2013

The Quality Measurement of China High-Technology Exports

Jie Xiong
University of Nebraska at Omaha, jxiong@unomaha.edu

Sajda Qureshi
University of Nebraska at Omaha, squreshi@unomaha.edu

Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Computer Science 17 (2013) 290 – 297

Procedia Computer Science

Information Technology and Quantitative Management (ITQM2013)

The Quality Measurement of China High-Technology Exports

Jie Xiong*, Sajda Qureshi

College of Information Science and Technology, University of Nebraska at Omaha, 6001 Dodge Street, Omaha, 68106, USA

Abstract

The foreign-led processing trade is an important driving factor in the process of China's rapid economic growth. Since the reform and opening up, China's foreign trade is growing rapidly with the product structure upgrading. Even so, the products made in China are still the byword of the low quality. To a large extent, China's export structure is not due to the local enterprises improving the technical content of the export, but to the processing trade and foreign enterprises participation. More and more study is focusing on the export product quality analysis and its influencing factors. However, it also obscures the real quality of Chinese exports, especially high-tech products. This paper measures the true quality level of Chinese high-tech exports by quality index model, and compares it with the obscured quality and exports quality of 14 countries.

Selection and peer-review under responsibility of the organizers of the 2013 International Conference on Information Technology and Quantitative Management

Keywords- *Processing Trade; Quality Index; High-Tech Export Products; Development*

1. Introduction

China's high economic growth has relied on large-scale exports in China since the 1990s. Besides, China has also been actively participating in international product division. With the growing scale of exports, China has become the world's factory and the processing trade has soared. Total imports and exports of processing trade in china increased by about 250 times in 30 years, from the initial $ 1.67 billion in 1980 to $ 417.43 billion in 2010. The product structure of processing trade gradually upgraded from the early low-value-added labor-intensive products, like textile and clothes, to capital-and technology-intensive products, like electronic products [7]. Several paper [9-11] discuss the importance of the ICT product in developing countries, especially in China. However, this so-called production method of capital and technology intensive is still based on processing and assembly. Export expansion still rely on large-scale imports of parts and production equipment, and processing and assembly production of capital and technology intensive products accounted for

* Corresponding author. Email address:jxiong@unomaha.edu

1877-0509
Selection and peer-review under responsibility of the organizers of the 2013 International Conference on Information Technology and Quantitative Management
doi:10.1016/j.procs.2013.05.038

the 90 percent of total exports, which means China's processing trade products still belong to the scope of labor-intensive products essentially. Since 1996, 92% of Chinese high-tech products have been exported in the form of processing trade, and the percent even exceeded 95.5% after 2002 [1]. Although the study showed that the trade competitiveness index of China's capital-and technology-intensive industries is on the rise, but in general it is still at a comparatively disadvantaged stage, since the achievement of continuous improvement of the total amount of exports is in the case of decline of export prices relative to imports. The quality and added value of exports lack competitive advantage [7]. This shows that the high growth of high-tech products largely due to the growth of processing trade, high quality reflected by high-tech products also cannot represent the true quality of China's products. Amiti & Freund [2] show that: although the quality of China's exports has improved significantly from 1992 to 2005, no evidence shows that China's exports have significant technical improvement after excluding processing trade. In addition, the quality improvement of capital-intensive product and the enhancement of trade competitiveness of China are not due to the traditional R&D or the local enterprises' imitation and improvement of foreign cash management experience and technology, but large introduction of foreign capital and the spillover effect on local enterprises of foreign-funded enterprises, namely processing trade lead by foreign capital [7]. Naughton [3] pointed out that since 2001, more than half of the high-tech products exported by foreign investment company, this indicator has even exceeded 85% since 2003, which means foreign direct investment greatly improve China's export structure. The establishment of multinational companies in China by developed countries, view China as an export platform, which greatly enhance the technological content of Chinese exports. Scholars hold different opinions on spillover effects of foreign capital, but the data showed that the scientific and technological content of China's domestic enterprises is not that high, the so-called high-tech products of China cannot represent the true quality of China's exports.

Previous study showed that the quality growth of China's exports was mainly driven by high-tech products. However, the above analysis shows that the quality of Chinese exports cannot represent the true quality of exports; the increasing quality of high-tech products measured by existing data cannot show the real quality changes of China's high –tech products. Given the above, the question investigated in this paper is: what is the real quality of China's high technology index? In order to obtain the real quality increase degree of China's exports, the contribution of processing trade and foreign-funded enterprises to the net trade must be removed.

2. Research Model

This part we will use exports quality measurement model to analyze respectively and compare product quality index of Chinese high-tech exports (SITC Rev.3, 5-8 classification) before and after the amendment of the net trade. And then we will compare and analyze the revised quality index with the high-tech product quality index of 14 other countries, which also obtained by exports quality measurement model. In order to accurately estimate the quality index of the high-tech exports, this paper establishes a viable estimation model described as follows:

First, the paper improves the exports quality index measurement model established by Hallak and Schott [4] by: (1) Adding net trade, freight and insurance as independent variables; (2) Using Tariff as other variables affecting net trade. The tariff will have an impact on the export product quality: reduction of tariffs to increase competition will increase the rapid upgrade of quality when exports are high-tech products. For non-high-tech products, low tariffs will hinder the quality upgrade (Amiti& Khandelwal,[2]). And tariff rate will also have an impact on trade between two countries. (3) Since the pure price in Hallak and Schott's model can only calculate the measurement range, but not be observed, to compensate for this shortcoming. This paper selects the Fisher index whose price falls in the range interval with the greatest probability, as the proxy variable of non-pure price. The three core formula as follows:

$$\ln P_s^{kk'} = \sqrt{\frac{\sum_z p_z^k q_z^k}{\sum_z p_z^{k'} q_z^k} \times \frac{\sum_z p_z^k q_z^{k'}}{\sum_z p_z^{k'} q_z^{k'}}} \tag{1}$$

$$T_{\mathrm{st}}^{\mathrm{k}} = \Upsilon'_{st} + \gamma_s \ln \hat{P}_{st}^{ko} + \theta_{\mathrm{s}} C_{st}^{\mathrm{ko}} + \beta_{\mathrm{s}} \tau_{\mathrm{st}}^{\mathrm{ko}} - \zeta_{0s}^{ko} - \zeta_{1s}^{ko} t + v_{st}^{ko} \tag{2}$$

$$\ln \hat{\lambda}_{st}^{ko} = -\left(\frac{\hat{\zeta}_{0s}^{ko} + \hat{\zeta}_{1s}^{ko} t}{\hat{\gamma}_s} \right) \tag{3}$$

Formula (1) requires to solute the non-pure price P of various sectors of various countries, involving the export price p and quantity q [†]of each product in various countries and sectors. Formula (2) is the core formula to measure quality; the required data is the most complex, including: net trade $T_{\mathrm{st}}^{\mathrm{k}} = \frac{T_s^k - b_s T^k}{Y^k - T^k}$ [‡];trade cost $\tau_z^k = \frac{cif_z^k - fob_z^k}{fob_z^k}$, In order to complete the calculation, we have to obtain the CIF of each country to the United States(benchmark), which represented by cif_z^k, as well as FOB when goods leave their port, which represented by fob_z^k [§].effective tax rate C_{st}^{ko}: In the selected reference countries, most countries can enjoy MFN exports to the United States or preferential, preferential tax rates, so the tax rate of different countries and sectors are bound to different[**]. The effective exchange rate: during the next empirical process, we need to instead the non-pure price with the instrumental variable-real exchange rate for two-stage least squares, therefore we have to know the real exchange[††] rate of the selected country and the United States of each year.

Second, the paper implements an amendment to the existing net trade, which removes the contribution of processing trade and foreign-funded enterprises to net trade:

Excluding the contribution of processing trade to net trade:

$$T_{st}^{k'} = export_{st}^k (1 - \frac{PT_{et}^k}{\exp ort_t^k}) - import_{st}^k (1 - \frac{PT_{it}^k}{im\,\mathrm{p}\,ort_t^k}) \tag{4}$$

Where, $T_{st}^{k'}$ is the net trade of sector s in country k net trade which excludes processing trade. $export_{st}^k$ and $import_{st}^k$ represent the export and import of sector s in country k respectively. PT_{et}^k and PT_{it}^k are the export and import of processing trade. $\frac{PT_{et}^k}{export_t^k}$ and $\frac{PT_{it}^k}{import_t^k}$ denote the proportion of processing trade export and import in total exports respectively.

According to the above formula, an important assumption in the amended model is that the proportion of processing trade exports of sector s in country k in total exports in sector s equals to the proportion of

---

[†] Data resource: UN COMTRADE(United Nations Commodity Trade Statistics Database) http://comtrade.un.org/db/

[‡] Data resource: UN COMTRADE(United Nations Commodity Trade Statistics Database)

[§] Data resource: WB(World Bank) http://data.worldbank.org/

[**] Data resource: WB(World Bank)

[††] Data resource: WB(World Bank)

processing trade in total exports, so is the import.

Continue to amend the revised net trade described above, eliminating the foreign contribution to the net trade. Since China's processing trade is mainly dominated by foreign capital, two amendments have some overlap. For this reason, this article firstly removes the processing part in foreign import and export volume, and then amends the revised trade volume by excluding the revised foreign import and export volume.

$$T_{st}^{k''} = export_{st}^{k'}(1 - \frac{FDI_{et}^{k}}{export_{t}^{k'}}) - import_{st}^{k'}(1 - \frac{FDI_{it}^{k}}{import_{t}^{k'}}) \tag{5}$$

Where, $T_{st}^{k''}$ is the net trade after two amendments. $export_{st}^{k'}$ and $import_{st}^{k'}$ denote export and import of sector s in country k after two amendments respectively; $\frac{FDI_{et}^{k'}}{export_{t}^{k'}}$ and $\frac{FDI_{it}^{k'}}{import_{t}^{k'}}$ represents the proportion of foreign direct investment in exports and imports respectively; $FDI_{et}^{k'}$ and $FDI_{it}^{k'}$ are export and import volume of foreign enterprises after excluding processing trade.

The amendment also addresses an important assumption, the proportion of export volume in total export volume after excluding processing trade of sector s equals to the proportion of export volume in total volume after excluding processing trade of country k, as well as import volume.

Finally, production created by high-tech industry is much more than that created by low-level industry, which has more far-reaching impact on the development of industry and economy and more representative of quality. Taking into account the different technological content of products, the quality degree of change will also be inconsistent. In order to clear the quality change situation of high-tech products in sample period, we divided manufacturing products of SITC Rev.3,5-8 classifications into high technology manufacturers, medium technology manufactures and low technology manufacturers [‡‡], in which high-tech products are mainly electronic products, whose quality index is the study objection.

3. Product Quality Index Analysis

Using product quality index model to measure amended net trade, we get the quality index of high-tech products before and after amendments, which can be seen in figure 1:

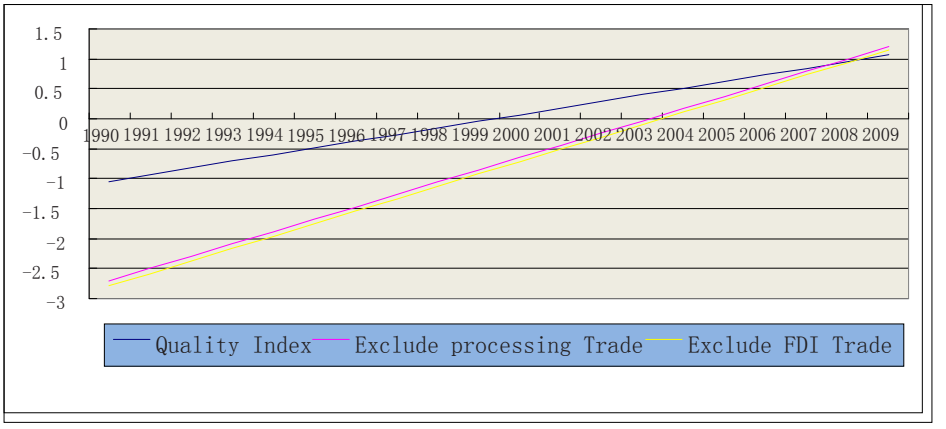

Figure1. **High-tech products before and after excluding processing trade and foreign capital contribution**

[‡‡] According to Lall (2000).

Figure1 shows that the quality starting point is lower after excluding the processing trade and foreign contribution, decreasing from -1 to -2.8. While the growth rate increased, from approximately 2 units to 4units. As we can see, after removing contributions made by processing trade and foreign capital, the quality of China's high-tech products decreased significantly. The decreasing rate of amended quality index declines gradually from 1990 to 2008, and then catch up to quality index before amendment, which means the processing trade products really enhance China's export products, especially the quality of the high-tech products. Quality of China's export products, especially high-tech products can not represent the real quality level, since it hidden under the guise of processing trade, especially processing trade led by FDI. In addition, the revised index has caught up, which shows the spillover effect of foreign-funded enterprises is positive, the Chinese began to introduce and study foreign advanced management experience and technology, and then into their own advantage.

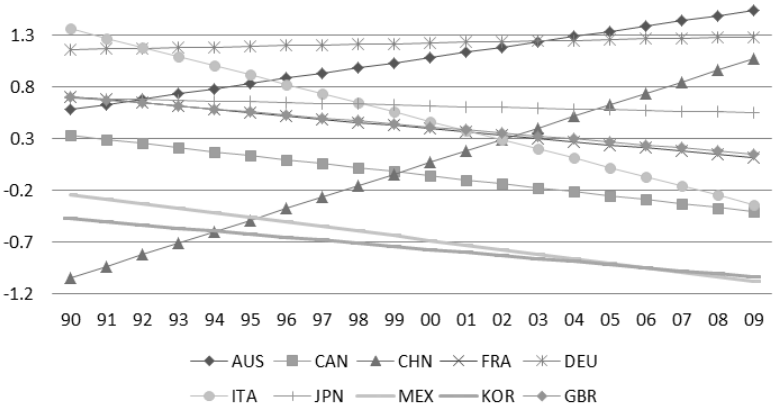

Figure2. **Quality comparison of high-tech products in China and OECD countries**

Figure 2 shows upward trends in quality indexes of Germany and Australia, and that of other countries have different levels of decline, but marginally. Quality index of Japan has been stable relatively, no significant change. Quality index of China's high-tech products is lower than all selected OECD countries. However, Quality of China's high-tech products has grown rapidly during last 20 years, and exceeded France, Japan, Britain and Italy and so on in 2009, Ranked third, only behind Australia and Germany.

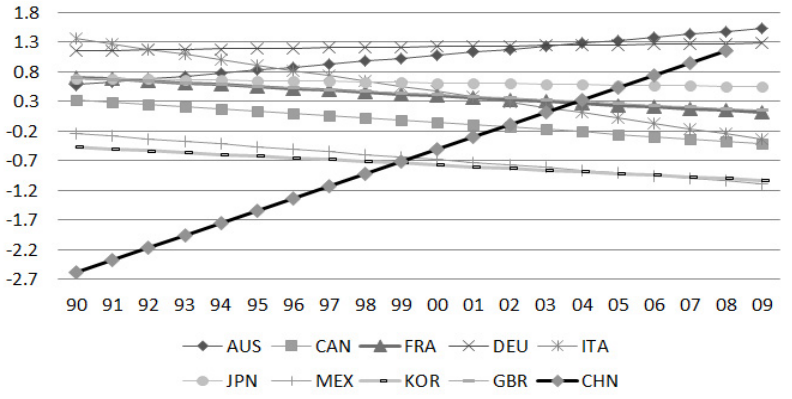

Figure3. **Revised quality comparison of high-tech products in China and OECD countries**

We can see from figure 3, the quality starting point of Chinese products is still the lowest among all the

OECD countries, and it's even lower than that before revising. Even growth rate is higher, due to the lower starting point, amended quality of China's high-tech products exceeded that of South Korea and Mexico until 1999 and 2000 respectively, a delay of five years compared with when it didn't revise. In addition, quality of China's high-tech products caught up with Germany in 2009, behind Australia.

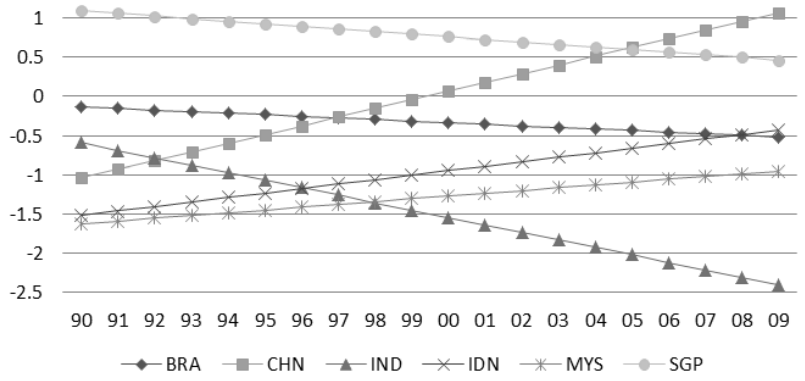

Figure4. **Quality comparison of high-tech products in China and non-OECD countries**

It can be seen from Figure 4, in non-OECD countries, quality of high-tech products in China, Malaysia and Indonesia has been increasing between 1990 and 2009, among which, growth rate of China's was greatest, which exceeded Singapore in 2005, ranking first and followed by Indonesia and Malaysia. Indonesia exceeded Brazil, ranked third, only behind China and Singapore. Singapore, India and Brazil decreased with varying degrees during sample interval, among which, Singapore and Brazil had a gentle decline, while India was showing a rapid decline.

The above analysis shows that a member of the ASEAN, quality of Singapore has been topped, but showing a slow downward trend, even caught up by China in 2005. With the enhancement of quality of high-tech products in Malaysia and Indonesia, it is possible for them to catch up with Singapore. China, India and Brazil are member countries of the BRIC, among which, China's high-tech products quality is better than that of India and Brazil, all of which are emerging market countries. China's high-tech products quality catch up with India in1992, and Brazil in 1997.

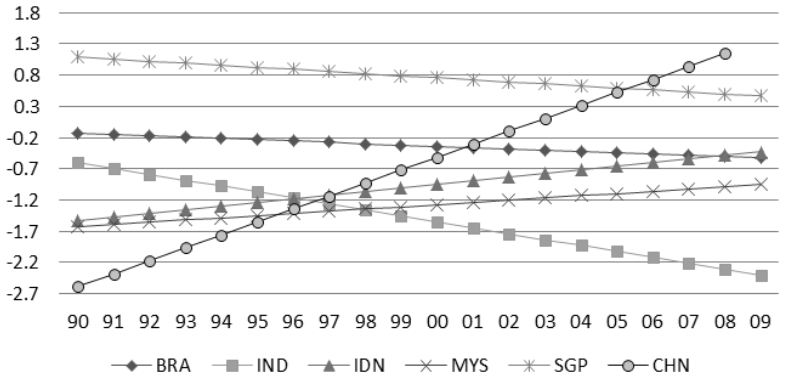

Figure 5. **Revised quality comparison of high-tech products in China and non-OECD countries,1990-2009**

It can be seen from Figure 5, revised quality starting point down to the last place from the fourth place

before amendment, decreased about 1.5 unit. Due the changes in the inercept and slope, quality of China's high-tech products ranked the last in the non-OECD countries before 1996. For the first time, it exceeded Malaysia in 1996, and then exceeded Brazil in 2001, ranked second place, and exceeded Singapore to become the first in 2005. Compared to ranking before amendment, it delayed five years before exceeding Brazil, but one year in advance to exceed Singapore.

4. Conclusion

This paper uses the improved Hallak & Schott quality index model to measure quality of high-tech products in China and other selected 14 countries during 1990 and 2009. The main conclusions are as follows: First, the initial value of the quality of Chinese high-tech products was low, but growing fast: it caught up with India in 1992, Brazil in 1997, was in first place in the BRIC group. In addition, it exceeded Singapore in 2005, and France, Japan, Britain, Italy and other developed countries in 2009, ranked No. 3, behind Australia and Germany. The quality of China’s high-tech prodcuts enhanced 2 units from 1990 to 2009. Second, this research takes into account the truth that foreign investment-oriented processing trade occupied a large part of China's exports of high-tech products, more than 90% of which are in the form of processing trade. This paper excludes the contribution of processing trade made to net trade, and further excluds the contribution made by foreign-funded addition to the processing trade to net trade. We find that there is a significant decline in the quality index of Chinese high-tech products from 1990 to 2008 after amendment, but the downward trend was gradually reduced, and cught up in 2009. Although the quality of the initial value has declined, the growth rate has increased.

The results analysis shows that processing trade, especially foreign-led processing trade plays a significant role in the promoting the quality of Chinese high-tech products, resulting in the overestimation of quality. The reason why the revised quality index exceeded the quality index before amendment, is because the technology spillover effect of foreign-funded enterprises and the increase investment into China’s R&D, research and development capacity enhances, as well as the ability to learn advanced technolgies and management experience.

5. Policy Implications

Since the reform and opening up, China’s economy has achieved rapid growth. Foreign-led processing trade is an important driving factor in the process of economic growth. With the increase of total amount of FDI and the rising of industrial level, the processing trade volume has occupied much of China's foreign trade. The development of processing trade can expand employment, optimize the industrial structure, promote GDP growth. The rapid expansion of foreign-oriented processing trade lead to the enhancement of the quality of Chinese exports rely heavily on the quality improvement of imported intermediate goods, hinders the independent innovation and long-term development of local enterprises. Besides, improvement of dependence on foreign trade has deepeded China's foreign trade insecurity. Based on this background as well as the results of the study, this paper proposes the following policy recommendations:

First, to promote the sustained, rapid and healthy economic development, improving the quality of export products from the endogenous. The development of a country's economy means government can offer much more investment in R&D, infrastructure construction, and the government policy support can support the improvement of the quality of Chinese exports. To this end, promoting China's sustained, rapid and healthy economy development is particularly important.

Second, increasing R&D investment, and encouraging enterprises to innovate. Domestic enterprises should actively increase investment in research so as to improve their own R&D and innovation capability, enhancing the absorptive capacity of advanced production technology and management experience of foreign-funded enterprises. In addition, companies should provide a more humane employment system, as well as a good working environment to attract the best talent. Government should continue to encourage independent

research, increase investment in R&D to enhance their own innovation capability.

Finally, a scientific and rational utilization of foreign capital should be applied in order to increase spillovers of foreign investment. Active use of the positive spillover effects of foreign investment and full use of domestic resources and markets to attract FDI to transfer high value-added processing sectors to China. And strive to learn advanced foreign technology and management experience, but avoid blind pursuit of foreign investment. Improving the international competitiveness of domestic enterprises fundamentally to establish the positive feedback mechanism between domestic and foreign-funded enterprises.

Acknowledgements

The authors would like to thank Dr. Peter Wolcott, Professor at University of Nebraska at Omaha for his careful polishing of the English writing. This research is funded by 1) The office of Research and Creative Activity (ORCA) and the Office of Graduate Studies (OGS) of the University of Nebraska at Omaha, under name “Grant Support for Graduate Research and Creative Activity (GRACA)”, and 2) the University of Nebraska Foundation, under the grant title “Strengthening and Elevating International Partnerships across Disciplines: India, China, Germany and Norway”.

References

[1] Gaulier, G.,Lemoine, F. & Unal-Kesenci, D. China’s Integration in East Asia: Production Sharing, FDI and High-Tech Trade. *CEPII Working Paper* No.2005-09,2005.

[2] Amiti, M. & C. Freund. The Anatomy of China's Export Growth .*Policy Research Working Paper* 4628, The World Bank Development Research Group,Trade Team,2008.

[3] Naughton, B. *The Chinese Economy: Transitions and Growth*. Cambridge MIT Press,2007.

[4] Hallak, Juan C. & Schott Peter K. Estimating Cross-Country Differences in Product Quality.*NBER Working Paper*, No. 13807,2009.

[5] Lall, S. The Technological Structure and Performance of Developing Country Manufacture Exports, 1985-98.*Oxford Development Studies*, Taylor and Francis Journals,2000,vol.28(3).

[6] Yang Yao,Linfeng Zhang. Chinese Local Enterprises Export Competitiveness and Technological Changes, *World Economy*, 2008,vol.(3).

[7] Xianhai Huang. Measurement and Analysis of China's Manufacturing Trade Competitiveness.*International Trade Issues*,2006,vol.(5):12-16.

[8] Zhixiong Guan. The Strength of "Made in China" from the U.S. Market: IT Products. *International Economic Review*,2002,vol.(7-8):5-12.

[9] Erik Baark China's software industry *Information Technology for Development* Vol. 5, Iss. 2, 1990

[10] Zhang Bingxun, Ian O. Angell Decision support systems in China: A clash of cultures *Information Technology for Development* Vol. 5, Iss. 2, 1990

[11] Edgar Huang Flying freely but in the cage -an empirical study of using internet for the democratic development in China *Information Technology for Development* Vol. 8, Iss. 3, 1999