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The Influence of Offshore Development on Strategies for Developing China's Software Industry

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ABSTRACT

This article recommends strategies to develop China's software industry, based on our analysis of the recent technology transfer to Chinese software firms from Japan. Li and Gao (2003) recommended that the Chinese software industry focus on its domestic software service market. However, since the end of the 1990s, Chinese software firms have obtained a significant amount of technology contract work from Japan, including coding, testing, and design. Chinese firms have been increasing their design skills through this joint software development with Japan. As a result, offshore software development from Japan has helped Chinese software firms acquire advanced technology. We conclude that the Chinese software industry should focus on both its domestic software service market and the export of software services.

Keywords

Technology transfer, Offshore software development.

INTRODUCTION

The Chinese software industry has been growing at a tremendous rate over the past decade. Sales have increased from 8.9 billion US dollars in 2001 to 54.3 billion US dollars in 2006. Exports have also increased from 700 million US dollars in 2001 to 5.9 billion US dollars in 2006.[1] Most of these exports have been in software development services, but exports of packaged software have also been increasing. For example, KINGSOFT Office 2007 and EIOffice2007 are now well-known in Japan.

Studies of the Chinese software industry suggest that its rapid expansion has been promoted by strong domestic economic growth and the support of the Chinese government; however, this industry faces many obstacles if it is to develop further. Zhang (1999), Zhang et al. (2001), Ju (2001), Tschang and Xue (2003), Saxenian (2003) and Wong and Wong (2004) consider development obstacles to include the lack of consulting capabilities, the shortage of highly skilled engineers, and rampant piracy. Kshetri (2005) describes the development of open source software as a new development option in China. Li et al. (2005) suggests the Chinese government promote open source software to foster the development of the industry. Assimakopoulos and Yan (2006) revealed that the main sources of seeking advice and learning how to solve technical problems for Chinese software engineers are communication with team colleagues and specialized Internet software technology forums.

The literature, however, does not identify the kind of strategy the Chinese software industry should adopt for its future development. Correa (1996) and Heeks (1999) both conducted a theoretical analysis for software strategies in developing countries. Correa (1996) considered three software strategies for exports according to the industry's technological level: export of work, export of software development services, and export of products. Heeks (1999) revealed five strategies in terms of the market (export or domestic market) and business (software development services or packaged software): export of software services, export of software packages, production of packages for the domestic market, selling software services to the domestic market, and selling products and services to niche markets.

Based on Heeks (1999)'s model, Li and Gao (2003) analyzed the strategy of the Chinese software industry. However, they both overlooked an important point, i.e., the interaction between domestic firms and foreign firms. In fact, the export of software development services, that is, offshore software development, has helped China's software firms acquire advanced technology.

This paper analyzes the technological progress of the Chinese software industry from the viewpoint of the international division of work, which has been overlooked in previous studies. We have interviewed Chinese software firms. Based on the

results, we investigate technology transfer to Chinese software firms through offshore development. Finally, we recommend various strategies to aid in the development of China's software industry.

This paper is organized as follows. In the following section, we examine the literature on strategies in the software industry in developing countries. In Section 3, we consider the expansion of the export of software in China. In Section 4, we discuss how the division of work between Japan and China changed at the end of the 1990s. Section 5 provides concluding remarks.

THE LITERATURE ON STRATEGIES TO DEVELOP THE SOFTWARE INDUSTRY

In this section, we examine the literature of strategies for the software industry in developing countries.

### Correa (1996): Software Export Strategies of Developing Countries

Correa (1996) described three software strategies for exports in developing countries. Strategy 1 is the export of work. According to this strategy, software engineers work for a brief period on site in developed countries. These operations are mostly confined to programming. The learning process, in terms of design, is not substantial. In India, software exports are predominantly based on this type of "body-shopping" operation.

Strategy 2 is the export of software development services. Regarding this strategy, software firms develop custom-made software in accordance with clients' specifications, or subcontract a part of the development process. Software developers may participate in the design, programming, and implementation of the systems. The value added and profitability is likely to be higher in Strategy 2 than in Strategy 1. The learning process would also be substantial. The governments in Taiwan and Singapore have promoted this strategy.

Strategy 3 is the export of products. With this strategy, suppliers have to develop or obtain access to a distribution network. Post sales services need to be ensured, competition is intense, and advantages based on low labor costs lose their relative importance. Israeli and Irish firms have focused on this strategy (Correa, 1996, pp.178-179).

Heeks (1999): Software Strategies in Developing Countries

In contrast to Correa (1996), who did not study strategies in domestic markets, Heeks (1999) compared software strategies of firms in various developing countries and classified them into five positions in terms of market (export or domestic market) and business (software development services or packaged software). The strategies are described in Figure 1.
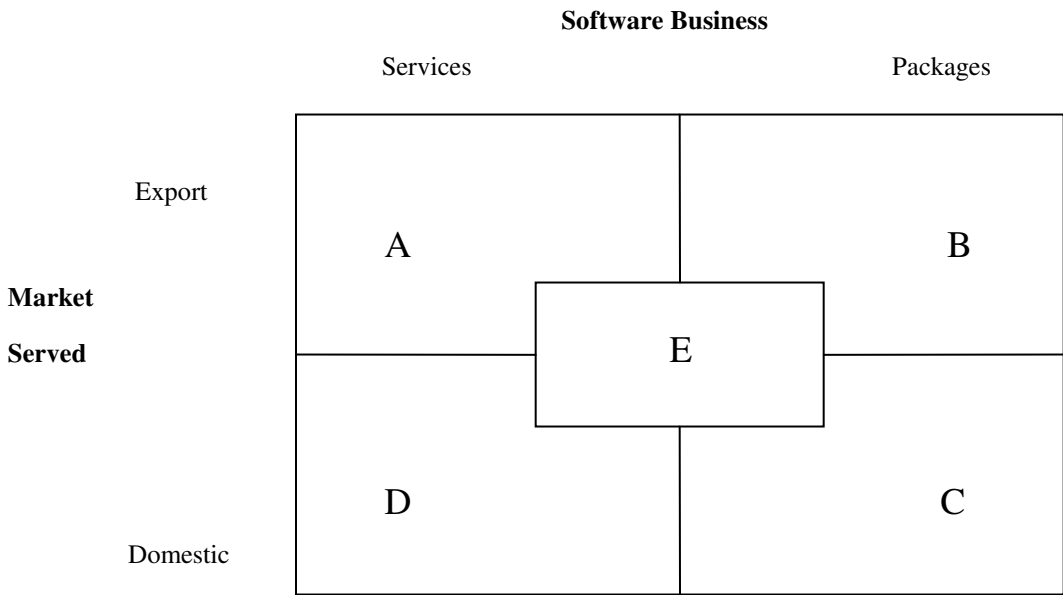
Source: Heeks (1999) Figure 1.

Figure 1. Strategic Positioning for Developing Country Software Enterprises

In Figure 1, Position A represents the export of software services, or offshore development. In this position, software firms in developing countries are entrusted by developed countries with the whole, or subsection, of software development. Position B is the export of software packages. Position C is the production of packages for the domestic market. Position D is the selling of software services to the domestic market. Position E represents the supply for niche markets, including sector niches (e.g. mining and forestry), application niches (e.g. Web browser add-ons), and linguistic niches (e.g. Swahili).

Positions A and B are export-oriented strategies, and are attractive to countries with an inexpensive labor force. India and Singapore arrived on the export scene many years ago. Ireland, Israel, and Hungary have been low-cost software export bases since the early 1990s. These countries have already built up contacts, policies, infrastructure, working methods, and track records. As a result, the more established firms threaten to consolidate their position whilst squeezing out late-comers.

Positions C and D are domestic-oriented strategies. In position C, software firms have many problems such as high development costs, piracy, and competition with foreign software firms like Microsoft. Therefore, the vast majority of software firms in development are in position D, which is considered a good starting point for making progress into the export market.

Position E represents the other main success story of software firms alongside position A (Heeks, 1999, pp.1-9).

Li and Gao (2003) analyzed the strategy of the Chinese software industry based on Heeks (1999)'s model.

Li and Gao discussed that Positions A and B were not good strategies for China. As Heeks (1999) described, latecomers are disadvantageous in these positions. China is a latecomer in the software export market, so the country faces insurmountable obstacles in position A in the immediate future. In addition, average wages in China were 15% to 20% higher than in India[2]. These higher costs plus the language barrier created additional disadvantages for China in the world export market. The export-oriented approach also had some serious side effects when skills and technology failed to trickle down into the domestic market. Arora and Athreye (2002) showed that the benefits of the Indian software industry and its growing productivity were largely passed on to its customers. Taking all these factors into account, it would not be wise for China to promote software exports without calculating the opportunity costs.

Li and Gao do not believe that Position C is an advisable strategy for China, either. The battle between KINGSOFT and Microsoft in the word processing market illustrates why. KINGSOFT developed the first software package for word processing in a simplified Chinese language. After being introduced in 1988, it soon became a monopoly. However, in 1994, Microsoft introduced its Chinese version of Word 6.0. With the Windows operation system being widely popular, the Windows-based MS Office took the most market share.

According to Li and Gao (2003), position D is the most appropriate starting point for China to develop its software industry for several reasons. Firstly, this segment is the easiest to enter. Secondly, this position can be a good starting point for progressing into exports. A sizable and demanding domestic market could be the springboard required to launch China into the export market as they can provide a base of relevant skills, relevant experience, and a strong track record. Additionally, a sizable domestic market draws large numbers of information technology (IT) multinationals. Collaboration with multinational firms will bring export components for local partners.

Position E will provide thriving market opportunities for China's software industry. With the high economic growth rate in China, large firms are thriving in various industries.

As a result, Li and Gao (2003) concluded that the best strategic positions for China's software industry are positions D and E (Li and Gao, 2003, pp.68-70).

As described previously, Correa (1996) considered that the export of software development services would accompany a substantial learning process. However, Heeks (1999) and Li and Gao (2003) overlooked this effect. The following sections show how the export of software development services plays an important role in developing China's software industry.

THE EXPANSION OF THE EXPORT OF SOFTWARE IN CHINA

In this section, we describe the rapid expansion of the exports of software in China. Figure 2 illustrates total sales and exports in the Chinese software industry.

(Billion yuan)   (%)
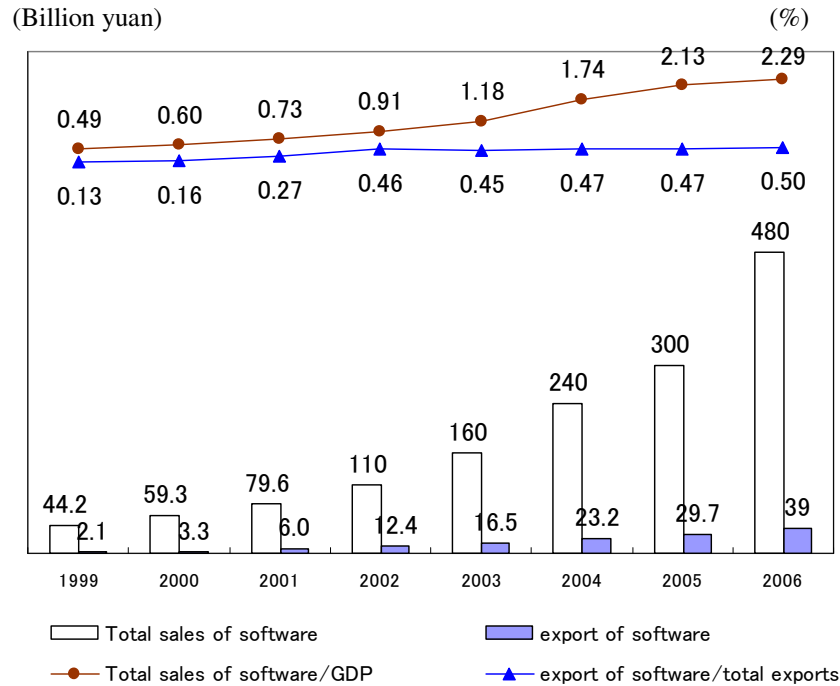
Note: Total sales of software are the sum of domestic sales and export of software.

Source: Created by author, based on the data from Chinese Software Industry Association.

Figure 2. Total Sales and Export of the Chinese Software Industry

Figure 2 suggests that the total sales of software have been expanding at a tremendous rate. Sales were 44.2 billion yuan in 1999 and 480 billion yuan in 2006, increasing 10.9 times in seven years. The ratio of total sales of software in GDP has also been increasing.

The export of software has been also growing at a high rate. The export of software was 2.1 billion yuan in 1999 and 39 billion yuan in 2006, increasing 18.6 times in seven years. As a result, the ratio of exports to total sales of software reached 11.2% in 2002. This means that exports have a substantial share of total sales in the Chinese software industry.
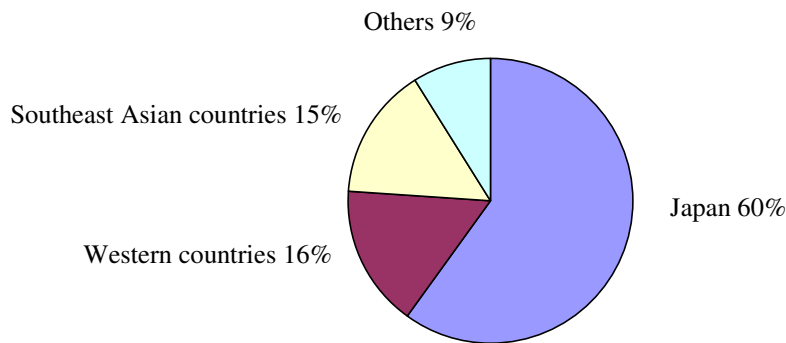
Source: China software industry development research report editing committee ed. (2005) Figure 1-4-1.

Figure 3. Destination for Exports of Software in China in 2004

Chinas exports go to many different countries. Figure 3 shows Japan imported 60% of all Chinese exports, occupying the majority of Chinese software exports. Most of these exports have been in software development services.

The rapid expansion of the exports was backed up by the government. The tenth five-year plan (2001-2005) by the Chinese government included a number of policies aimed at promoting the export of its software industry; tax reductions, subsidies, low interest rate bank loans, along with other preferential treatment. As well as on a national governmental level, local governments implemented supporting measures for software firms. For example, in 2003, the Beijing municipal government planned to train one thousand people to become software engineers each year and encourage software firms to reach over ten million US dollars in sales.

In summary, exports have been increasing in importance in the Chinese software industry, and the government has been promoting it. We will next examine the influence of exports on Chinese software firms in terms of technology transfer.

THE CHANGE OF THE INTERNATIONAL DIVISION OF WORK

This section examines offshore development from Japan to China. We investigate the change of the division of work between Japanese firms and Chinese software firms.

When Japanese firms conduct offshore software development, they are typically applying the waterfall model. Processes in the waterfall model include (1) requirement definitions, (2) external design, (3) internal design, (4) programming design, (5) coding, (6) unit tests, (7) join tests, (9) system tests, and (10) operations and maintenance. To conduct external and internal design, one not only needs extensive technical knowledge and skills, but also the business know-how. Business know-how includes information regarding individual customer business styles, and where and how the software is used, as well as ideas to develop software that suits the business style of each customer.

In most cases of the offshore development from Japan to China in the 1990s, requirement definition and design were conducted by Japanese firms, while Chinese software engineers conducted the coding and unit tests. However, we found that several Japanese firms have entrusted not only coding and unit tests, but also external and/or internal design, to Chinese firms since the end of the 1990s.

We interviewed twenty Chinese software firms that received orders from Japan in 2007. Over half of them were entrusted with external and/or internal design. We will now present the results of interviews with four firms, chosen as being representative of the various fields of software development in China. Firm A and Firm B are among the biggest IT vendors in China. Firm C is a manufacturer and develops software for its own products. Firm D is a small IT vendor. General firm information is described in Table A-1 in the Appendix. These Chinese firms have had difficulty in obtaining design skills by themselves. This suggests that technology transfer to Chinese software firms through offshore development is an important factor in the rapid expansion of the industry.

Figure 4 shows the changes in the balance of tasks between Japanese firms and Chinese Firms A, B, and C.

	Requirement definition	External design	Internal design	Programming design	Coding	Unit test
1990s End of the 1990s 2000s	Japanese Firms				Chinese Firms A, B, C	

Figure 4. Changes in the Division of Work between Japanese Firms and Chinese Firms A, B, and C

Firm A was entrusted with programming design, coding and unit tests by Japanese IT (Information Technology) vendors in the 1990s. As a result, Firm A opened an office in Japan in 1999. Its Chinese engineers had high levels of software development skills and Japanese literacy. They served as mediators between Japanese IT vendors and Firm A's main office.

Around 2000, a Japanese IT vendor invited these highly skilled Chinese engineers from Firm A to participate in the internal design phase, which was previously the role of Japanese engineers. As a result, those Chinese engineers gradually acquired

the same level of design skills as the Japanese engineers. Eventually, they conducted the internal design by themselves. Today, the Japanese firm and the Chinese firm jointly conduct external designs.

Firm B is a joint venture between a Japanese IT vendor and another Chinese software firm. The Japanese IT vendor had entrusted coding and unit tests to the Chinese firm for over 10 years.

Because the Chinese firm transferred a lot of experience in software development to Firm B, the Japanese parent company invited the engineers from Firm B to participate in the internal design phase. In 1998, the Japanese and Chinese engineers jointly started the external design of software development. Several years later, Firm B conducted external designs by itself. Ever since Firm B established an office in Japan in 2001, their orders have been increasing.

Firm C is a joint venture firm established by a Japanese machine manufacturer and a Chinese firm. At times, Engineers from Firm C work at the Japanese parent company's office and conduct external and internal design under the guidance of Japanese engineers. In the late 1990s, Firm C's engineers, that had acquired the design skills, conducted the external design phase by themselves. In addition, they also conducted the requirement definition.

In these cases, Chinese firms conducted both external and internal design. However, the following is a case of a Chinese firm conducting internal design after a Japanese software firm already conducted the external design.

	Requirement definition	External design	Internal design	Programming design	Coding	Unit test
2000s Present	A Japanese Firm			Chinese Firms D		

Figure 5. Changes in the Division of Work between a Japanese Firm and Chinese Firm D

Firm D was founded in 2000. After which, a Japanese IT vendor invited the highly skilled Chinese engineers from Firm D to Japan to participate in internal and programming design. Firm D established a Japanese office in 2003, staffed by the Chinese engineers, to increase sales to Japanese firms. As a result, Firm D now conducts internal design by themselves. Figure 5 illustrates the changes in the division of work between the Japanese firm and Firm D.

These examples reveal how change in the division of work has been developing over the years. First, Chinese engineers worked with Japanese engineers in the design phase. Once they acquired the necessary skills, the Chinese engineers conducted the design phase by themselves. Though the entrusting of design to China is not currently being implemented on a large scale, there is a chance that it might increase in the future. This trend will accelerate technological progress in the Chinese software industry further.

The technological progress transferred by offshore development also promoted the development of the Chinese domestic software market. According to the interviews conducted by the authors, the Chinese firms had acquired advanced skills from Japan, and took advantage of these skills to develop software in China. For instance, Firm A used the skills when developing the software to manage firms or subways. Firm D used the skills when developing the software to manage a tunnel. This fact means that the technology and know-how of Chinese software firms acquired from Japan contributed to the development of the Chinese domestic software market. We believe that this is one of the factors that contributed to the rapid expansion of the Chinese software industry. In other words, Japanese firms indirectly contributed to the development of the Chinese domestic software market.
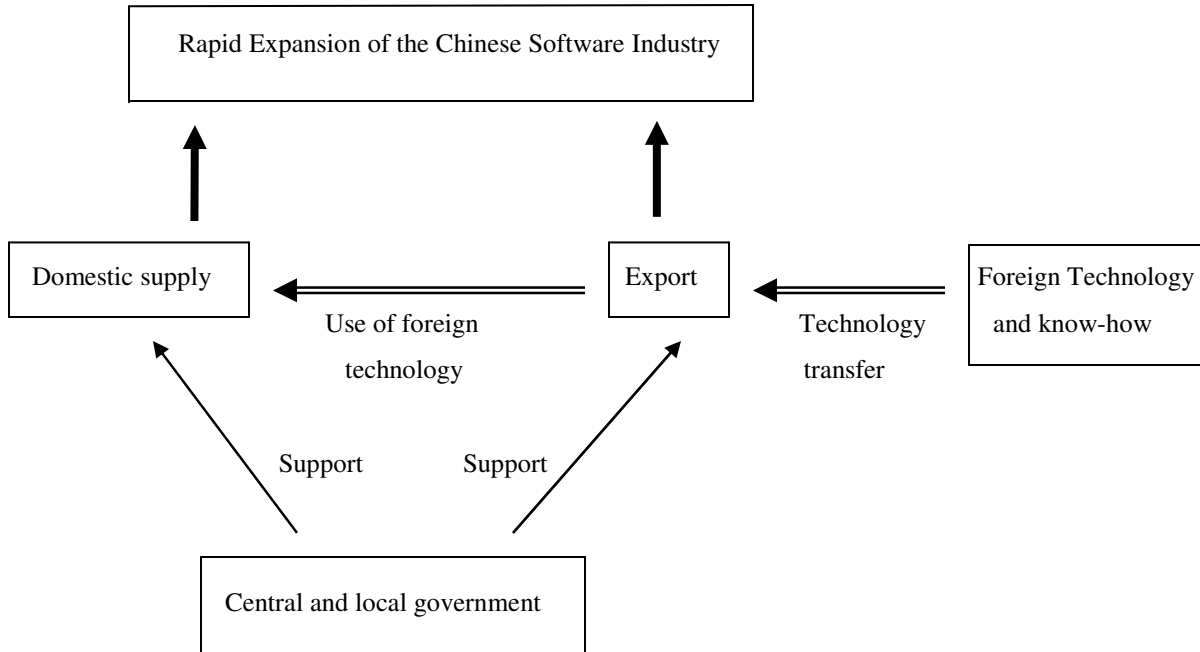
Source: Created by author.

Figure 6. The Strategies to Develop China's Software Industry

Based on the above analysis, we recommend several strategies to develop China's software industry. Chinese software firms acquire advanced technology through the export of software. These firms utilize the technology for domestic supply. The Chinese government also supports the export and domestic supply of software firms. This mechanism is described in Figure 6.

Li and Gao (2003) insisted that positions D and E in Figure 1 are the best strategies for China's software industry. However, the export of software causes technology transfer. The foreign technology Chinese firms have acquired can also be utilized for the domestic supply. This means that exports significantly contribute to the industry. Therefore, we recommend that the Chinese software industry not only adopt positions D and E, but also position A. In other words, China should focus on both its domestic software service market and the export of software services.

CONCLUDING REMARKS

This article discussed technology transfer to Chinese software firms caused by offshore software development from Japan. We then analyzed the technology transfer influence on the development of the Chinese software industry. Chinese software firms, especially large firms, acquired the skill of conducting design directly from the Japanese firms. In addition, these Chinese firms took advantage of these skills for their domestic supply. This means that the technology transfer helped Chinese firms to catch up with developed countries in their technology.

Li and Gao (2003) argued that the supply for the domestic software development services is the best strategy for China's software industry. However, based on our analysis, we conclude that China should focus on both its domestic software service market and the export of software services.

This paper focused on offshore software development and technology transfer. We recommend that future studies focus on how the technology transfer contributes to domestic supply.

APPENDIX

	Outline of firm	Products	Weak points	Phases entrusted by Japan	What they absorbed from Japan
Firm A	Founded in 1991, 780 workers, local Chinese firm	System development, packaged software	Lack of business know-how, lack of skill in external design and quality control	From internal design to system test. Joint development of external design with Japan	Business know-how, design skills and quality control (QC)
Firm B	Founded in 1996, 1300 workers, joint venture between Japan and China	System development, embedded software	Lack of business know-how, lack of project management skills	From external design to system test	Business know-how, design skills, QC, and corporate philosophy
Firm C	Founded in 1991, 430 workers, joint venture between Japan and China	Software for numerical control devices	Lack of QC skills, lack of corporate management skills	From external design to system test.	Business know-how, requirement definition skills, design skills, and QC
Firm D	Founded in 2000, 2642 workers, local Chinese firm	System development, embedded software	Lack of business know-how, lack of experience	From internal design to system test	Skill of organizing development teams, business know-how, and design skills

Interview place and time for Firms A, C, D: Shanghai, June 2007, Firm B: Shenyang, China, February 2007.

Table A-1. Chinese Firms that have been Entrusted with Design from Japan

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NOTES

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[1] Sales in yuan are converted into US dollars based on the average exchange rate of every year. Ministry of Internal Affairs and Communications, ed. (2007) p.60.

[2] According to a study by NASSCOM (News released from NASSCOM on July 18, 2002).