It may be considered that it is simply due to differences in companies that the quantity and the quality of engineers' performance are different. For example, an engineer who was in a company with a low propensity to apply would have a relatively small number of applications before transfer, even if the

engineers' productivity is high after acquisition. In order to take into consideration individual effects like such companies, a company dummy was added to the analysis as a control variable. Besides that, technical field dummies and annual dummies were added to the analysis as control variables.

Figure 14 shows details of the main variables. The inventor does not necessarily have a patent application every year, and it is possible that the inventor did not apply one year before the company was acquired. Therefore, in order to confirm the robustness of the results, this analysis not only uses 1-lagged but also 3-lagged for the above main variable.

2. How did the transfer affect the performance of the engineers?

Next, we analyze the impact of transfer to Chinese companies on Japanese engineers. We compare the performances of engineers before and after transfer, and consider the difference as the effect of transfer. For example, prior to transfer, an engineer applied for three patents every year. After transfer, he/she filed five patents every year. Can we say that the difference is the effects of the acquisition? Or, even without transfer, has the number of applications increased due to the country's promotion policies for patent application? In such a case, the number of applications of this engineer is often beginning to increase from before the transfer. In this case, we will use the difference in difference (DID) to eliminate the influence of such policy and to measure the effect of transfer.

There are two groups. One is the treatment group (in this article, an engineer who transferred to a Chinese company through acquisition), and the other is the control group (in this paper, a engineer who did not transfer to a Chinese company by acquisition). We focus on the difference in the change of the two groups. In this study, we focus on the difference of 10 years before and after acquisition. There are two differences. The first difference is a comparison before and after the acquisition. The second difference is the comparison between the treatment group and the control group. In other words, the difference before and after the acquisition of the transferred engineers subtracted from the difference before and after the acquisition of the engineers who did not transfer is the effect of transferring on the engineer.

There are two analysis methods of DID used in this paper. The first method uses regression analysis. For the engineers i = 1, ..., N, period t, the following fixed effects model is assumed.

$$\ln(performance_{it}) = \beta_0 + \beta_1 transferdummy_{it} + \beta_2 acquisitiondummy_t + \beta_3 transferdummy_{it} \cdot acquisitiondummy_t + \varepsilon_{it} \quad (1)$$

Here, as variables related to performance, quantitative indicators (the number of applications, the number of head applications), qualitative indicators (the number of claims, the number of backward citations, the number of forward citations, the number of forward citations as reason for refusal), and the spillover indicators (forward citation by Chinese engineers) are used. *transferdummy* is 1 if the engineer is transferred to a Chinese company, otherwise it is 0. *acquisitiondummy* is 1 if the period is after the acquisition, otherwise it is 0. $\varepsilon_{it}$is the error term of the mean zero. In this model, the sample average performance of untransferred engineers is β_0, the sample average performance of transferred engineers before the acquisition is$\beta_0 + \beta_1$, the performance of non-transferred engineers after acquisition is $\beta_0 + \beta_2$, and the performance of the transferred engineers after the acquisition is $\beta_0 + \beta_1 + \beta_2 + \beta_3$. As a result, the average treatment effect on the performance of the engineers transferred to the Chinese company in the DID estimate is

$$\begin{aligned} DID = [&E(performance|transferdummy = 1, acquisitiondummy = 1) \\ &- E(performance|transferdummy = 1, acquisitiondummy = 0)] \\ &- [E(performance|transferdummy = 0, acquisitiondummy = 1) \\ &- E(performance|transferdummy = 0, acquisitiondummy = 0)] == \beta_3 \end{aligned} \quad (2)$$

According to the data in this study, there is a possibility that the treatment group and the control group will respond differently to corporate factor, age of invention, patent right transfer and so on. So, we should pay attention to the result of DID estimation. Therefore, we conduct regression analysis including covariates as a second method.

$$\begin{aligned} \ln(performance_{it}) &= \beta_0 + \beta_1 transferdummy_{it} + \beta_2 acquisitiondummy_t + \beta_3 transferdummy_{it} \\ &\cdot acquistiondummy_t + \gamma_1 X_{it} + \gamma_2 a_i + \varepsilon_{it} \end{aligned} \quad (3)$$

Where, $a_i$is an individual effect, and $X_{it}$is a vector of covariates. $a_i$is an individual corporate dummy, technical field dummy, and year dummy. X_{it} is the age of invention, the dummy of patent transfer before acquisition.

VI. Empirical results

1. Statistics results

Chart 15 shows descriptive statistics on the age and performance of engineers transferred to Chinese companies, and Chart 16 shows descriptive statistics for engineers who did not transfer.

Chart 15 and Chart 16 show that the invention ages of engineers transferred to Chinese companies are higher than those who did not transfer. Regarding the quantitative indicators such as the number of applications, the number of head applications and the number of applications (partial), it is shown that they are fewer for transferred engineers than the engineers who did not transfer. Regarding the number of forward citations, the number of forward citations (reasons for refusal), the number of backward citations, and the number of claims, it shows that they are more for the transferred engineer than the engineer who did not transfer. For the variables that indicate the spillover of technology, such as the dummy of patent transfer and dummy of forward citation by the Chinese engineers, higher values are shown for the transferred engineers. This result means that an engineer having a patent forward cited by the Chinese side and an engineer having patents that are transferred to the Chinese company have a trend to transfer to the Chinese company.

2. What kind of engineers will transfer to the Chinese company?

This section explains the results of the logit analysis on factors of transfer to Chinese companies. Charts 17 to 19 show estimation results using 1-lagged explanatory variables.

Regarding the age of invention, there is a significant positive effect in transferring to a Chinese company, and the squared invention age has a significant negative effect on transfer to a Chinese company. In other words, there is an inverse U-shaped relationship between transfer and invention age. When other values are kept constant, the peak invention age is 13, showing that the higher the age of invention is, the higher the possibility of transferring to a Chinese company until 13. On the other hand, when the age of invention is over 13, it indicates that the possibility of transfer to the Chinese company has become lower. There is a significant negative effect on the number of applications, the number of applications (partial), and the number of head applications, which are variables indicating the quantitative index of performance. However, the indexes of the quality of performance, such as the number of forward citations, the number of forward citations (reasons for refusal), the number of claims, and the number of backward citations, are significantly positive. The dummy of technology transfer before acquisition and the dummy forward citation by Chinese researchers before the acquisition are significantly positive.

To summarize the above analysis results, it is shown that engineers with smaller numbers of applications but with higher quality of applications tend to transfer to Chinese companies. Also, it is found that engineers who have the technology that is needed by Chinese companies before the acquisition tend to transfer to Chinese companies.

In order to confirm the robustness of the estimation results, we also conduct the analysis by using 3-lagged main explanatory variables (Charts 20 to 22). The results are similar to those of Charts 17 to 19, with the result that the quantitative index is significantly negative, the qualitative index is significantly positive, and the age of invention has an inverted U-shaped relationship with transfer. Also, the dummy of technology transfer before acquisition and the dummy forward citation by Chinese engineers before the acquisition are significantly positive.

So why are engineers who have a smaller number of applications but higher quality applications transferred to Chinese companies? First, since the invention age has an inverted U-shaped relationship with the transfer, the engineer who transferred to a Chinese company is considered to be a middle-tier group in terms of invention age. Next, the Chinese company may really want to acquire engineers who have large application quantity and high quality of application. However, in terms of the cost, it is considered that Chinese companies prefer to obtain engineers with higher quality of applications rather than engineers with a larger quantity of applications.

In addition, it is considered that middle-class engineers with higher quality but lower quantity of applications may manage research management projects (for example, they are in a management position for difficult and important invention projects), so they are the target of Chinese companies, because acquiring know-how and experience in R&D may be the aim of Chinese companies.

Furthermore, since the dummy of technology transfer before acquisition and the dummy forward citation by Chinese engineers before the acquisition are significantly positive, it indicates that Chinese companies acquire engineers in the needed technical fields. Based on the above, it is obvious that Chinese companies obtain engineers who are in the technical field that Chinese companies need and middle-ranking engineers who have sufficient experience (including management experience) and knowledge of R&D.

3. Impact of transfer to Chinese companies on technological development performance of engineers

Next, in order to clarify the impact of transfer to Chinese companies on the engineers' performance, we use DID analysis. In this section, we show the results of DID analysis and provide explanations. Chart 23 shows estimation results without covariates. When comparing in 10 years before and after the acquisition, it was found that the number of applications and the number of

head applications of Japanese engineers who transferred to the Chinese companies after acquisition have decreased significantly. At the same time, in terms of the number of backward citations, the number of forward citations, the number of forward citations (reasons for refusal), and the number of claims, the transferred Japanese engineers also showed a significant decline. However, the number of forward citations by Chinese engineers is significantly positive, suggesting that Chinese companies are utilizing the accumulation of know-how and knowledge of Japanese engineers after acquisition.

Chart 24 shows the results of DID analysis with covariates (invention age, technology transfer dummy, company dummy, technical field dummy, and year dummy). The results are consistent with those without covariates. Therefore, even after the transfer to a Chinese company, although the quantity and quality of patent applications of Japanese engineers have declined, the accumulation of know-how and knowledge of Japanese engineers is utilized by engineers in Chinese companies.

We summarize the above results. First of all, regarding what kind of engineers have transferred to the Chinese companies, our results show that engineers who have a smaller number of patent applications but higher quality of application tend to transfer to Chinese companies. We also show that engineers who have forward citations by Chinese companies before the acquisition, or engineers who have a patent that has been transferred to Chinese companies, tend to transfer to Chinese companies. With respect to the age of invention, there is inverse U-shaped relationship between the invention age and the transfer to a Chinese company and the peak value is 13. In other words, the older the invention age is, the more the tendency to transfer, if the invention age is before 13. However, once the invention age of 13 is exceeded, the older they are, the less likely they are to transfer to a Chinese company. In short, engineers with high abilities, engaged in research project management, tend to transfer to Chinese companies. Hypothesis IA is supported and hypothesis IB is not supported.

Next, we analyzed whether the transfer to a Chinese company affected the innovative performance of engineers. From the viewpoint of both quantitative indexes and qualitative indexes aspects, the transfer to Chinese companies had negative effects on innovative performance. However, after transfer, the accumulation of innovation by Japanese engineers has been used more by other Chinese engineers in Chinese companies. Therefore, it suggests that hypothesis Ⅱ is supported.

It is wondered why engineers with higher quality innovation performance and management experience tend to transfer, why the innovation performance declines after the transfer, and why Chinese engineers make full use of the innovative experience and knowledge of Japanese engineers. I would like to introduce an example below. In Onishi (2014), there was an interview with a former Sanyo engineer who transferred to Haier. The engineer joined Sanyo in 1986 and joined Haier in the 25th year of his work. From the post-transfer engineer's interview, it can be seen that he was engaged

in a research environment not as good as before transfer, engaged in global activities, and imparted his experience and knowledge to Chinese engineers. Based on this interview, we can conclude that the goal of Chinese companies is to obtain the expertise and management experience of Japanese engineers.

VII. Conclusion

In this research, using the IIP patent database, RECOF M&A database, the SIPO patent transfer database, and the SIPO patent citation database, we focused on the invention age and innovation performance of the former Japanese engineers whose companies were acquired by Chinese companies. Using engineer level data, I analyzed what characteristic engineers were transferred to Chinese companies, and the change of innovation performance of transferred engineers. From the analysis results of this study, we found that the age of invention was in a reverse U-shaped relation to the transfer to Chinese companies. Until the age of invention came to be 13, the higher the age, the higher the tendency to transfer to a Chinese company, and when the age of invention exceeds 13, it turns out that the tendency to transfer to Chinese companies decreased. Next, although engineers with fewer applications tend to transfer to Chinese companies, at the same time, engineers with higher quality of application have a tendency to transfer to Chinese companies. In addition, it turns out that there is a tendency to transfer to Chinese companies for engineers who have forward citations by Chinese engineers, or engineers who have patents transferred to Chinese companies.

Next, regarding the effects of transfer to a Chinese company on the innovation performance of engineers, a negative effect is found on innovative performance both quantitatively and qualitatively. However, after transfer, the accumulation of experience and know-how of Japanese engineers was used by Chinese engineers more than before.

From the analysis results of this research, Chinese companies have acquired experienced Japanese engineers for short-term purposes such as analysis of existing products and addition of added value, rather than the long-term purpose of cutting edge technology development. It indicates that Chinese companies require Japanese engineers to teach their experience and know-how in innovation. The analysis results of this study highlight that Chinese companies are still in the process of catching up, and also show it is the acquiring technology strategy to obtain knowledge and experience in innovation from developed countries.

The experience and knowledge acquisition of such innovative activities should continue to be a driving force for Chinese companies' rapid catch-up. After Chinese companies have caught up to a certain level of Japanese companies, they will prefer to obtain engineers with the long-term objective of improving advanced technology, rather than acquiring engineers aimed at short-term business

objectives. Therefore, if Japanese companies do not focus on the most advanced technology development, price competition with Chinese companies is inevitable in the near future.

At the same time, it is necessary to delay competitors' catch-up. Specifically, for example, it is necessary to prevent leakage of technology and invention experience held by an engineer due to the flow of engineers caused by M&As. In this case, in order to deal with the leakage of technology, it is necessary to establish a legal system related to M&As and improve the treatment of Japanese engineers.

This research includes some problems which have not been solved. For example, is the characteristic of acquiring such engineers a unique characteristic of Chinese companies, or is there a difference compared with other developing countries? I would like to discuss these issues in the future.