

## Offshoring of Software Development from Japan to China

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### ABSTRACT

*This article discusses the recent development of offshoring in the software industry in Japan. Following interviews with several Japanese ICT companies, we reveal the present status and problems of offshoring software development, which cannot be recognized from its macro data. Japanese firms must expand offshoring because of increasing competition within Japan, although offshoring creates an outflow of technology and know-how to foreign firms. This outflow fosters prospective foreign competitors, and improves their technology, especially in China. Small and medium-sized Japanese software companies that lack advanced technology will face competition for survival against foreign firms in the near future. The income gap among Japanese software engineers will also increase.*

**Keywords:** *offshoring software development, technology, small medium enterprise*

### Introduction

The practice of offshoring software development has been increasing in Japan. Many coding tasks are transferred from Japan to China, India, and other countries. Offshoring includes not only computer systems for

banks and other companies, but also packaged and embedded software. Many Japanese information and communication technology (ICT) companies conduct transactions with software companies in China, India, or elsewhere, and establish subsidiaries or invest money in firms in those countries. Business process outsourcing (BPO) to China and India is also increasing. The development of the ICT industry in India and China has already been discussed in the academic literature, in such studies as Saxenian (2002), Banerjee (2004),

D'Costa and Sridharan eds. (2004), Tschang and Xue (2003), and Gregory et al. (2007). Regarding the effect of this development on the Japanese software industry, Kubo (2000), Ohtsuki (2001), and Kojima (2004) address the relationship between Japan and India. Kyo (2005), Umezawa (2005), and Asai (2005) discuss the relationship between Japan and China. Sawada (2005) addresses the relationship between Japan and the two countries. Kin (2005) interviewed Japanese-affiliated firms in China and researched conditions for success of offshoring.

On the other hand, there is very little research on how each Japanese ICT firm evaluates offshoring. Several years ago, the Japan Information Processing Development Corporation (2003) conducted interviews with several Japanese companies. Their conclusion was that "the Japanese business environment, in such aspects as language, ambiguous specification sheets, unique business processes, and culture is, as it were, a nontariff barrier for foreign engineers and firms. Entry into the Japanese market is therefore not easy" (Japan Information Processing Development Corporation, 2003, Ch.6). Therefore, the paper predicted that offshoring would occupy only a small part of the Japanese market.

However, the present situation has changed from that time. Our interviews reveal that, with several years' experience, Chinese programmers have learned to read Japanese specification sheets and that Chinese firms understand Japanese business customs. Therefore, entry barriers have become smaller. In addition, many Japanese firms feel concerned about the outflow of technology and know-how to foreign companies. Although total offshoring in Japan has expanded, a company that we interviewed has been reducing the scale of offshoring. One of the major reasons for this is that the company is concerned about the outflow of technology to foreign companies.

We obtain the following conclusions. First, expansion of offshoring reduces the unit price of software development. As a result, Japanese ICT firms must expand offshoring because of increasing competition within Japan, although offshoring creates an outflow of technology and

know-how to foreign firms. This outflow fosters prospective foreign competitors, and improves their technology, especially in China. Japanese small and medium-sized software companies lacking advanced technology will face competition for survival against foreign firms in the near future. In addition, it is possible that the hollowing out of software technology will happen in Japan. Therefore, Japanese firms and government must intensify their efforts to improve their technology and know-how.

Second, the income gap will increase among Japanese software engineers in the near future. Engineers who have the most ability and manage more difficult projects will continue to enjoy high incomes, while those who have average skills will suffer reduced incomes or change their careers.

It is often said that the development of ICT in Japanese society is desirable. However, development of ICT is closely related to globalization. Japan must face the negative side of globalization: possibility of the hollowing out of technology or expanding income disparities among engineers.

This paper is organized as follows. In Section 2, we explain the present situation of and reasons for the increase of offshoring in the Japanese software industry. In Section 3, we reveal some facts about offshoring from our interviews in Japanese companies. Then, we analyze the effects of offshoring on Japanese ICT firms. Section 4 discusses the effects on Japanese software engineers. Section 5 concludes the paper.

## **Expansion of Offshoring in Japan**

In this section, we explain the present situation of and reasons for the increase of offshoring from Japan to China, India, and other countries.

Recently, the Japanese information service industry has realized remarkable growth. The sales of the industry are 14.5 trillion yen (120 billion US dollars) in 2004, which is 2.3 times the figure for 1995 (Ministry of Economy, Trade and Industry, 2005). In 2006, orders for system development for banks and other big companies surged, so the demand for software development exceeded supply. Most software firms were short of engineers. In this situation, many Japanese companies cooperated with firms in China, India, or other countries, or established subsidiaries in those countries for offshoring. Foreign companies have also established subsidiaries in Japan, which take orders for software

development in Japan. Coding is performed by their parent companies in their home countries.

Offshoring serves to ease the excess demand for software development. It also plays the role of improving efficiency in human resource allocation in the Japanese ICT industry. Therefore, offshoring encourages economic growth in Japan.

There are no data on the total amount of offshoring in Japan. However, the trends can be seen through a survey jointly conducted by Japan Information Technology Service Association and two other associations.

Table 1. Offshoring of Information Services in Japan (n = million yen)

In 2002, n = 58. In 2003, n = 58. In 2004, n = 77.

Countries	2002	Year 2003	2004	Year-to-year comparison in 2004
1 China	9,833	26,280	33,241	126%
2 USA	3,260	4,988	5,147	103%
3 India	1,908	6,312	4,255	67%
4 Australia	0	2,626	3,133	119%
5 UK	20	1,827	2,126	116%
6 Philippines	1,864	2,494	2,117	85%
7 South Korea	1,952	1,871	1,415	76%
8 France	0	834	548	66%
9 Canada	496	616	262	43%
10 Vietnam	30	30	216	720%
Others	888	1,082	237	22%
Sum 20,251	48,960	52,697	108%	

Source: Japan Information Technology Service Association *et al.* (2005), Table 3(2).

Seventy-seven firms, or 24% of 213 respondents, conducted offshoring directly or indirectly with foreign software companies in 2004 in Table 1. The total value of this offshoring was 52.7 billion yen (US\$440mn), which is 2.6 times greater than two years previously. Respondents of this research were limited to members of the three

associations, and the response rate was low. Therefore, the total amount of offshoring in Japan is probably several times larger than this value.

It is striking that China accounts for 63% of Japanese offshoring investment in 2004, and that many Asian countries are included. For example, the proportion of offshoring to Vietnam is small, but increased yearly by 720% over the period of study.

Table 2. Costs of Work that One Japanese Engineer does in a Month (n = 10,000 yen)

Countries	Japan	Korea	India	China	Vietnam
Price	90–100	80	40–50	25–30	15–20

Source: Kin (2005), Table 5.

The main reasons why offshoring is conducted in Japan are cost reduction and lack of engineers. As Table 2 shows, costs of work in India and China are less than half that of Japan. However, offshoring incurs additional costs. Either (or both) companies must use foreign languages. Foreign companies sometimes misunderstand the instructions from Japanese firms. Culture and business customs are very different between Japan and foreign countries. Communication is therefore not easy and problems frequently occur. In addition, Japanese companies have to test and adjust what foreign companies make. As a result, cost reduction is approximately 10–30% of the project budget.<sup>1</sup> Some Japanese software firms, however, advertise that the cost is reduced to one third by offshoring.

China is the largest recipient of Japanese offshoring. The reasons for this are its low wages, adjacency to Japan, and the availability of many Japanese speakers. In addition, because Chinese and Japanese scripts have many characters in common, Chinese programmers with several years' experience have learned to read Japanese specification sheets (see our interview with Company B in Section 3). Japanese companies send Japanese specification sheets to China without translating them.

However, software development in China has many drawbacks. The technological capability of Chinese companies is low. The size and maturity of offshore development in China is said to be lagging ten years behind India. In addition, turnover is high. Many workers easily switch companies, so Chinese companies cannot retain their technology and

know-how. Piracy is also a big problem in China, and stems from inadequate understanding of intellectual property rights among Chinese firms. Some Japanese in the ICT industry are concerned about outflow of technology and know-how to China.

Japanese firms started offshoring in the late 1980s. Since then, they have faced many problems in offshoring. In 2003, NEC tried to develop software for distribution of goods, but the software that the Chinese company developed was inadequate so NEC lost 2 billion yen (17 million US dollars). Many Japanese firms had similar experiences and learned a lot from them.<sup>2</sup> As a result, the quality of software from offshoring has improved. Japan's biggest IT vendors, such as NEC, Fujitsu, Hitachi, Nomura Research Institute, and NTT Data, planned to increase the amount of offshoring in 2006. In addition, some small and middle-sized Japanese software companies advertise low costs from offshoring. This means that the reputation of software development in China has improved. As a result, offshoring in Japan will increase in the future.

In addition to this, the number of foreign IT engineers working in Japan for onsite development is increasing. The number of Chinese engineers in Japan is more than ten thousand, and that of Indian engineers is more than two thousand in 2005.<sup>3</sup> They work for Japanese companies or for subsidiaries of foreign companies. Some Japanese companies complain that the turnover rate of those foreign engineers is too high.

Thus far, Japanese firms have entrusted mainly coding to foreign firms. Hereafter, entrustment of not only coding, but also other processes will increase. NETS System Integration, a joint venture of Toshiba and NEUSOFT, was established in 1996. NETS was entrusted coding of Japanese projects by Toshiba at that time. In 1998, NETS started conducting design of some projects. Now this company is responsible for design of all projects.<sup>4</sup> In addition, in 2006, NTT Data said "So far, we have entrusted Chinese companies with coding of software for business users, but henceforth we will extend the entrustment of processes from design to multiple testing."<sup>5</sup>

## **Effects on Japanese ICT Firms**

In the previous section, we reported that offshoring involves many problems, but has been increasing. We now focus on how Japanese ICT firms evaluate this issue. We interviewed four Japanese companies, and below we describe the results.

The four firms receive orders for system development from banks, manufacturing firms, and so on. They conduct the processes of requirement definition and software design. Coding is performed by themselves in some cases and entrusted to other companies in others. When they entrust it to foreign companies, it is referred to as offshoring. All interviews were conducted in August 2006.

## **Company A**

This company is one of the biggest IT vendors in Japan. It receives orders for system development and design, but does not perform coding. It entrusts this to its subsidiaries or to other companies. In some cases, it commits tasks to foreign companies (direct offshoring). In other cases, companies who receive orders from Company A delegate some tasks to foreign companies (indirect offshoring).

This company started full scale offshoring around 2003, but had conducted it previously. Now it has subsidiaries in China and entrust coding to them. It also invests money in Indian firms for developing some kinds of software (middle software and enterprise resource planning) and for BPO. In addition, it develops software in South Korea and Vietnam, but the volume is very small. The reason for offshoring is the low cost. Moreover, Chinese firms are advantageous because they can communicate in Japanese.

The proportion of offshored tasks compared with the total number (measured by the amount of work) is about one-sixth.

According to Company A, because rival companies have been offshoring, this company must also do so. The current policy of this company is to increase offshoring. This company had undergone various troubles with offshoring. Now both they and their foreign business partners have learned much from their experiences. Foreign companies and engineers have learned Japanese culture and business customs. Therefore, the number of projects that go into the red has been decreasing.

The ability of foreign programmers is not low, but problems arise from difficulty in communication or disagreements over approaches to projects. This company is anxious about the outflow of specification sheets and other confidential documents to China. From this viewpoint, Indian companies are preferable.

The unit cost of orders that this company receives has not decreased.

## **Company B**

This company is a subsidiary of one of the biggest IT vendors in Japan. The number of employees of this company is about twenty. Most of the orders it receives come not from customers directly, but from its parent company and another subsidiary of the parent company. Company B conducts coding by itself in some cases, and entrusts it to its subsidiary in China in others. The Chinese subsidiary was established in 1998 and now has 15 employees, 13 of whom are engineers. Some of them communicate with Company B in Japanese, and convey the instructions from Company B to other engineers.

Chinese programmers with several years of work experience have learned to read Japanese specification sheets. This is because many Chinese and Japanese scripts have many characters in common. The ability of Chinese programmers is greater than that of novice Japanese programmers.

The wages in China are lower than in Japan. However, Company B incurs additional costs. It has to test and revise software produced by the Chinese subsidiary, so offshoring does not reduce production costs drastically. One of the reasons for revision is that Chinese engineers only produce software according to the content of the specification sheet. Company B must revise the software according to its customers' requests, which are not written in the specification sheet. Another reason is that Chinese engineers sometimes misunderstand the specification sheet.

In the initial stages of the Chinese subsidiary, communication with Company B was not easy. Workers from the two companies had a lot of quarrels. Through the quarrels, the companies have come to understand each other's way of thinking.

The capital of the Chinese subsidiary is more than 20 million yen (167 thousand US dollars). The equipment required for start-up was personal computers, telephones, faxes, and access to the internet. The Chinese subsidiary did not require expensive machines.

They think the unit price of system development is decreasing.

## **Company C**

This company is a telecom-related large company whose yearly sales far exceed 1 billion US dollars. It develops software for its own products



and for those of other companies. Company C conducts coding by itself in some cases, and entrusts it to other firms in others.

This company contracts with foreign firms and entrusts them with coding for some projects. As a result, this company offshores to China and Sri Lanka. It previously offshored to India, but no longer does so because of high costs (hourly wages are approximately US\$12.5-15 in China, \$16.7 in Sri Lanka, and \$25 in India). The ability of Chinese engineers is almost equivalent to that of Japanese engineers.

This company communicates in Japanese with Chinese companies and in English with Sri Lankan companies. Understanding each other is not easy in each case. In addition, face-to-face communication is indispensable in some cases. Therefore, this company feels that working with Japanese engineers makes things progress more smoothly.

This company had been increasing offshoring, but changed its policy several years ago and has been decreasing it since then. The reasons are that it is anxious about the outflow of technology to foreign companies, and that it is not easy for this company to manage systems produced by others.

They think the unit cost of software development has been falling recently.

## **Company D**

This company is the Japanese subsidiary of a multinational corporation that provides management consulting and technology services for other firms. The multinational corporation established a Chinese subsidiary in 2003, and takes advantage of this Chinese office for offshore software development and BPO.

Company D communicates with its Chinese office in Japanese or English. The advantage of the Chinese office is that it can communicate directly with Company D's customers in Japanese.

This company rarely revises software that the Chinese office produces. This is because this multinational corporation ensures the Chinese side understands the demands from the Japanese side by sharing its way of thinking.

Chinese engineers are not good at new technology, but their ability to use basic computer languages is better than that of Japanese engineers. The deficiencies of Chinese engineers are that engineers sometimes do not work overtime even when a delivery date is approaching, and that

they do not care about the compatibility of their products with other parts of the system.

Offshoring reduces the cost of system development by 30-60%. Therefore the company can supply its products at cheaper prices.

The Interviewee personally believes that Chinese engineers who speak Japanese fluently would be able to work out the basic design of software (though this company does not hire such engineers for the basic design).

The above four interviews reveal several important facts. First, Chinese companies, whether they are subsidiaries of Japanese companies or not, correspond in Japanese, understand Japanese specification sheets, and communicate successfully with Japanese companies. Furthermore, the technical ability of Chinese engineers is on a par with their Japanese counterparts. Second, Japanese companies' fears of outflow of technology and know-how are serious enough to induce a large company to decrease its offshoring. Many other firms are also anxious about this. Third, three of the four Japanese firms report that the unit price of software development has been falling.

The first fact means that entry barriers for foreign firms, such as Japanese language, culture, and business customs, have been gradually diminishing. Several years ago, the Japan Information Processing Development Corporation (2003, Ch.6) argued that "the Japanese business environment, in such aspects as language, ambiguous specification sheets, unique business processes, and culture is, as it were, a nontariff barrier for foreign engineers and firms. Entry into the Japanese market is therefore not easy. Chinese firms will not dominate the Japanese market."

Compared with coding, more communication skill is needed for requirement definition and design. In these fields, Japanese engineers have an advantage over foreigners in conducting transactions with Japanese customers, so it will never happen that foreign companies replace all Japanese firms. However, entry barriers are not as large as previously. Some Japanese ICT firms, such as NTT Data, will extend entrustment of processes from design to multiple testing. Furthermore, as the interviewee of Company D commented, Chinese engineers who speak Japanese fluently would be able to work out the basic design of software.

The second fact, the prevalence of fear of outflow of technology and know-how, is, as we mentioned, significant. There are many reasons why the outflow occurs. First, Japanese firms need to transfer technology and know-how to foreign firms in the course of their business. Without such transfers, foreign firms cannot develop software that suits the

business style of each Japanese customer. In addition, Japanese firms must improve the ability of their foreign subsidiaries to gain high returns, so offshoring inevitably involves the outflow of technology and know-how. Second, frequent job-hopping by Chinese engineers creates outflow to many other Chinese firms. Third, piracy causes outflow. As a result, foreign firms improve their technology by legal and illegal outflow of technology and know-how. This means that Japanese software companies are fostering prospective foreign competitors, especially in China.

The above analysis shows that offshoring offers good opportunities for Chinese companies to catch up with Japanese firms. In the near future, the range of development processes that foreign software firms substitute for their Japanese counterparts will expand.

As for falling unit prices, no wide-ranging research has been conducted in Japan. However, a survey also reports that unit prices have been falling (Information Service Industry Association, 2006, p. 277). In addition, Hitachi Software Engineering said that “unit prices have fallen by some 10% because of customers’ requests” (*The Nihon Keizai Newspaper*, Jan 27, 2005). There are several reasons for unit price decline: customers intensify efforts to select projects according to cost–benefit performance and attempt to reduce their total number of orders. Moreover, competition in the software industry is fierce. We assume that offshoring accelerates these tendencies. That is, offshoring intensifies price competition in the Japanese market. Furthermore, increases in low cost projects strengthen discount demand by customers.

As offshoring increases hereafter, unit prices will fall further. Therefore, as our interviewee in Company A commented, Japanese companies must expand offshoring to compete with their domestic rivals even if it generates an outflow of technology and know-how.

In the Japanese software industry, there is a huge subcontracting system, like that of the construction industry. A system development project can be as large as a seven-tier pyramid; that is, tasks of the project are divided and subcontracted six times. Some small software firms in the lower levels of the pyramid do not have advanced technology. They receive orders simply because their unit prices for work are cheap. These small software firms are convenient to the bigger firms; they use small firms when they cannot line up enough engineers for each project, and the costs of contracting out to small firms are cheaper than those of implementing tasks by themselves. The pyramid system interferes with the improvement of productivity and quality of software development. One of the reasons is that firms in the lower levels of the pyramid have

no incentive to improve productivity and quality. In addition, multiple subcontracting occasionally causes inappropriate coding and its checking, which invite many problems in the software. However, firms in the lower levels do not have to take responsibility of this. These small software firms which don't have advanced technology will face fierce competition with foreign companies in the near future.

What Japanese firms ought to do in this situation is to develop higher technology and know-how. "To strengthen international competitiveness and to avoid hollowing out, we need to nurture people highly talented in IT" (Ministry of Education and Science, 2005, p.5). So the Ministry of Economy, Trade and Industry established the Software Engineering Center to cope with "the hollowing out of software technology due to an escalation of price competition and the rise of software firms in China, India, and other Asian areas" (Information Service Industry Association, 2005, p.49). Therefore, Japanese firms and government must intensify their efforts to improve their technology and know-how.

To sum up, the unit price of software development has fallen due to the expansion of offshoring. As a result, Japanese companies must expand offshoring further, although they are fostering prospective competitors in China through outflows of technology and know-how. Small and medium-sized Japanese software companies lacking advanced technology will face competition for survival against foreign firms in the near future. In addition, it is possible that the hollowing out of software technology will happen in Japan. Therefore, Japanese companies and government must develop more advanced technology and know-how.

## **Effects on Japanese Software Engineers**

As we explained before, small and medium-sized Japanese software companies will face competition for survival against foreign firms. In this section, we analyze the effects of this competition on Japanese software engineers by reviewing the American experience.

In 2001, the United States experienced a recession, which intensified outsourcing in business management. Hence, outsourcing of IT increased, and the ratio of offshoring in IT-related spending was augmented from 12% in 2000 to 28% in 2003.<sup>6</sup> Layoffs of IT engineers due to offshoring were frequent. According to estimation, offshoring reduced the number of IT engineering jobs by 104,000 in the United States in 2003 (Global

Insight, 2004). This shows that offshoring is an important factor hindering employment of IT engineers.<sup>7</sup>

To verify this observation, we focus on Silicon Valley. In Silicon Valley, the average wage in the software industry in the 2005 fiscal year was US\$141,972.<sup>8</sup> What is striking is that the average wage in the industry rose by 19% during the fiscal years 2002–2005, but the number of employees in the industry decreased by 11% during the same period. Furthermore, the same tendency was evident in many other manufacturing sectors in Silicon Valley (Joint Venture Silicon Valley Network, 2006, pp.8, 24).

In August 2003, San Jose's Office of Economic Development warned that "In the next five years, technology jobs paying \$40,000 to \$80,000 a year in Silicon Valley will be a 'vanishing breed.'" (*The San Jose Mercury News*, August 26, 2003). Offshoring was one of the major reasons for this prediction. That is, jobs of engineers in that wage bracket were being transferred to foreign countries, so the numbers of engineers decreased and the average wage rose in all the affected industries.

In brief, on the one hand, the best engineers receive high incomes. On the other hand, engineers with average skills lose their jobs. Further, many foreign engineers return home and some continue working for half of their previous wage to obtain green cards or citizenship. Thus, the income gap among engineers in Silicon Valley has widened.

We may now proceed to the discussion of the effect on Japanese software engineers,<sup>9</sup> in light of the American experiences. Offshoring in Japan has not increased to the same degree as in America, because the Japanese software market was segmented due to its unique language and customs. However, as foreign engineers understand Japanese language and customs, offshoring will expand as we describe above. This expansion and the fierce competition in the Japanese market will affect Japanese software engineers greatly.

There are 850,000 IT engineers in Japan, of whom several tens of thousands are freelance engineers. Now that the demand for system development exceeds supply, many firms feel short of engineers.

However, in the near future, the range of development processes that foreign software firms substitute for their Japanese counterparts will expand. Then, the excess demand in the Japanese market may disappear and the unit price of software development may decrease further. At that time, trends similar to those faced in the United States will occur in Japan. Excellent engineers who can manage difficult projects will continue to enjoy high incomes, but engineers with average skills will

have to accept projects with lower pay. In addition, companies will reduce the numbers of engineers with average skills. Most Japanese firms try to avoid layoffs as much as possible even when they are in the red. So they transfer redundant engineers to marketing, consulting, maintenance and so on. Thus, wages for regular workers in Japanese companies will remain unchanged so long as they continue working for their companies. However, freelance engineers and engineers who change companies will receive lower incomes unless they improve their skills. Some engineers will be forced to accept occupations with lower incomes. As a result, the income gap between Japanese engineers will increase.

## **Conclusion**

Paul Krugman wrote “The accelerated pace of globalization means more losers as well as more winners; workers’ fears that they will lose their jobs to Chinese factories and Indian call centers aren’t irrational” (Krugman, 2004). The effect of globalization is greater in the software industry than in manufacturing, because software companies do not need expensive equipment. They only need skilled workers, so entry barriers are relatively low in this industry.

Offshoring presents various problems, as we have described above. However, it brings an increase in nationwide employment. Large cost savings in the United States due to offshoring of software development generated more investment in IT and other areas. It produced interindustrial effects that many industries enjoyed. According to estimation, in the United States in 2003, offshoring reduced the number of IT engineering jobs by 104,000, but created 194,000 jobs over all sectors, so the net increase was 90,000 jobs. In addition, if offshoring expands at an annual 26% from 2003 to 2008, the net increase will be some 320,000 jobs. The indirect effects of offshoring contribute mainly to industries such as construction, marketing, transportation services, education and healthcare (Global Insight, 2004). We shall have to estimate this effect on the Japanese economy.

What should be sought after is that both Japanese and foreign software industries develop in the long run. Japanese and Chinese business people have already had a lot of international conferences on this topic. If both industries continue to share their interests of offshoring, this goal will be realized.

## Notes

- <sup>1</sup> “Successful approach to software development in China,” Nikkei System Provider, March 1, 2003, p.40.
- <sup>2</sup> In the 1990s, there were many Japanese software firms which established subsidiaries in China, then made losses and withdrew from China.
- <sup>3</sup> The number of Chinese who have technology visas is 11,981, and that of Indians is 2,298 in 2005 (Japan Statistics Association, 2006, Table 5.3). Most of them are probably IT engineers.
- <sup>4</sup> Authors interviewed NEUSOFT in Shenyang, China in March 2007.
- <sup>5</sup> “Offshore Development of NTT,” Business Communication, 2006, Vol.43, No.1, p.95.
- <sup>6</sup> Internetnews.com, March 19, 2003, <http://www.internetnews.com/ent-news/article.php/2118191>.
- <sup>7</sup> Regarding to the effect of offshoring on job numbers and wages of the US ICT workers, see Kirkegaard (2004) and Mann and Kirkegaard (2006, Ch.5).
- <sup>8</sup> In 2002, the average annual wage of IT engineers in the United States was \$68,330. That of all private workers was \$36,520 (U.S. Department of Commerce, 2003, p.23).
- <sup>9</sup> The average annual income of IT engineers, including those in management positions in Japan of persons 55 years of age and older is 9.93mn yen, and that of persons 40-45 years of age is 7.69mn yen (Information Service Industry Association, 2003, Table 3-41). According to an outplacement service company, the average annual income of 40-year-old engineers in 2006 was 4.85mn yen for programmers, 6.36mn yen for program architects, and 8.16mn yen for system consultants.

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