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Abstract

China's ICT industry has become the dynamic source of China's economic growth in recent years. In the whole ICT industry there are some leading domestic companies are playing more and more significant role. In this paper 24 leading companies in China and 24 leading companies in Japan are selected to analyze the correlation between R&D activities and leadership in the ICT manufacturing industry. The reason that causes the difference will also be discussed.

1. Introduction

1.1 Background

In recent years China's long-term rapid economic growth has attracted world attention. By utilizing the inexpensive and high quality labor force, China has built a large manufacturing system which makes China becoming the factory of the world. Of all the industries in this system, Information and Communication Technology (ICT) manufacturing industry has been becoming more and more important with the influence of New Economy. The growth rate of ICT manufacturing industry is much higher than the GDP growth which shows that ICT industry has become the dynamic indicator to China's economic development (See Fig. 1).

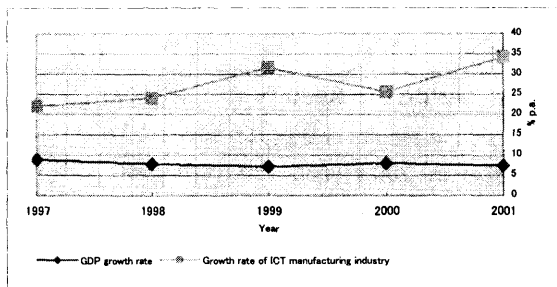


Fig. 1. Growth Rate of GDP and ICT Manufacturing Industry in China (1995-2001).

Source: Ministry of Information Industry in China.

In the same time with the high growth of the whole industry, the leading firms in the ICT manufacturing industry are also growing very quickly, the top 10 firms share 29% in the 16 years ago and 53.77% in the 2003 valued by the revenue of the top 100 firms. The leading firms are playing an import role now and will be more import in the future by seeing the developing trend.

ICT manufacturing industry is based on the semiconductor technology which is the most innovative one in the world. The famous Moore's Law which is found by the co-founder of Intel, Gordon Moore (1965), is still effective. It said that the number of transistors per square inch on integrated circuits had doubled every year since the integrated circuit was invented. With innovation of ICT manufacturing industry, a lot of our dreams are becoming true. The performance of our computer doubles within 2 years; the band of Internet is dramatically increasing; we can buy and sell goods, transfer money, even do our medical examination online, and new online applications and services are emerging endlessly.

1.2 Focus of the Analysis

By developing the advanced chip manufacturing technology Intel has become the giant of the whole industry; surrounding by the "air full of ideas" Silicon Valley has become the bethel of ICT technology within only 20 years. Beyond all doubt, innovative capability has become the anima of the ICT manufacturing industry.

For one firm, it can improve its innovative capability and develop new technologies by its R&D activities which can be weighed by its R&D spending.

What relationship between the R&D spending and the leadership in the industry? What other institutional factors can affect the one firm's innovative capability? In this paper, these two questions will be discussed by comparing firms in China and Japan.

2. Analysis

2.1 Samples

24 Japanese firms leading Japan's electronic manufacturing industry are selected based on the data gathered by the members of Watanabe laboratory in the Department of Industrial Engineering and Management, Tokyo Titech.

In the same time, 24 Chinese leading firms in ICT manufacture industry are selected which meet the three standards:

- (1) It must be in the list of top 100 firms from 2002 to 2004 in electronic manufacturing industry in China.
- (2) Its product is including ICT equipment.
- (3) More than 51% of its stock is held by the china's government or investors in China.

The rank of leadership in industry is weighed by the revenue of these 48 firms. All the values are nominal prices.

2.2 Regression Analysis

Single regression function is used to find the correlation between the firm's R&D spending and the leadership in the whole industry both in China and Japan. In the case of China, the newest data of 2003 is found by searching the Web site of China's Ministry of Information Industry. Successive data from 2001~2003 is selected to find the developing trend of China's ICT manufacturing industry. For the Japanese firms the data of 2002 and 2001 is chosen and analyzed as comparison.

2.3 Results

Table 1 shows the results of single regression analysis about the ICT manufacturing firms in China from 2001 to 2003. The constant variable is the ranking of R&D spending, the dependent variable is

the ranking of leadership measured by the revenue. From this table we can see in 2001 and 2002, the correlation coefficient are 0.588 and 0.607, which show the interrelation of the two variables but not very strong; in 2003, correlation coefficient is 0.823, which can demonstrate the strong correlation between the two factors in the ICT manufacturing industry.

Table 1 Correlation between Revenue Ranking and R&D Ranking of China's ICT Firms

$$Y = \alpha_0 + \alpha_1 X$$

Year	α_0	α_1	adj. R ²
2001	5.377 (2.095)	0.588 (3.337)	0.315
2002	5.113 (2.020)	0.607 (3.498)	0.338
2003	2.299 (1.271)	0.823 (6.643)	0.662

Y: revenue ranking; X: R&D ranking; α_0 , α_1 : coefficients

As a comparison, the analytical results using data of Japanese firms from 2001 to 2002 are shown in **Table 2**. Here we can see the correlation coefficients in 2001 and 2002 are 0.946 and 0.921, which show very strong correlation between the R&D spending and leadership in Japanese firms comparing to Chinese leading firms.

Table 2 Correlation between Revenue Ranking and R&D Ranking of Japan's ICT Firms

$$Y = \alpha_0 + \alpha_1 X$$

Year	α_0	α_1	adj. R ²
2001	0.633 (0.706)	0.946 (14.698)	0.907
2002	1.028 (0.828)	0.921 (10.830)	0.841

Y: revenue ranking; X: R&D ranking; α_0 , α_1 : coefficients

2.4 Inside the Results

From the results two points seem to be attractive: one is in 2003 year, the correlation coefficient reached 0.823 for Chinese leading firms, and they seemed to reach a higher level in 2003. There seem to be a trend that they are relying on their R&D activity more and more to keep their leadership in the industry; the other is even in the 2003 the correlation coefficient is still smaller than that of

Japanese leading firms in 2002 which shows weaker dependency on R&D spending for Chinese firms than for Japanese leading firms.

3. Comparison by Focusing on the Institutional System of the Two Countries

To discuss why for Chinese firms R&D activities are weaker correlative with leadership than Japanese firms, we must focus on the different institutional system between the two countries.

Institutional system is like "Soil" emerging innovation consisting of three dimensions (see Fig. 2) including National strategy and socio-economic system, entrepreneurial organization and culture, and historical perspectives (C. Watanabe et al., 2004). The R&D activity of enterprise is just like "seeds" in the "soil". New technology or innovation is like a "sprout", if it is adapted by the institutional system it will grow and self-propagating develop, in the same time because of co-evolution effect, the institutional system will grow up to a higher level; if not the innovation will diminish.

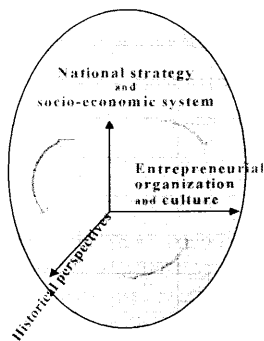


Fig. 2. Three Dimensions of Institutional System.

Source: C. Watanabe et al., 2004.

3.1 The Weaker Correlative between R&D Spending and Leadership in China's ICT Manufacturing Industry.

China is the largest developing country in the world, in the market place "revolutions" are happening everywhere, everyday. For most of

Chinese consumer they never use a lot of product such as PCs, auto cars and Etc. They only need the basic function of the product and be sensitive to the price because most of them are lacking of money. But in the case of Japan, as the modern developed country, consumers here are paying more attention to the advanced function of products which need more brand-new technologies generated by the R&D activity.

When China opened her door about 25 years ago, China began importing new technologies from Japan and western countries. It is a wise policy for china in the stage of catching-up. It will save much time and money to get the same advanced technology. It affects firm's R&D activity simultaneously as an acceptor of world technology spillover. They buy not develop technology themselves. On the other hand Japan has been standing at the front line of world's newest technology from the late 1960s. From then on Japan has become the donor in the cycle of world-wide Technology Spillover (TSO). Because firms in Japan are at the high level of technology and have strong capability of innovations, Japanese firms pay more attention to their R&D activities.

China is transforming from highly centralized planned economy to modern market economy. Now governments in China still have strong influence to the enterprises and market. A lot of monopolistic rules are still alive. If enterprises can get thick profit by making use of administrative instruction or monopolizing they will lose the motility to develop new technologies. On the other hand, Japan is a mature market economic society. Competence is main rhythm among the Japanese firms especially in the era of economic stagnation. Providing better product and service is only way to survive, so it is not strange there are strong correlation between R&D spending and leadership in case of Japan.

3.2 The Trend of Chinese Firms Depending on R&D Activity

Although only three-year data is analyzed we still

can see the trend obviously that Chinese firms are becoming more dependent on the R&D activity, the correlation coefficient is keeping increasing and jumped from 0.588 to 0.823 in 2003. How can we explain that?

After 20 years development, generally there is still a huge gap between china and other developed countries but in some fields of ICT manufacturing industry China has caught the advanced country. Some Chinese leading firms such as Haier, Founder have had relatively strong R&D capability. In the same time in some metropolis not only market but also consumer has become matured. The consumer needs advanced function; competence is becoming more and more vehement. To survive in the market many firms choose to develop their own technologies.

On the other hand, more and more Chinese firms are planning to exploit overseas market; most competitors they are facing have strong innovative capability in the developed countries. To survive in the world market they have to invest more to the R&D activity.

Last but not least important, from the macro way, many nation-wide R&D programs have started in recent years such as "863" program which is aiming to improve the fundamental science and technology; "973" program which is focusing on the applicable science and technology. These programs have given many leading firms financial supports and some special policy treatment, which not only improve the R&D capabilities of enterprises but also upgrade the institutional system.

4. Conclusions

4.1 General Summary

This paper compares the ICT manufacturing industry by selecting 48 leading firms both in China and in Japan. The result of regression analysis shows the difference of the industry between the two countries. By focusing on the institutional

system, the reasons inside the difference and the developing trend of Chinese firms have been discussed.

4.2 New Findings

By using the single regression analysis, we discuss the correlation between R&D spending and leadership in the ICT manufacturing industry. The strong correlation of Japanese enterprises demonstrates not only high level of technology in Japan but also the advanced and mature institutional system of Japan's society. On the hand China's developing trend also shows that China's leading firms pay more attention on their R&D development. Coevolved with the enterprise's R&D activities, China's institutional system also has been improved in recent years.

4.3 Future Works

This paper analyze the correlation between R&D spending and leadership in the industry among Chinese and Japanese leading firms. I have collected about 20-year data of Japan but only 3-year data of China. If data is available long time trend will be analyzed in both country and the correlation among R&D stuff, education investment, patent, and profit will also be discussed in the future.

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