The rise of China's manufacturing sector: challenges and opportunities for ASEAN-5

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Abstract

This study investigates the trends of manufacturing export from China and ASEAN-5 (Indonesia, Malaysia, Philippines, Thailand, and Singapore). The Balassa revealed comparative advantage (RCA) method was used to study the trade flows from these nations. The strength of the export specialization of the countries was measured using the Spearman's rank correlation coefficient. The study was conducted using the Standard International Trade Classification (SITC) product categories at three-digit level for the period 1993-2004. The results showed that China is not only active in labor and resource-based industries, but is also moving up in the innovation value chain—that is, it is increasing its presence in technology and knowledge-intensive industries as well. The dual-strategy adopted by China has serious implications on the manufacturing industries in ASEAN-5. The paper discusses the strategies and policies to enhance the competitiveness of the manufacturing sector in ASEAN-5.

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1. Introduction

The opening of China to the outside world since 1979 has significantly influenced the growth of its economy. Over the last decade efforts were taken in China to reduce tariffs, decentralize trade, unify the dual exchange rates (in 1994), and remove exchange controls on current account transactions (in 1996) [Adhikari and Yang 2002]. The standard of living in China has improved due to market reforms, which have increased China's demand for consumer goods, energy, technology, education, and other services.

China's participation in the global economy has also transformed the global industrial and trade landscape. China's inclusion in the global market economy has

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increased the degree of competition in the global manufacturing sector. The large labor market in China puts it in a better position to pursue economies of scale. The large market potential and the possibility of economies of scale have helped China attract large foreign direct investment (FDI). For example, China's export trade has grown from US$ 10 billion in 1978 to US$ 278 billion in 2000. China's trade to gross domestic product (GDP) ratio increased from 10 percent in the early 1970s to 40 percent in the late 1990s.

In contrast, the ASEAN's share of world merchandise exports also increased over the last decade. In 2000 the share of merchandise exports increased to 6.9 percent (US$ 89.89 billion), while in 1990 it was 4.3 percent (US$ 26.31 billion). Among the leading exporting nations in the ASEAN region were Singapore, Malaysia, Thailand, Indonesia, and the Philippines. ASEAN's top five export markets are the United States, the European Union, Japan, China (including Hong Kong), and South Korea.

China and ASEAN-5 have had a long history of bilateral economic cooperation. Most of ASEAN-5's exports to China include machines and equipment (from Singapore and the Philippines), rubber, palm oil, timber and wood-related products (Malaysia and Indonesia), and rice and sugar (Thailand). China's exports to the ASEAN region in the early 1980s were mainly food products. In the late 1980s China's exports shifted to manufacturing products.

While the trade between China and ASEAN-5 has been on an upward trend, there is growing concern that China's focus on developing its manufacturing sector may impact the industries in the ASEAN region. There is also the concern that the FDI that helped develop the ASEAN region may be diverted to China, given the large market share and cheaper factor costs in China. FDI figures show that there is indeed a shift in inflow of FDI from the ASEAN region to China. In 1990, ASEAN accounted for 30 percent of FDI in Asia while China accounted for 18 percent. In 2000, ASEAN FDI share was only 10 percent, while China's FDI share increased to 30 percent.

This paper's primary objective is to empirically examine the trade flows in the manufacturing sector between China and ASEAN-5 countries. We will determine whether China's entry into the global economy has eroded the competitiveness of the manufacturing sectors in the ASEAN-5. Our discussion will focus on the following manufacturing sectors: labor-intensive and resource-based, low-skilled / technology, medium-skilled / technology, and high-skilled / technology.

This paper is organized as follows. A brief literature review on the impact of China's trade on ASEAN exports is given in section 2. Section 3 describes the empirical measures and the data used in this paper. Section 4 reports the findings, while section 5 discusses the policy implications and strategies to enhance the competitiveness of ASEAN exports. Section 6 provides concluding remarks.

2. Literature review

In recent years, a number of studies have examined the impact of China's growing openness to ASEAN's export competitiveness. Most of the studies have shown that China's growing openness has had a negative impact on ASEAN export, especially in labor-intensive sectors. For example, Herschede [1991] examined the competitiveness of ASEAN, China, and several newly industrialized countries (NIC) from East Asia in ten SITC categories. The study showed that the NICs performed very well in their exports to Japan. The study also concluded that China enjoyed a significant competitive advantage in Japan. Further, China's exports in eight of the ten SITC categories had a negative impact on exports of ASEAN countries.

Voon [1998] showed that while both ASEAN and China saw an increase in export of manufactured goods to the United States from 1980 to 1994, the share of Chinese export exceeded that of ASEAN, especially in labor-intensive sectors. However, during the same period, smaller ASEAN economies such as Singapore and Malaysia had become more competitive than China in value-added manufactured products. Liu and Yao [1999] found similar results. They showed that while China has competitive advantage in low-tech and labor-intensive sectors, it lacks comparative advantage in high-tech and knowledge-intensive sectors. The reason is that most Chinese industries are still in an infant stage of adopting new technology from more developed countries.

More recent studies by Weiss and Shanwen [2002] showed that the Chinese government's push to transform China's industrial and manufacturing industries to be more technology-intensive and knowledge-driven are bearing fruits to the nation's industries. Chinese industries (especially in textile and garments) have increased market share at the expense of ASEAN in highly developed markets such as the United States, the European Union, and Japan. This study also found that ASEAN countries have lost market share for primary products, especially in resource-based manufacturing sector, to China. However, ASEAN continued to expand its specialization in electrical and electronics products.

Mckibbin and Woo [2003] found that Southeast Asian manufacturing exports faced stiff competition from China from two fronts. First, China is competing in both labor-intensive and technology-intensive sectors. With significant investment in science, technology, and innovation in the last two decades, Chinese industries have gained market share in traditional ASEAN markets such the United States, the European Union, and Japan. With better technology and larger labor pool, Chinese industries not only produce final products but are also a source of cost-effective intermediate goods that are integral part of innovation cycle of products and services from more advanced countries. Second, China's participation in the global economy has increased not only competition in the manufacturing sector, but also competition for foreign direct investments. The ability to produce products and services cost-effectively due to a large labor pool and the adoption of more advanced technology

has made China a more attractive destination for FDI than ASEAN. The authors argue that this trend can lead to significant welfare loss to ASEAN if countermeasures are not taken to enhance the competitive position of industries in the ASEAN region.

3. Methodology and data

In this section, we will describe the empirical measures used to assess the trade dynamics between China and ASEAN-5. The data used in this study, as well as the source of the data, are given in this section.

The trade flow between China and selected ASEAN countries were based on these countries' share in world exports and imports. Here, we calculate the given country's export/import of a product as a share of world exports/imports. Thus, a country's exports share (CES) is defined as:

$$CES_{ij} = \left(\frac{x_{ij}}{\sum_l x_{il}} \right) \times 100 \tag{1}$$

where, CES_{ij} is the export share of product i for country j, x_{ij} is the export value of product i of country j, and Σx_{il} is the value of the world export of product i.

Next, we measure the extent of trade specialization in the different products for the sample countries using the Balassa revealed comparative advantage (RCA) measure [Balassa 1965]. The RCA measure for product i and country j is as follows:

$$RCA_{ij} = \frac{\dfrac{x_{ij}}{x_{tj}}}{\dfrac{X_{iw}}{X_{tw}}} = \frac{x_{ij}}{X_{iw}} \times \frac{X_{tw}}{x_{tj}} \tag{2}$$

where x_{ij} is the export value of country i of product j, x_{tj} is the total export of country j, X_{iw} is the total world export value of product i, and X_{tw} is the total world export. This index measures the degree of comparative advantage of a country by calculating the country's share in the export of a given product category relative to the share of world export. For example, if $RCA_{ij} > 1$, this indicates that country j has comparative advantage in product i. If $RCA_{ij} < 1$, country j has a comparative disadvantage in product i.

Based on the RCA measure, the major manufacturing export products are ranked and compared between countries. To assess the strength of the export specialization between the countries, we used the Spearman's rank correlation coefficient (SRCC).

The SRCC of the RCA in this study compares the ranked data for China and the selected ASEAN countries. The SRCC ranges from −1 to +1. If $SRCC = -1$, it suggests that the export specializations between China and the selected ASEAN country complement each other. If $SRCC = +1$, then China's and the selected ASEAN country's export specializations are positively correlated. Hence, China and the selected country have total agreement in terms of export specialization, which could intensify competition between them. A value of 0 would indicate that there is no correlation between the two countries.

In this study, we used country export and import data from the COMTRADE trade statistic database for the sample period 1993-2004. The data were obtained from the International Trade Center. The data is classified based on the Standard Industrial Trade Classification (SITC). This study used disaggregated data at three-digit SITC level for the following manufactured products: chemicals (SITC 5), semi-manufactured products (SITC 6), machinery and transportation (SITC 7), and clothing and other consumer products (SITC 8).

4. Empirical findings

In this section, the following empirical results will be presented for China and ASEAN-5: export/import share in the world, revealed comparative advantage measures, and the degree of association in export specialization. The empirical analysis will be conducted for the following: (a) labor and resource-based, (b) low-skilled and technology, (c) medium-skilled and technology, and (d) high-skilled and technology sectors.

4.1. Export and import shares

Based on Table 1, China and ASEAN-5 have accounted for almost 20 percent of world exports of labor and resource-based products in 2004. Evidently, China has been the leading exporter of labor and resource-based products compared to other ASEAN-5 countries. China's share in the total labor and resource-based products of the world has increase from 8.6 percent to 17.5 percent between 1993 and 2004. This translated to an export growth rate of 12.3 percent. Among the ASEAN-5, Indonesia is the leader in this sector, followed by Thailand and Malaysia.

Singapore's share of the labor and resource-based products has been decreasing over the years. The downtrend is attributed to the limited natural resources and the nation's shift toward high-skilled and technology-based products. Indicators show that China's share in import of labor and resource-based products is stable throughout the sample period, with an average of 3 percent per annum. Singapore's import of labor and resource-based products is more than that of other ASEAN countries. However, in recent years, Singapore's share has declined.

Table 1. Export and import share in world labor and resource trade (%): China and ASEAN-5

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Export average growth rate
China	8.6[3.1]	9.8[3.2]	9.5[3.2]	9.5[3.5]	12.6[3.4]	12.6[3.2]	12.8[3.3]	12.1[3.1]	12.6[3.1]	14.5[3.2]	15.8[3.2]	17.5[3.2]	12.3
Indonesia	3.2[0.5]	2.8[0.5]	2.5[0.5]	2.7[0.4]	3.4[0.4]	2.9[0.3]	4.0[0.2]	2.5[0.3]	2.3[0.2]	2.1[0.2]	1.8[0.2]	1.8[0.2]	2.7
Malaysia	1.3[0.7]	1.3[0.7]	1.3[0.8]	1.5[0.7]	1.5[0.6]	1.3[0.4]	1.4[0.5]	1.2[0.4]	1.1[0.4]	1.1[0.4]	1.0[0.3]	1.1[0.4]	1.3
Philippines	0.4[0.3]	0.4[0.3]	0.4[0.3]	0.6[0.4]	0.6[0.4]	0.6[0.3]	0.6[0.3]	0.6[0.3]	0.5[0.3]	0.5[0.3]	0.4[0.3]	0.3[0.3]	0.5
Singapore	1.0[1.5]	1.0[1.5]	0.9[1.4]	0.9[1.4]	0.9[1.3]	0.7[0.9]	0.7[0.9]	0.6[0.9]	0.5[0.7]	0.5[0.7]	0.5[0.7]	0.5[0.7]	0.7
Thailand	2.1[0.8]	2.1[0.7]	2.2[0.8]	1.9[0.7]	1.9[0.6]	1.8[0.5]	1.9[0.5]	1.6[0.5]	1.6[0.5]	NA	1.4[0.5]	NA	1.9

Note: Figures in brackets indicate the import share in the total world import.
Source: Author's calculation based on COMTRADE trade statistic database.

Table 2. Export and import share in world low-skilled and technology-intensive trade (%): China and ASEAN-5

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Export average growth rate
China	2.4[7.6]	3.2[5.5]	4.7[3.4]	4.4[3.4]	5.3[2.9]	5.2[2.7]	5.4[3.0]	6.4[3.4]	6.4[3.9]	7.0[4.5]	8.2[5.8]	9.7[5.0]	5.7
Indonesia	0.5[1.5]	0.4[1.4]	0.4[1.4]	0.5[1.5]	0.4[1.5]	0.5[0.8]	0.5[0.7]	0.5[1.1]	0.4[1.0]	0.4[0.9]	0.4[0.7]	0.3[0.9]	0.4
Malaysia	0.6[1.8]	0.6[2.2]	0.7[2.1]	0.7[2.2]	0.7[2.3]	0.7[1.3]	0.6[1.4]	0.5[1.1]	0.6[1.1]	0.6[1.1]	0.6[1.1]	0.8[1.2]	0.7
Philippines	0.1[0.8]	0.1[0.9]	0.1[0.8]	0.1[0.9]	0.1[0.8]	0.1[0.5]	0.1[0.6]	0.1[0.5]	0.1[0.5]	0.1[0.5]	0.1[0.5]	0.1[0.4]	0.1
Singapore	1.2[2.7]	1.3[2.4]	1.1[2.5]	1.2[2.9]	1.2[2.8]	1.0[2.0]	0.8[1.8]	0.8[1.4]	0.8[1.2]	0.7[1.2]	0.6[1.1]	0.6[1.1]	0.9
Thailand	0.5[2.4]	0.6[2.4]	0.7[2.8]	0.7[2.7]	0.6[2.1]	0.6[1.4]	0.7[1.9]	0.7[1.4]	0.6[1.4]	NA	0.8[1.6]	NA	0.7

Note: Figures in brackets indicate the import share in the total world import.
Source: Author's calculation based on COMTRADE trade statistic database.

The export and import shares for low-skilled and technology-intensive products are given in Table 2. From Table 2, we observe that China's share in world export increased from 2.4 percent in 1993 to 9.7 percent in 2004—an average annual growth rate of 5.7 percent. Import share also increased over the same sample period. However, the import share was significantly smaller than the export share. The ASEAN-5 countries' export and import shares have been relatively stable over the sample period, but significantly lower than China's.

Table 3 provides the export and import shares for medium-skilled and technology-intensive industries for China and ASEAN-5. China's share in world export in this sector increased from 1 percent in 1993 to almost 5 percent in 2004. On the other hand, China's import share has relatively increased over the sample period—from 3.8 percent in 1993 to 5.6 percent in 2004. The export and import shares for ASEAN-5 have been relatively consistent over the sample period, with Singapore leading the other ASEAN-5 countries in this sector.

The export and import shares for high-skilled and technology-intensive sectors for China and ASEAN-5 are given in Table 4. China's share in this sector has increased significantly over the sample period—from 1.8 percent in 1993 to 11.1 percent in 2004. The import share for high-skilled and technology-intensive products also increased from 2.9 percent in 1993 to 10.1 percent in 2004. Singapore's export share was higher than that of China for the sample period. Import share for Singapore was on a downtrend in the late 1990s, and this continued to 2004. Malaysia is the second ASEAN country to register a high export share in this sector, although it was significantly lower than that of China and Singapore. All other ASEAN countries' export and import shares were relatively low compared to that of China, Singapore, and Malaysia.

4.2. Revealed comparative advantage

Table 5 shows the ranking of the labor and resource-based products for China and ASEAN member countries for the years 1993, 1995, 1997, 1999, 2001, 2003, and 2004. The RCA was measured for products at the SITC three-digit level. The empirical results confirm the dominance of China and Indonesia in resource-based products. In the case of China, 22 of the 37 labor and resource-based industries have maintained a comparative advantage.

Table 3. Export and import share in world medium-skilled and technology-intensive trade (%): China and ASEAN-5

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Export average growth rate
China	1.0[3.8]	1.2[3.5]	1.4[3.1]	1.5[3.1]	1.7[2.6]	1.8[2.3]	2.1[2.5]	2.6[3.0]	2.9[3.5]	3.4[4.2]	3.8[5.0]	4.5[5.6]	2.3
Indonesia	0.2[1.2]	0.3[1.1]	0.3[1.2]	0.3[1.2]	0.4[1.1]	0.2[0.6]	0.2[0.4]	0.3[0.5]	0.2[0.4]	0.3[0.4]	0.3[0.4]	0.3[0.4]	0.3
Malaysia	0.5[1.5]	0.6[1.7]	0.6[1.8]	0.6[1.7]	0.6[1.6]	0.6[0.9]	0.6[1.0]	0.7[1.2]	0.6[1.1]	0.6[1.0]	0.6[0.9]	0.7[1.0]	0.6
Philippines	0.1[0.5]	0.1[0.5]	0.1[0.5]	0.1[0.7]	0.2[0.6]	0.2[0.4]	0.2[0.4]	0.3[0.4]	0.2[0.3]	0.2[0.3]	0.2[0.3]	0.2[0.2]	0.2
Singapore	1.1[2.1]	1.4[2.2]	1.4[2.2]	1.4[2.2]	1.3[2.1]	1.1[1.6]	1.1[1.6]	1.2[1.7]	1.1[1.4]	1.0[1.4]	1.0[1.2]	1.0[1.4]	1.2
Thailand	0.6[1.7]	0.6[1.7]	0.7[1.9]	0.6[1.8]	0.6[1.3]	0.6[0.8]	0.7[0.8]	0.8[0.9]	0.8[0.9]	NA	0.9[1.0]	NA	0.7

Note: Figures in brackets indicate the import share in the total world import.
Source: Author's calculation based on COMTRADE trade statistic database.

Table 4. Export and import share in world high-skilled and technology-intensive trade: China and ASEAN-5

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Export average growth rate
China	1.8[2.9]	2.2[3.1]	2.5[2.9]	2.7[2.9]	3.1[3.0]	3.3[3.3]	3.5[3.9]	4.1[4.5]	5.1[5.5]	6.9[7.1]	9.0[8.8]	1.1[10.1]	4.6
Indonesia	0.3[0.7]	0.4[0.6]	0.4[0.7]	0.4[0.7]	0.4[0.6]	0.3[0.3]	0.4[0.3]	0.7[0.4]	0.6[0.4]	0.6[0.4]	0.5[0.3]	0.5[0.4]	0.5
Malaysia	2.8[2.2]	3.3[2.5]	3.5[2.8]	3.6[2.7]	3.5[2.6]	3.2[2.2]	3.7[2.3]	3.8[2.4]	3.6[2.2]	3.8[2.5]	3.5[2.3]	3.4[2.3]	3.5
Philippines	0.2[0.5]	0.3[0.5]	0.3[0.5]	1.0[1.1]	1.3[0.8]	1.6[1.2]	1.9[1.1]	1.7[0.9]	1.5[0.9]	1.7[1.2]	1.5[1.1]	0.8[1.1]	1.2
Singapore	5.2[4.6]	6.2[5.0]	6.6[5.1]	6.8[5.1]	6.4[5.0]	5.5[3.8]	5.5[3.9]	5.7[4.0]	5.3[3.7]	5.4[3.7]	5.4[3.5]	5.7[3.8]	5.8
Thailand	1.1[1.5]	1.3[1.7]	1.4[1.8]	1.5[1.7]	1.5[1.5]	1.4[1.0]	1.4[1.2]	1.5[1.3]	1.4[1.4]	NA	1.5[1.3]	NA	1.4

Note: Figures in brackets indicate the import share in the total world import.
Source: Author's calculation based on COMTRADE trade statistic database.

Table 5. RCA of labor and resource-based products: China and ASEAN-5

China	1993	1995	1997	1999	2001	2003	2004
831 Trunks and cases	8.6	8.2	8.6	8.4	6.0	4.9	4.5
894 Baby carr / toy / game / sport	6.9	6.2	6.7	6.4	5.6	4.9	4.4
842 Women / girl clothing wven	6.8	5.5	5.4	5.0	3.5	3.0	2.8
848 Headgear / non-text clothg	6.7	7.2	7.4	6.8	6.1	5.4	4.9
658 Made-up textile articles	6.6	6.1	6.2	5.7	4.0	3.5	3.4
851 Footwear	6.1	5.2	6.2	6.5	4.5	3.5	3.5
652 Cotton fabrics, woven	5.3	5.0	4.5	4.1	3.0	3.1	2.8
666 Pottery	5.1	5.9	3.5	3.6	5.0	4.2	4.1
845 Articles of apparel nes	4.8	4.3	4.8	4.9	3.6	2.9	2.8
843 Men / boy wear knit / croch	3.8	3.3	4.5	5.0	3.4	3.3	3.3
613 Furskins tanned / dressed	3.7	2.3	1.6	2.8	2.9	2.1	2.7
846 Clothing accessories	3.3	3.0	3.9	3.2	2.8	2.7	2.7
844 Women / girl wear knit / cro	3.3	3.1	5.9	5.0	3.2	3.4	3.4
654 Woven textile fabric nes	3.3	3.3	2.7	2.5	2.2	2.0	1.9
655 Knit / crochet fabrics	3.1	3.1	2.2	2.3	2.3	2.5	2.3
635 Wood manufactures nes	2.5	2.4	2.2	2.3	2.0	1.8	1.7
659 Floor coverings etc.	2.4	1.8	1.5	1.7	1.1	0.9	0.9
651 Textile yarn	2.3	2.1	2.2	2.3	1.9	1.7	1.5
653 Man-made woven fabrics	1.9	2.3	2.5	2.4	2.5	2.6	2.9
661 Lime / cement / constr mat'l	1.7	2.5	3.0	2.3	1.8	1.5	1.4
821 Furniture / stuff furnishg	1.3	1.2	1.4	1.7	1.6	1.6	1.7
656 Tulle / lace / embr / trim etc	1.1	1.7	1.7	1.2	1.1	1.3	1.6
612 Leather manufactures	0.9	2.7	2.0	2.1	3.0	2.6	2.5

Source: Author's calculation based on COMTRADE trade statistic database.

Table 5. RCA of labor and resource-based products:
China and ASEAN-5 (continued)

Thailand		1993	1995	1997	1999	2001	2003	2004
612	Leather manufactures	14.1	11.8	11.5	11.1	6.4	2.9	N.A
843	Men / boy wear knit / croch	5.6	5.8	5.2	5.7	4.0	3.2	N.A
831	Trunks and cases	5.0	4.0	3.9	4.4	3.3	1.4	N.A
848	Headgear / non-text clothg	4.8	5.4	3.3	3.4	2.9	3.2	N.A
666	Pottery	3.8	3.1	1.8	1.8	3.6	3.8	N.A
851	Footwear	3.6	5.2	3.2	2.6	1.8	1.5	N.A
667	Pearls / precious stones	3.3	2.9	7.1	4.3	1.1	1.2	N.A
894	Baby carr / toy / game / sport	3.3	2.5	1.9	1.7	1.6	1.3	N.A
842	Women / girl clothing wven	3.2	3.1	2.0	1.8	1.2	1.0	N.A
845	Articles of apparel nes	3.1	2.5	2.4	2.4	2.0	1.5	N.A
635	Wood manufactures nes	2.8	2.3	2.2	2.1	1.8	1.5	N.A
844	Women / girl wear knit / cro	2.6	2.7	1.5	2.0	1.5	1.1	N.A
653	Man-made woven fabrics	2.1	1.9	2.1	2.1	1.7	1.5	N.A
821	Furniture / stuff furnishg	2.0	1.6	1.6	1.5	1.3	1.2	N.A
658	Made-up textile articles	1.8	1.3	1.6	1.4	1.0	0.8	N.A
656	Tulle / lace / embr / trim etc	1.8	1.6	1.7	1.9	2.0	1.9	N.A
611	Leather	1.7	1.8	2.2	1.5	1.5	1.7	N.A
651	Textile yarn	1.5	1.6	2.1	1.9	1.7	1.7	N.A
652	Cotton fabrics, woven	1.3	1.2	1.8	1.7	1.3	1.1	N.A
664	Glass	1.2	1.0	1.2	1.3	1.0	1.3	N.A
661	Lime / cement / constr mat'l	1.2	1.4	2.5	3.7	3.0	2.2	N.A
846	Clothing accessories	1.2	1.1	0.9	0.8	0.6	0.6	N.A

Source: Author's calculation based on COMTRADE trade statistic database.

Table 5. RCA of labor and resource-based products:
China and ASEAN-5 (continued)

Indonesia	1993	1995	1997	1999	2001	2003	2004
634　Veneer / plywood / etc	44.7	36.7	39.8	25	17	14.3	11.7
656　Tulle / lace / embr / trim etc	13.9	2.0	2.1	2.0	1.9	1.1	1.1
635　Wood manufactures nes	10.6	12.8	11.7	10.3	8.1	7.6	7.3
851　Footwear	7.3	8.7	7.7	7.7	4.9	4.0	4.4
653　Man-made woven fabrics	6.8	6.0	5.5	6.7	5.7	5.5	4.6
843　Men / boy wear knit / croch	6.8	6.1	4.4	6.7	4.0	3.0	3.5
842　Women / girl clothing wven	5.1	4.4	5.0	5.6	4.1	3.9	4.1
844　Women / girl wear knit / cro	4.0	3.1	1.8	2.6	2.9	2.3	2.6
845　Articles of apparel nes	3.4	2.8	2.4	3.1	2.8	2.7	2.7
652　Cotton fabrics, woven	3.1	2.5	61	62.7	3.0	2.5	2.5
821　Furniture / stuff furnishg	3.0	3.2	3.0	3.9	3.3	3.4	3.2
658　Made-up textile articles	3.0	2.3	2.0	2.2	1.9	1.1	1.1
651　Textile yarn	2.6	4.4	5.0	8.0	6.4	6.6	7.4
665　Glassware	2.2	1.7	1.4	2.0	1.5	1.4	1.3
894　Baby carr / toy / game / sport	1.8	2.4	1.0	1.4	1.1	0.9	1.0
831　Trunks and cases	1.5	1.4	1.4	2.2	2.1	1.0	0.9
848　Headgear / non-text clothg	1.5	1.9	1.9	2.0	2.0	1.3	1.7
666　Pottery	1.5	2.1	0.9	1.1	2.1	2.4	2.6
846　Clothing accessories	1.4	1.4	1.0	1.4	1.2	1.4	1.4
661　Lime / cement / constr mat'l	1.4	0.4	0.8	2.8	2.3	1.5	1.5
641　Paper / paperboard	1.2	1.6	2.0	3.6	2.6	2.4	3.0
657　Special yarns / fabrics	1.0	1.0	1.1	1.3	1.1	1.1	1.1
642　Cut paper / board / articles	0.7	1.3	1.6	3.0	3.2	3.9	2.6
664　Glass	0.6	1.0	1.2	2.1	1.6	1.8	1.9

Source: Author's calculation based on COMTRADE trade statistic database.

Table 5. RCA of labor and resource-based products:
China and ASEAN-5 (continued)

Malaysia	1993	1995	1997	1999	2001	2003	2004
634 Veneer / plywood / etc	8	7.1	8.2	6	4.8	4.4	4.5
848 Headgear / non-text clothg	5.5	5.6	6.4	6.3	4.3	4	4.4
843 Men / boy wear knit / croch	2.3	1.5	1.6	1.3	1	0.9	0.9
635 Wood manufactures nes	2	1.4	1.7	1.4	1.2	1.1	1.2
844 Women / girl wear knit / cro	1.9	1.2	0.7	0.9	0.8	0.6	0.6
821 Furniture / stuff furnishg	1.5	1.4	1.8	1.7	1.4	1.4	1.4
894 Baby carr / toy / game / sport	1.4	1	0.7	0.5	0.4	0.4	0.4
655 Knit / crochet fabrics	1.2	1.1	1	0.7	0.7	0.5	0.5
666 Pottery	1.2	0.9	0.4	0.3	0.5	0.6	1
663 Mineral manufactures nes	1	1.2	0.8	0.7	0.5	0.5	0.4
651 Textile yarn	0.8	1.1	1.5	1.3	1	1	1.1

Singapore	1993	1995	1997	1999	2001	2003	2004
844 Women / girl wear knit / cro	1.5	0.8	0.6	0.9	0.9	0.8	0.6
655 Knit / crochet fabrics	1.4	0.9	0.7	0.5	0.6	0.4	0.3
843 Men / boy wear knit / croch	1.4	1	1	1.2	0.9	0.7	0.6

Philippines	1993	1995	1997	1999	2001	2003	2004
843 Men / boy wear knit / croch	9.5	10.6	5.3	4.1	3.5	2.9	5.9
635 Wood manufactures nes	7.8	6.3	2.3	1.4	1.3	1.3	1.6
666 Pottery	6.5	5.5	1.2	0.7	1.1	0.8	0.3
845 Articles of apparel nes	5.9	4.4	2.8	1.5	1.5	1.2	1
844 Women / girl wear knit / cro	5.5	4.9	2.2	2.1	2.2	1.8	1.1
894 Baby carr / toy / game / sport	4.4	4.1	1.5	0.8	0.9	0.7	0.9
831 Trunks and cases	4.1	5.3	4	3.1	3.4	1.4	0.6
821 Furniture / stuff furnishg	3.6	3.3	1.3	0.9	0.7	0.6	0.9
842 Women / girl clothing wven	2.6	3.2	3.5	2.9	2.8	2.6	2.4
851 Footwear	2.5	2.1	1	0.3	0.3	0.2	0.2
656 Tulle / lace / embr / trim etc	2.1	2.1	1	0.6	0.8	0.9	1.4
658 Made-up textile articles	1.6	1.7	1.4	0.9	0.6	0.4	0.5
655 Knit / crochet fabrics	1.6	2.9	1.5	0.2	0.3	0.2	0.2
846 Clothing accessories	1.2	1.9	0.9	0.7	0.8	0.6	1.1
612 Leather manufactures	1.1	1	0.5	0.2	0.2	0.2	0.2
664 Glass	1.1	0.7	0.3	0.8	0.7	0.7	0.6

Source: Author's calculation based on COMTRADE trade statistic database.

Despite the similar pattern of export specialization between China and Indonesia, the rankings of the product are different. For instance, Indonesia's export specialization is toward natural resources such as wood production. On the other hand, China exhibits a strong presence in unskilled labor products—mainly toys, textile, and clothing—in which it has lower-cost advantage. China's export specialization is mainly in clothing products (SITC 8). The top-ranking products based on RCA are trunks and cases (SITC 831), baby car/toy/game/sport (SITC 894), women/girl clothing woven (SITC 842), headgear/non-text clothing (SITC 848), made-up textile articles (SITC 658), footwear (SITC 651), woven cotton fabrics (SITC 652), pottery (SITC 666), articles of apparel (SITC 845), men/boy wear knit/croch (SITC 843), furskins tanned/dressed (SITC 613), clothing accessories (SITC 846), women/girl wear knit/cro (SITC 844), and woven textile fabric (SITC 654).

In Indonesia, the first three highest-ranking products are wood-based products such as veneer/plywood/etc (SITC 634), tulle/lace/embr/trim etc. (SITC 656), and wood manufactures (SITC 635). The empirical analysis also indicates that Indonesia has to compete with China in the clothing sector. However, it is noticeable that Indonesia's comparative advantages have improved significantly in woven cotton fabrics (SITC 652).

As for Malaysia, the comparative advantage is clearly present in products such as veneer/plywood (SITC 634), headgear (SITC 848), men/boy wear (SITC 843), wood manufactures (SITC 635), women/girl wear (SITC 844), and furniture (SITC 821). China and Indonesia will be the closest competitors for Malaysia in these product categories as both countries have lower labor cost compared to Malaysia. Additionally when the implementation of the ASEAN Free Trade Area (AFTA) takes full effect, Indonesia could be the major player in wood and clothing industries.

Thailand, on the other hand, has the comparative advantage in leather manufacturing (SITC 612). Although this industry is also on the comparative advantage list for China and the Philippines, Thailand's leather industry seems to have a better comparative advantage than these two countries. Thailand also has comparative advantage in the clothing sector. Among the sample ASEAN countries, the Philippines seems to dominate the clothing sector.

The RCA for low-skilled and technology-based industries is given in Table 6. In the low-skilled export products, it is clear that only China has maintained a comparative advantage in several industries. The leading industries of China in this category are mainly in manufactures of metal such as pig iron (SITC 671), cutlery (SITC 696), base metal household equipment (SITC 697), hand/machine tools (SITC 695), and mainly in road vehicles such as trailers/caravans (SITC 786) and motorcycles/cycles (SITC 785). In comparison, ASEAN does not seem to have a comparative advantage in low-skilled sectors. This is indicated by the low RCA values for all the ASEAN-5 countries.

**Table 6. RCA of low-skilled and technology-based products:
China and ASEAN-5**

China		1993	1995	1997	1999	2001	2003	2004
671	Pig iron etc ferro alloy	3.9	6.2	5.4	2.9	1.8	1.6	1.8
696	Cutlery	3.2	3.2	3.8	3.7	3.9	3.5	3.4
697	Base metal h'hold equipm	2.2	2.5	2.9	3.4	3.5	3.2	3.1
786	Trailers / caravans / etc	1.9	3.9	3.1	3.9	4.4	3.9	3.4
785	Motorcycles / cycles / etc	1.6	1.7	1.7	2.0	2.6	2.4	2.3
695	Hand / machine tools	1.5	1.4	1.2	1.2	1.1	1.1	1.0
693	Wire prod exc ins electr	1.4	1.2	1.4	1.4	1.2	1.0	1.1
694	Nails / screws / nuts / bolts	1.3	1.3	1.0	1.1	1.2	1.1	1.3
699	Base metal manufac nes	1.2	1.3	1.4	1.3	1.2	1.1	1.2
678	Iron / steel wire	1.2	0.8	0.7	0.7	0.6	0.6	0.7
677	Iron / steel railway matl	1.1	0.8	0.6	0.7	0.3	0.3	0.2
691	Iron / stl / alum structures	0.6	0.8	0.9	1.0	1.2	1.0	1.0
672	Primary / prods iron / steel	0.2	3.2	3.5	2.1	0.8	0.4	1.2
Indonesia		1993	1995	1997	1999	2001	2003	2004
697	Base metal h'hold equipm	2.7	2.6	1.7	2.3	1.8	1.1	1.1
785	Motorcycles / cycles / etc	2.6	2.6	1.9	1.8	1.3	1.3	1.5
696	Cutlery	1.8	2.0	2.1	1.8	1.4	0.9	0.9
676	Iron / steel bars / rods / etc	1.0	0.3	0.4	0.7	0.5	0.4	0.5
671	Pig iron etc ferro alloy	0.9	1.5	1.5	1.2	0.8	1.1	0.7
Malaysia		1993	1995	1997	1999	2001	2003	2004
671	Pig iron etc ferro alloy	1.4	1.0	1.1	0.4	0.3	0.5	0.3
693	Wire prod exc ins electr	0.9	0.7	0.9	1.0	0.9	0.7	0.8
694	Nails / screws / nuts / bolts	0.8	0.8	1.0	0.8	0.8	0.8	0.9
785	Motorcycles / cycles / etc	0.8	0.6	0.6	0.5	0.4	0.4	0.5
678	Iron / steel wire	0.8	0.7	0.3	0.5	0.4	0.7	0.9
672	Primary / prods iron / steel	0.8	0.0	0.0	0.3	0.0	0.8	0.6
Singapore		1993	1995	1997	1999	2001	2003	2004
785	Motorcycles / cycles / etc	1.5	1.0	0.9	0.7	0.5	0.5	0.5
793	Ships / boats / etc	1.1	0.7	0.7	0.5	0.6	0.3	0.2
695	Hand / machine tools	0.6	0.6	0.7	0.5	0.7	0.8	0.8
699	Base metal manufac nes	0.6	0.5	0.4	0.4	0.3	0.3	0.3

Table 6. RCA of low-skilled and technology-based products:
China and ASEAN-5 (continued)

Thailand		1993	1995	1997	1999	2001	2003	2004
786	Trailers / caravans / etc	2.2	0.9	0.2	0.2	0.1	0.2	NA
785	Motorcycles / cycles / etc	1.6	2.4	2.1	2.0	1.6	1.8	NA
697	Base metal h'hold equipm	1.6	1.6	2.3	2.3	2.2	1.6	NA
812	Sanitary / plumb / heat fixt	1.3	1.1	1.0	1.2	1.3	1.1	NA
679	Iron / steel pipe / tube / etc	1.1	1.0	0.8	0.8	0.7	0.7	NA
Philippines		1993	1995	1997	1999	2001	2003	2004
691	Iron / stl / alum structures	2.55	0.29	0.42	0.23	0.13	0.16	0.25
671	Pig iron etc ferro alloy	1.25	1.11	0.07	0.00	0.01	0.00	0.01
697	Base metal h'hold equipm	1.21	1.47	0.60	0.40	0.30	0.30	0.53
812	Sanitary / plumb / heat fixt	1.00	0.48	0.07	0.44	0.49	0.50	0.00
679	Iron / steel pipe / tube / etc	0.86	0.61	0.08	0.10	0.06	0.07	0.08
696	Cutlery	0.72	0.10	0.21	0.08	0.10	0.05	0.10
785	Motorcycles / cycles / etc	0.35	0.81	0.53	0.42	0.44	0.45	0.78
699	Base metal manufac nes	0.31	0.28	0.22	0.19	0.21	0.16	0.23
673	Flat rolled iron / st prod	0.23	0.13	0.15	0.03	0.01	0.00	0.04

Table 7 gives the RCA for medium-skilled and technology-based industries for all the sample countries. It is evident that electrical machinery is an important export for countries like China, Singapore, Malaysia, and Thailand. Two ASEAN countries (Philippines and Indonesia) are far behind the other three ASEAN countries and China in this sector. Note that the Philippines has comparative advantage only in the SITC 773 subsector. On the other hand, Indonesia had comparative advantage in the SITC 778 subsector from 1993 to 1997. However, this subsector lost its comparative advantage in 1999. Indonesia's subsector SITC 625 gained comparative advantage only in 2001.

China has export comparative advantage in most of the subsectors in the medium-skilled and technology-based industries. The comparative advantage in these subsectors has been on an upward trend. However, China's import in some of the subsectors such as SITC 716, 743, 772, and 744 are also high. This may be due to the fact that China has relatively low capital-intensive industries and industrial equipment over the sample period. Hence, China had to import technology and skilled workers to transform these local industries to become more competitive. The terms of trade may change in favor of China once they are able to produce most of the technology in the country.

**Table 7. RCA of medium-skilled and technology-based based products:
China and ASEAN-5**

China		1993	1995	1997	1999	2001	2003	2004
893	Articles nes of plastics	1.8	1.9	2.1	2.1	1.9	1.6	1.5
771	Elect power transm equip	1.8	2.2	2.1	2.6	2.4	2.4	2.4
716	Rotating electr plant	1.4	1.3	1.4	1.5	1.3	1.2	1.1
775	Domestic equipment	1.3	1.4	1.7	2.1	2.4	2.2	2.1
743	Fans / filters / gas pumps	0.8	0.8	0.6	0.6	0.6	0.6	0.6
778	Electrical equipment nes	0.8	0.9	1.0	1.3	1.4	1.4	1.3
772	Electric circuit equipmt	0.6	0.7	0.7	0.8	0.8	0.8	0.8
724	Textile / leather machinry	0.5	0.5	0.5	0.7	0.8	0.8	0.8
773	Electrical distrib equip	0.5	0.6	0.8	0.9	0.8	0.9	0.9
744	Mechanical handling equi	0.5	0.3	0.4	0.4	0.5	0.5	0.6
625	Rubber tyres / treads	0.4	0.6	0.6	0.7	0.8	0.8	0.8
711	Steam generating boilers	0.4	0.4	0.6	0.6	0.7	0.5	0.7
722	Tractors	0.3	0.2	0.1	0.2	0.2	0.1	0.1
737	Metalworking machine nes	0.3	0.3	0.3	0.3	0.4	0.4	0.4
728	Special indust machn nes	0.2	0.2	0.2	0.2	0.2	0.2	0.2
749	Non-elec parts / acc machn	0.2	0.2	0.2	0.3	0.4	0.4	0.4
621	Materials of rubber	0.2	0.1	0.1	0.1	0.2	0.2	0.2
742	Pumps for liquids	0.2	0.2	0.2	0.2	0.3	0.3	0.4
727	Food processing machines	0.2	0.2	0.2	0.2	0.2	0.2	0.2
725	Paper industry machinery	0.1	0.1	0.1	0.1	0.1	0.2	0.2
721	Agric machine ex tractr	0.1	0.1	0.1	0.1	0.2	0.3	0.2
723	Civil engineering plant	0.1	0.1	0.1	0.1	0.3	0.2	0.3
745	Non-electr machines nes	0.1	0.1	0.2	0.3	0.4	0.5	0.5
718	Power generating equ nes	0.1	0.2	0.2	0.2	0.3	0.2	0.2
741	Indust heat / cool equipmt	0.1	0.2	0.3	0.5	0.8	1.0	1.1
Indonesia		1993	1995	1997	1999	2001	2003	2004
778	Electrical equipment nes	3.0	4.8	6.8	1.0	0.9	1.1	1.2
625	Rubber tyres / treads	0.6	1.3	1.7	1.6	1.5	2.2	2.5
893	Articles nes of plastics	0.6	0.7	0.4	0.6	0.7	0.9	0.8
771	Elect power transm equip	0.3	0.5	0.8	0.5	1.1	1.7	1.7
621	Materials of rubber	0.3	0.7	0.5	0.7	0.3	0.3	0.4
743	Fans / filters / gas pumps	0.2	0.3	0.2	0.2	0.3	0.5	0.6
773	Electrical distrib equip	0.2	0.4	1.0	1.2	1.3	1.3	1.5

Source: Author's calculation based on COMTRADE trade statistic database.

**Table 7. RCA of medium-skilled and technology-based based products:
China and ASEAN-5 (continued)**

Malaysia		*1993*	*1995*	*1997*	*1999*	*2001*	*2003*	*2004*
621	Materials of rubber	2.8	2.2	2.0	1.5	1.4	1.6	1.5
771	Elect power transm equip	2.7	1.7	1.4	1.3	1.3	0.9	1.0
741	Indust heat / cool equipmt	1.9	1.8	0.8	0.9	0.9	0.8	0.9
772	Electric circuit equipmt	1.4	1.2	1.7	1.9	2.0	2.2	2.2
716	Rotating electr plant	1.2	1.3	1.0	0.9	0.7	0.6	0.5
773	Electrical distrib equip	0.8	0.8	0.7	0.6	0.6	0.5	0.7
893	Articles nes of plastics	0.8	0.7	0.8	0.7	0.8	0.8	0.9
778	Electrical equipment nes	0.6	0.6	0.6	0.7	0.9	0.9	1.0
Philippines		*1993*	*1995*	*1997*	*1999*	*2001*	*2003*	*2004*
773	Electrical distrib equip	8.3	8.4	3.3	2.1	2.1	2.1	4.8
771	Elect power transm equip	0.9	0.8	0.4	0.4	0.5	0.4	0.7
893	Articles nes of plastics	0.8	0.8	0.5	0.3	0.3	0.3	0.2
772	Electric circuit equipmt	0.7	0.9	1.3	2.2	1.8	1.0	0.4
784	Motor veh parts / access	0.6	0.8	0.5	0.4	0.7	0.8	1.5
775	Domestic equipment	0.5	0.5	0.2	0.1	0.1	0.1	0.2
Singapore		*1993*	*1995*	*1997*	*1999*	*2001*	*2003*	*2004*
771	Elect power transm equip	1.8	1.9	1.4	1.3	1.3	1.2	1.2
716	Rotating electr plant	1.7	1.7	1.6	1.3	1.2	1.1	1.0
772	Electric circuit equipmt	1.3	1.4	1.3	1.5	1.5	1.5	1.4
723	Civil engineering plant	1.0	1.2	1.3	1.2	1.4	1.4	1.3
778	Electrical equipment nes	1.0	1.2	1.3	1.2	1.5	1.2	1.1
743	Fans / filters / gas pumps	1.0	0.7	0.7	0.5	0.5	0.5	0.5
741	Indust heat / cool equipmt	0.9	0.6	0.6	0.4	0.4	0.4	0.3
775	Domestic equipment	0.8	0.6	0.6	0.6	0.6	0.4	0.5
749	Non-elec parts / acc machn	0.8	0.8	0.8	0.9	0.9	1.2	1.1
773	Electrical distrib equip	0.6	0.7	0.6	0.5	0.5	0.4	0.4
728	Special indust machn nes	0.6	0.6	0.6	0.7	0.7	0.6	0.7
893	Articles nes of plastics	0.6	0.5	0.5	0.4	0.5	0.4	0.4
744	Mechanical handling equi	0.5	0.5	0.5	0.4	0.3	0.3	0.3
737	Metalworking machine nes	0.3	0.4	0.3	0.4	0.3	1.2	1.7

Source: Author's calculation based on COMTRADE trade statistic database.

**Table 7. RCA of medium-skilled and technology-based based products:
China and ASEAN-5 (continued)**

Thailand		1993	1995	1997	1999	2001	2003	2004
893	Articles nes of plastics	3.7	2.9	1.2	1.1	1.1	1.2	NA
749	Non-elec parts / acc machn	3.5	0.7	0.3	0.3	0.3	0.4	NA
773	Electrical distrib equip	2.1	1.7	1.6	1.5	1.0	1.1	NA
775	Domestic equipment	1.6	1.7	1.6	1.7	2.0	2.0	NA
771	Elect power transm equip	1.6	2.4	2.6	2.7	2.5	2.3	NA
741	Indust heat / cool equipmt	1.4	2.1	2.4	2.4	2.8	2.9	NA
716	Rotating electr plant	1.1	1.6	2.8	2.8	2.4	1.9	NA
778	Electrical equipment nes	1.0	0.9	0.7	0.8	1.0	1.2	NA
625	Rubber tyres / treads	1.0	0.9	1.1	1.2	1.4	1.4	NA
772	Electric circuit equipmt	0.9	1.4	1.5	1.8	1.7	1.8	NA
621	Materials of rubber	0.9	0.8	1.1	1.2	1.4	1.9	NA
743	Fans / filters / gas pumps	0.8	0.8	0.6	0.8	1.0	0.9	NA

Source: Author's calculation based on COMTRADE trade statistic database.

A detailed examination of Singapore's RCA showed that Singapore has comparative advantage in products such as electrical power transmitter equipment (SITC 771), rotating electrical plant (SITC 716), electrical circuit equipment (SITC 772), civil engineering plant (SITC 723), and electrical equipment (SITC 778). Singapore's RCA profile is similar to that of China.

In the case of Malaysia, four products maintained comparative advantage with declining RCA: materials of rubber (SITC 621), electrical power transmitter equipment (SITC 771), industrial heat/cool equipment (SITC 741), and electric circuit equipment (SITC 772). Thailand, on the other hand, has comparative advantage in products like plastics (SITC 893), electrical distribution equipment (SITC 773), domestic equipment (SITC 775), electrical power transmitter equipment (SITC 771), industrial heat/cool equipment (SITC 741), and rotating electrical plant (SITC 716).

The RCA for China and ASEAN-5 for high-skilled and technology-intensive products are given in Table 8. We note that China's RCA is high for a wide range of products (especially SITC 762, 523, 881, 871, 531, 751, 764, and 763) over the sample period. Only Singapore's and Malaysia's RCAs are comparable with that of China for some of the subsectors in this category. In some of these subsectors, China's RCA has surpassed that of Singapore and Malaysia. Hence, China seems to be building stronger comparative advantage in the high-skilled and technology-intensive sectors, which were traditionally dominated by Singapore and Malaysia.

Table 8. RCA of high-skilled and technology-based products: China and ASEAN-5

China		1993	1995	1997	1999	2001	2003	2004
762	Radio broadcast receiver	4.0	4.0	4.5	4.0	3.4	3.0	2.5
885	Watches and clocks	3.5	3.2	3.0	2.9	2.1	1.6	1.3
524	Other inorganic chemical	2.3	3.3	2.3	1.8	1.1	1.2	1.3
522	Elements / oxides / hal salt	1.9	2.1	1.9	1.7	1.5	1.3	1.2
523	Metal salts of inorg acd	1.8	2.3	2.2	2.3	2.3	1.8	1.7
881	Photographic equipment	1.7	1.7	2.1	2.1	1.7	1.1	0.7
761	Television receivers	1.7	1.1	0.8	0.9	1.0	1.3	1.4
871	Optical instruments nes	1.2	1.6	1.8	1.7	1.5	3.4	3.7
541	Pharmaceut exc medicamnt	1.2	1.4	1.1	1.1	0.9	0.7	0.5
531	Synth org colour agents	1.1	1.4	1.6	1.8	1.8	1.3	1.3
751	Office machines	1.0	1.6	2.3	2.3	2.7	3.0	2.4
513	Carboxylic acid compound	0.8	0.8	0.7	0.9	0.8	0.6	0.6
764	Telecomms equipment nes	0.8	1.0	1.1	1.2	1.5	1.8	2.0
763	Sound / tv recorders etc	0.8	1.4	1.8	2.1	3.1	3.8	3.8
551	Essent.Oil / perfume / flavr	0.8	0.6	0.4	0.3	0.2	0.1	0.1
884	Optical fibres	0.7	0.9	0.9	1.1	1.1	1.1	1.1
512	Alcohols / phenols / derivs	0.7	0.5	0.5	0.4	0.4	0.3	0.3
532	Dyeing / tanning extracts	0.6	0.3	0.3	0.5	0.5	0.7	0.5
516	Other organic compounds	0.6	0.8	0.7	0.7	0.6	0.6	0.6
515	Organo-inorganic compnds	0.6	0.6	0.5	0.4	0.4	0.3	0.3
514	Nitrogen function compds	0.5	0.7	0.8	0.7	0.7	0.6	0.6
759	Office equip parts / accs.	0.5	0.5	0.6	0.8	1.3	1.9	2.0
591	Household / garden chemcal	0.4	0.6	0.7	0.9	0.9	0.8	0.9
598	Misc chemical prods nes	0.4	0.4	0.4	0.4	0.4	0.3	0.3
873	Meters and counters nes	0.3	0.3	0.4	0.4	0.6	0.7	0.6
553	Perfume / toilet / cosmetics	0.3	0.2	0.2	0.2	0.2	0.2	0.2
533	Pigments / paints / varnish	0.3	0.4	0.3	0.3	0.3	0.2	0.2
554	Soaps / cleansers / polishes	0.3	0.3	0.2	0.2	0.2	0.1	0.2
592	Starches / glues / etc.	0.2	0.3	0.3	0.3	0.3	0.4	0.4
752	Computer equipment	0.2	0.5	0.9	1.1	1.5	2.8	3.0
872	Medical / etc instruments	0.2	0.3	0.3	0.3	0.3	0.3	0.3
582	Plastic sheets / film / etc	0.2	0.3	0.3	0.3	0.3	0.2	0.3
874	Measure / control app nes	0.2	0.2	0.2	0.3	0.3	0.3	0.3
511	Hydrocarbons / derivatives	0.2	0.3	0.3	0.3	0.3	0.2	0.2
562	Manufactured fertilizers	0.2	0.3	0.4	0.4	0.5	0.7	0.8

Source: Author's calculation based on COMTRADE trade statistic database.

Table 8. RCA of high-skilled and technology-based products:
China and ASEAN-5 (continued)

Indonesia		1993	1995	1997	1999	2001	2003	2004
763	Sound / tv recorders etc	2.7	5.3	7.6	3.2	4.6	4.3	4.7
881	Photographic equipment	2.5	1.7	2.7	1.4	1.2	0.7	0.4
562	Manufactured fertilizers	2.3	3.2	4.3	2.4	1.2	2.0	0.8
762	Radio broadcast receiver	2.2	4.3	2.8	2.2	6.3	3.9	4.4
532	Dyeing / tanning extracts	1.8	1.0	3.3	1.6	1.2	0.9	1.8
514	Nitrogen function compds	1.2	1.2	1.7	1.5	2.1	1.9	1.9
554	Soaps / cleansers / polishes	1.1	1.5	1.4	2.2	1.9	2.2	2.5
551	Essent.Oil / perfume / flavr	1.1	1.0	1.2	1.0	1.1	0.9	0.9
761	Television receivers	1.0	0.2	0.5	0.3	1.7	1.2	1.2
512	Alcohols / phenols / derivs	0.8	1.2	1.8	2.8	2.5	3.0	2.8
592	Starches / glues / etc.	0.6	0.4	0.2	0.4	0.2	0.2	0.8
531	Synth org colour agents	0.6	0.4	0.9	1.0	1.2	1.7	1.6
522	Elements / oxides / hal salt	0.5	0.7	1.0	0.8	1.5	2.2	1.7
764	Telecomms equipment nes	0.5	0.5	0.8	0.7	1.1	1.1	0.7
513	Carboxylic acid compound	0.4	1.5	2.4	2.8	2.5	2.7	3.5
873	Meters and counters nes	0.4	0.2	0.6	0.6	0.8	0.6	0.7
Thailand		1993	1995	1997	1999	2001	2003	2004
761	Television receivers	4.5	4.0	4.7	3.2	3.0	2.8	NA
751	Office machines	2.7	2.8	2.0	1.7	1.6	0.9	NA
759	Office equip parts / accs.	2.7	2.4	4.1	4.9	4.4	2.5	NA
592	Starches / glues / etc.	2.6	3.3	3.6	3.2	3.1	3.3	NA
532	Dyeing / tanning extracts	2.2	0.5	0.5	0.5	0.4	0.3	NA
763	Sound / tv recorders etc	1.9	2.3	3.5	1.9	1.2	1.1	NA
776	Valves / transistors / etc	1.9	1.5	1.7	1.8	2.1	2.3	NA
885	Watches and clocks	1.9	2.2	2.2	1.6	1.9	1.8	NA
884	Optical fibres	1.3	1.4	1.2	1.4	1.5	2.0	NA
764	Telecomms equipment nes	1.2	1.2	1.1	1.0	0.9	1.2	NA
752	Computer equipment	1.1	2.0	1.7	1.1	1.0	2.1	NA
881	Photographic equipment	1.0	1.2	1.6	1.3	1.7	1.9	NA
582	Plastic sheets / film / etc	0.8	0.9	0.9	0.7	0.7	0.8	NA
533	Pigments / paints / varnish	0.8	1.9	0.2	0.2	0.2	0.2	NA
872	Medical / etc instruments	0.7	0.7	0.7	0.6	0.6	0.5	NA
572	Styrene primary polymers	0.6	0.4	2.1	3.3	3.7	2.8	NA

Source: Author's calculation based on COMTRADE trade statistic database.

Table 8. RCA of high-skilled and technology-based products: China and ASEAN-5 (continued)

Malaysia		1993	1995	1997	1999	2001	2003	2004
762	Radio broadcast receiver	11.5	12.3	10.4	10.3	8.9	6.9	8.1
763	Sound / tv recorders etc	7.1	9.0	8.0	5.1	5.9	3.4	2.8
776	Valves / transistors / etc	6.5	5.0	4.9	4.7	4.8	6.0	5.6
761	Television receivers	6.1	6.9	5.0	4.0	4.1	3.3	3.0
759	Office equip parts / accs.	3.6	3.5	3.4	5.4	4.4	4.2	3.7
881	Photographic equipment	2.6	2.4	2.2	2.0	2.7	3.2	2.7
764	Telecomms equipment nes	2.4	2.2	2.0	1.6	1.9	1.7	1.7
512	Alcohols / phenols / derivs	1.8	1.5	2.0	1.9	2.0	2.6	2.5
751	Office machines	1.4	1.0	0.7	0.8	1.2	0.7	0.8
572	Styrene primary polymers	1.1	1.4	1.6	1.5	1.6	2.0	2.1
554	Soaps / cleansers / polishes	1.1	0.8	0.9	0.9	0.8	0.9	1.0
792	Aircraft / spacecraft / etc	1.0	1.2	0.7	0.4	0.1	0.2	0.2
885	Watches and clocks	0.7	0.9	1.1	0.7	0.6	0.6	0.6
871	Optical instruments nes	0.7	0.5	0.4	0.2	1.1	0.2	0.1
562	Manufactured fertilizers	0.7	0.6	0.4	0.4	0.6	0.8	0.7
872	Medical / etc instruments	0.6	0.5	0.4	0.4	0.4	0.4	0.6
884	Optical fibres	0.6	0.4	0.3	0.2	0.3	0.3	0.3
533	Pigments / paints / varnish	0.5	0.4	0.5	0.5	0.5	0.5	0.6
516	Other organic compounds	0.4	0.4	0.5	0.3	0.5	0.7	0.5
752	Computer equipment	0.4	1.1	2.4	2.4	2.9	2.9	3.5
513	Carboxylic acid compound	0.3	0.3	0.6	0.7	1.8	2.0	2.2
591	Household / garden chemcal	0.3	0.3	0.3	0.4	0.3	0.4	0.4
598	Misc chemical prods nes	0.3	1.2	1.2	0.8	0.8	0.8	0.9
874	Measure / control app nes	0.3	0.2	0.4	0.3	0.7	0.9	1.0

Source: Author's calculation based on COMTRADE trade statistic database.

Table 8. RCA of high-skilled and technology-based products: China and ASEAN-5 (continued)

Philippines		1993	1995	1997	1999	2001	2003	2004
883	Cine fild developed	8.8	14.0	2.2	0.3	0.0	0.0	0.0
562	Manufactured fertilizers	5.2	4.4	1.4	0.5	0.4	0.6	1.1
776	Valves / transistors / etc	4.8	4.3	8.2	9.9	9.1	10.4	6.8
764	Telecomms equipment nes	2.8	2.6	1.5	0.6	0.7	0.6	1.4
762	Radio broadcast receiver	2.6	3.2	0.6	0.9	1.4	1.1	1.5
512	Alcohols / phenols / derivs	2.5	1.6	0.6	0.5	0.4	0.5	0.8
752	Computer equipment	1.2	1.0	2.5	2.8	3.7	3.5	4.9
554	Soaps / cleansers / polishes	1.1	1.2	0.4	0.2	0.3	0.3	0.5
884	Optical fibres	0.9	0.8	0.3	0.3	0.4	1.0	1.2
759	Office equip parts / accs.	0.2	0.9	3.5	2.5	3.4	3.4	4.7
881	Photographic equipment	0.2	1.0	1.9	0.6	2.4	4.5	0.3
516	Other organic compounds	0.1	0.0	0.0	0.0	0.0	0.0	3.5
Singapore		1993	1995	1997	1999	2001	2003	2004
752	Computer equipment	6.4	5.7	5.5	5.0	4.2	3.5	2.9
762	Radio broadcast receiver	5.9	4.1	3.7	2.7	2.9	1.8	1.8
763	Sound / tv recorders etc	4.5	4.0	2.7	1.6	1.3	1.1	1.0
761	Television receivers	3.8	3.0	1.9	0.9	0.9	0.7	0.5
776	Valves / transistors / etc	3.5	3.9	4.0	4.4	5.6	6.2	7.2
759	Office equip parts / accs.	3.2	3.7	3.8	3.6	3.5	3.2	3.5
764	Telecomms equipment nes	2.4	2.2	1.7	1.3	1.1	1.4	1.5
515	Organo-inorganic compnds	2.0	1.2	1.1	1.6	1.5	3.7	3.5
751	Office machines	1.8	1.3	1.5	1.2	1.3	0.7	0.6
885	Watches and clocks	1.3	1.6	2.2	1.7	1.6	1.2	1.2
882	Photographic supplies	1.2	1.1	1.1	1.6	2.1	2.0	2.0
872	Medical / etc instruments	1.2	1.0	0.9	0.9	0.9	0.8	0.9
881	Photographic equipment	1.0	0.9	1.0	0.9	1.2	1.1	0.8
871	Optical instruments nes	1.0	1.2	1.0	0.8	0.8	1.3	1.4
598	Misc chemical prods nes	1.0	0.6	0.6	0.6	0.6	0.7	0.7
533	Pigments / paints / varnish	0.8	0.7	0.7	0.8	1.0	1.0	0.9
572	Styrene primary polymers	0.8	0.8	0.8	0.9	0.9	1.2	1.0
553	Perfume / toilet / cosmetics	0.8	0.7	0.7	0.8	0.8	0.7	0.8
884	Optical fibres	0.8	0.7	0.8	0.8	0.7	0.9	0.9
512	Alcohols / phenols / derivs	0.8	0.6	0.7	0.9	1.2	1.6	1.6

Source: Author's calculation based on COMTRADE trade statistic database.

Table 8. RCA of high-skilled and technology-based products:
China and ASEAN-5 (continued)

Singapore		1993	1995	1997	1999	2001	2003	2004
531	Synth org colour agents	0.7	0.5	0.4	0.6	1.0	1.1	1.0
874	Measure / control app nes	0.6	0.6	0.5	0.7	0.8	1.0	0.9
532	Dyeing / tanning extracts	0.6	0.3	0.2	0.2	0.5	0.5	0.4
551	Essent.Oil / perfume / flavr	0.5	0.6	0.8	0.9	0.8	0.9	0.9
513	Carboxylic acid compound	0.5	0.5	0.6	1.0	1.4	1.2	1.2
514	Nitrogen function compds	0.5	0.5	0.8	1.2	0.9	1.8	2.1
516	Other organic compounds	0.5	0.7	0.7	0.7	1.0	1.3	1.3
554	Soaps / cleansers / polishes	0.5	0.4	0.4	0.4	0.4	0.4	0.4
541	Pharmaceut exc medicamnt	0.4	0.5	0.5	1.3	0.8	0.5	0.5
511	Hydrocarbons / derivatives	0.4	0.9	1.0	0.9	0.7	1.3	1.4

Source: Author's calculation based on COMTRADE trade statistic database.

4.3. Degree of association in the export specialization

One way to examine the similarities and differences in trade patterns between ASEAN-5 countries and China is to compare the Spearman's rank correlation coefficient of the RCA indices for the countries over the sample period. The SRCC may provide some insight on the potential trade diversion effect from the ASEAN region (degree of competition from China), which depend on the degree to which the exports of China and other ASEAN members are similar.

Table 9 shows the SRCC between China and ASEAN-5. The SRCC was computed for four groups: labor and resource-based industries, low-skilled and technology-intensive industries, medium-skilled and technology-intensive industries, and high-skilled and technology-intensive industries. The SRCC for the labor and resource-based industries indicates that the Philippines and Thailand have a strong correlation coefficient in their RCA index with China from 1993 to 2004. This implies that the industrial structures of China and the two ASEAN countries in this category of products are similar. Hence, these two ASEAN countries compete with China in a large number of labor and resource-based products.

In the case of Indonesia, the SRCC was significant in 1993, 1995, and 1997. However, in the other periods, the SRCC was not statistically significant. This implies that the labor and resource-based industries in Indonesia have become dissimilar to that of China after 1997. Thus, there is limited competition from China for Indonesian industries in this category. Indonesia may indeed be able to expand labor and resource-based products to China.

Table 9. Spearman's rank correlations coefficient between China and ASEAN-5

Country/year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
LABOR AND RESOURCE-BASED INDUSTRIES												
Indonesia	0.386*	0.295	0.349*	0.397*	0.357*	0.289	0.221	0.227	0.188	0.147	0.142	0.172
Malaysia	0.318	0.201	0.185	0.193	0.084	0.106	0.084	0.034	0.042	0.108	0.146	0.161
Philippines	0.597**	0.561**	0.596**	0.718**	0.701**	0.675**	0.640**	0.646**	0.588**	0.598**	0.595**	0.380**
Singapore	0.036	0.047	0.115	0.178	0.216	0.116	0.151	0.144	0.078	0.013	0.064	0.089
Thailand	0.531**	0.601**	0.608**	0.601**	0.548**	0.549**	0.513**	0.488**	0.48**	NA	0.447**	NA
LOW-SKILLED AND TECHNOLOGY-INTENSIVE INDUSTRIES												
Indonesia	0.290	0.362	0.360	0.458**	0.369	0.088	0.087	0.091	0.312	0.378	0.409	0.187
Malaysia	0.338	0.470**	0.226	0.352	0.344	0.378	0.236	0.068	0.253	0.430	0.148	0.099
Philippines	0.345	0.382	0.292	0.355	0.256	0.230	0.118	0.255	0.448*	0.279	0.273	0.140
Singapore	0.281	0.300	0.048	0.212	0.117	0.209	0.218	0.240	0.294	0.273	0.277	0.178
Thailand	0.355	0.431	0.113	0.147	-0.38	-0.60	-0.049	-0.36	0.255	NA	0.222	NA
MEDIUM-SKILLED AND TECHNOLOGY-INTENSIVE INDUSTRIES												
Indonesia	0.759**	0.741**	0.615**	0.702**	0.710**	0.657**	0.675**	0.694**	0.710**	0.706**	0.672**	0.751**
Malaysia	0.617**	0.636**	0.691**	0.717**	0.721**	0.701**	0.693**	0.626**	0.617**	0.679**	0.676**	0.624**
Philippines	0.574**	0.657**	0.520**	0.527**	0.642**	0.667**	0.587**	0.545**	0.599**	0.608**	0.586**	0.693**
Singapore	0.594**	0.617**	0.624**	0.715**	0.756**	0.699**	0.729**	0.672**	0.725**	0.741**	0.704**	0.700**
Thailand	0.697**	0.794**	0.736**	0.703**	0.689**	0.661**	0.626**	0.633**	0.591**	NA	0.557**	NA
HIGH-SKILLED AND TECHNOLOGY-INTENSIVE INDUSTRIES												
Indonesia	0.362*	0.256	0.282	0.243	0.250	0.219	0.211	0.231	0.286	0.236	0.322*	0.230
Malaysia	0.130	0.094	0.096	0.172	0.214	0.237	0.212	0.303	0.367*	0.339*	0.301	0.333*
Philippines	0.032	0.164	0.210	0.359*	0.245	0.306	0.375*	0.434**	0.421**	0.446**	0.439**	0.324*
Singapore	0.193	0.216	0.262	0.309*	0.295	0.338*	0.335*	0.332*	0.376*	0.334*	0.240	0.230
Thailand	0.232	0.169	0.142	0.208	0.238	0.354*	0.276	0.251	0.282	NA	0.229	NA

Note: ** and * indicate that correlation is significant at 0.01 and 0.05 (2-tailed) levels, respectively.

In contrast, Malaysia's and Singapore's SRCCs are not statistically significant. This implies that the industrial structures for this category of products and services between China and the two ASEAN nations are dissimilar. This may be due to the fact that Malaysia and Singapore have been moving away from labor and resource-intensive sectors to more value-added sectors. Thus, there is potential for Malaysia and Singapore to move some of their labor and resource-intensive sectors to China.

In the low-skilled and technology-intensive industries, only Indonesia in 1996, Malaysia in 1994, and the Philippines in 2001 were statistically significant. This implies that most ASEAN-5 countries do not directly compete with China in low-skilled and technology-intensive sectors.

For the medium-skilled and technology-based industries, the entire rank correlation coefficients for all the countries are statistically significant. This implies that China's industrial structure and RCA are very similar to that of the ASEAN-5. In this case it can be concluded that China and ASEAN-5 will be competing in the foreign market, particularly for the medium-skilled products. Among the subsectors in which ASEAN-5 can expect intense competition are sectors such as electrical power transmitter equipment (SITC 771), electrical distribution equipment (SITC 773), electrical equipment (SITC 778), and industrial heat/cool equipment (SITC 741).

In the high-skilled and technology-intensive sectors, the SRCC showed that China's comparative advantage is correlated with that of Singapore for the period 1996 and 1998-2002, Philippines for the period 1996 and 1999-2004, Malaysia 2001-2002 and 2004, Thailand 1998, and Indonesia 2003. The empirical evidence suggests that China's industrial structure in high-skilled and technology-intensive sectors has become similar to that of Singapore, Malaysia, and the Philippines in the later sample period.

5. Policy implications

The empirical evidence suggests that China is not only competitive in low-skilled and resource-based industries; it is also gaining ground in high-skilled and technology-intensive sectors. China's potential to pursue economies of scale in high-skilled and technology-intensive sectors can erode the competitiveness of ASEAN countries in these sectors.

China's increased competitiveness in the high-end sectors is attributed to several strategies put in place by the Chinese government to transform the nation into an industrial powerhouse. First, over the last decade, the Chinese government has been investing heavily in science, technology, and innovation, especially in state-owned enterprises (SOEs). Over the last decade, there was significant increase in funding for research and development (R&D) and commercialization of R&D outcomes. The total national R&D expenditure per capita and business R&D expenditure for China

and ASEAN-5 are given in Figures 1 and 2, respectively [IMD 1995-2006]. Note that China's total and business R&D expenditures per capita were below that of Singapore and Malaysia. However, China's R&D per capita was significantly higher than that of Thailand, the Philippines, and Indonesia.

To focus and enhance R&D activities in areas strategic to the development of the economy, the State Science and Technology Commission (SSTC) of China established 52 high-technology zones modeled after the technology zones in the United States. From these technology zones emerged global players such as Legend Computer (PC manufacturer), ZTE Corporation and Huawei Technologies (information and communications technology [ICT] manufacturer).

Various incentives were also put in place to encourage bright Chinese students to undertake research degrees (master's and doctor's), especially in science, technology, and medical areas. Figures 3 and 4 show that the number of research personnel nationwide per 1,000 workers and the number of R&D personnel in business enterprises per 1,000 workers in China is higher than that in Malaysia, Thailand, and the Philippines [IMD 1995-2006].

Increased R&D funding and research personnel in China resulted in an increase in the number of patents granted to Chinese residents in China and abroad. During the periods 2000-2002 and 2002-2004, China recorded a higher number of patents granted to its residents than the five ASEAN countries (Figure 5) [IMD 2005, 2006]. In 2003, Chinese residents also secured a higher number of patents abroad than residents from ASEAN countries, with the exception of Singapore (Figure 6) [IMD 2006].

To encourage greater diffusion of advanced foreign technology and innovation, the Chinese government encouraged foreign technology-intensive multinational corporations to establish research centers in the country. In return for access to the local market, foreign corporations were required to transfer technology to local staff and firms. In 1995, General Motors supported R&D in six Chinese universities and initiated a joint venture with Shanghai Auto Works to manufacture the Buick Regal in a new plant in the Pudong District in Shanghai. In the same year, IBM opened a research laboratory in the Haidian district, one of the technology zones. In 1998, Intel Corporation opened its first research center to explore new-generation ICT-related products.

The above strategies have transformed China from a low-cost production center to a leading hub for innovation. China today is one of the main manufacturers/producers of new-generation products, especially in the electronics, electrical, and ICT areas.

Innovation has also been the key driver for increasing productivity and economic growth in China over the last decade. While the global community has benefited from cheap and high-quality products from China, this has been at the expense of industries in the ASEAN region—both in terms of market share and inflow of FDI.

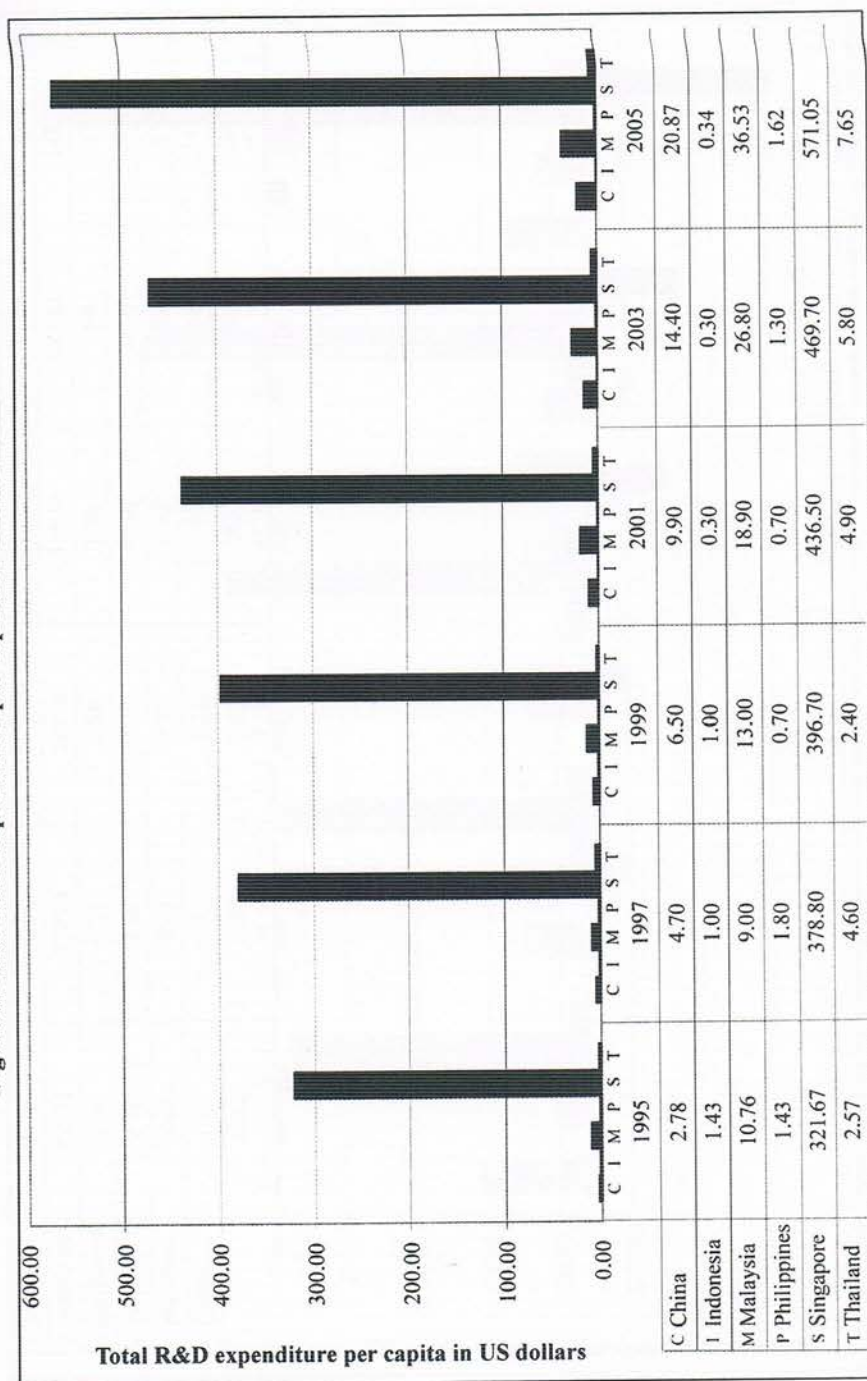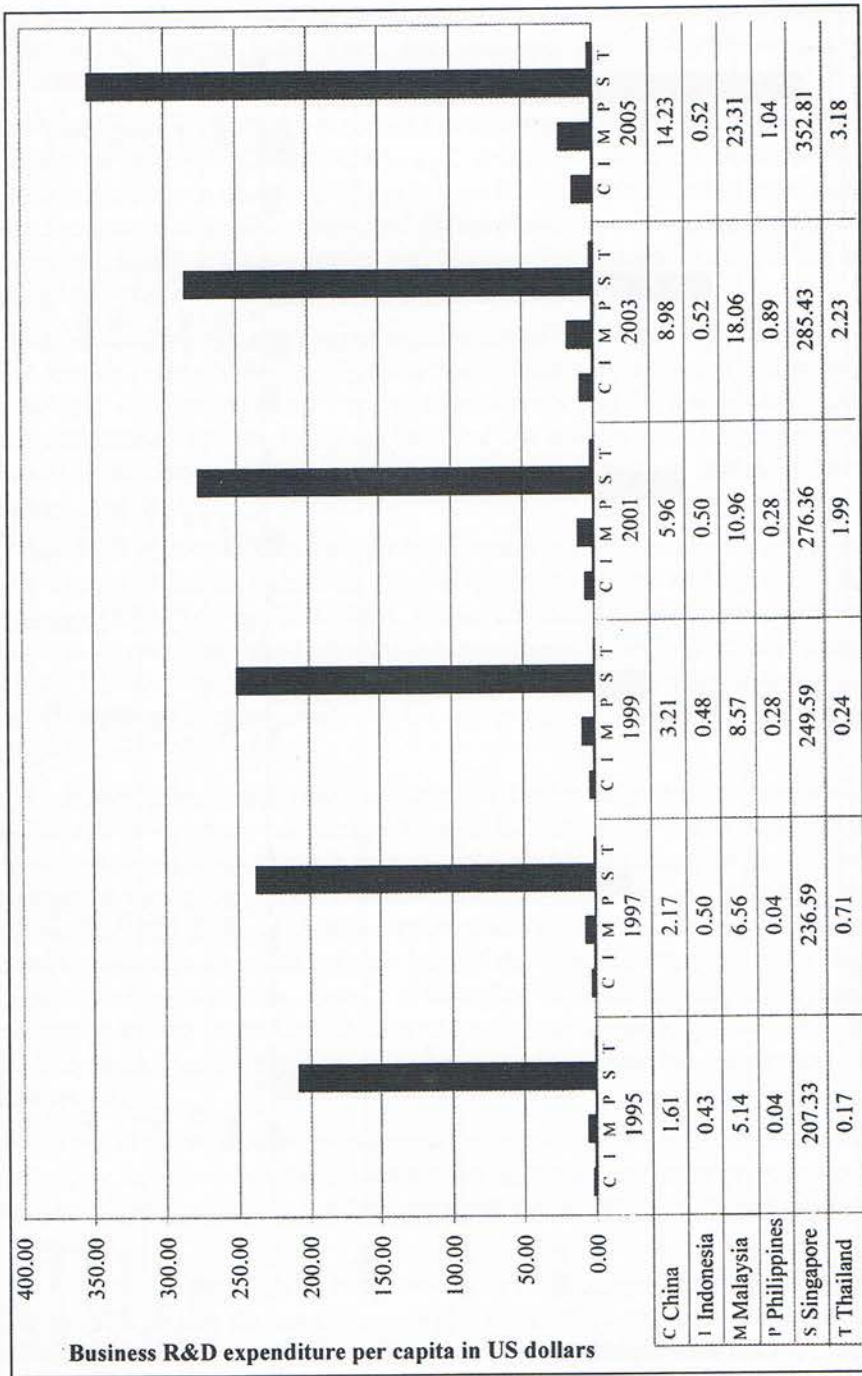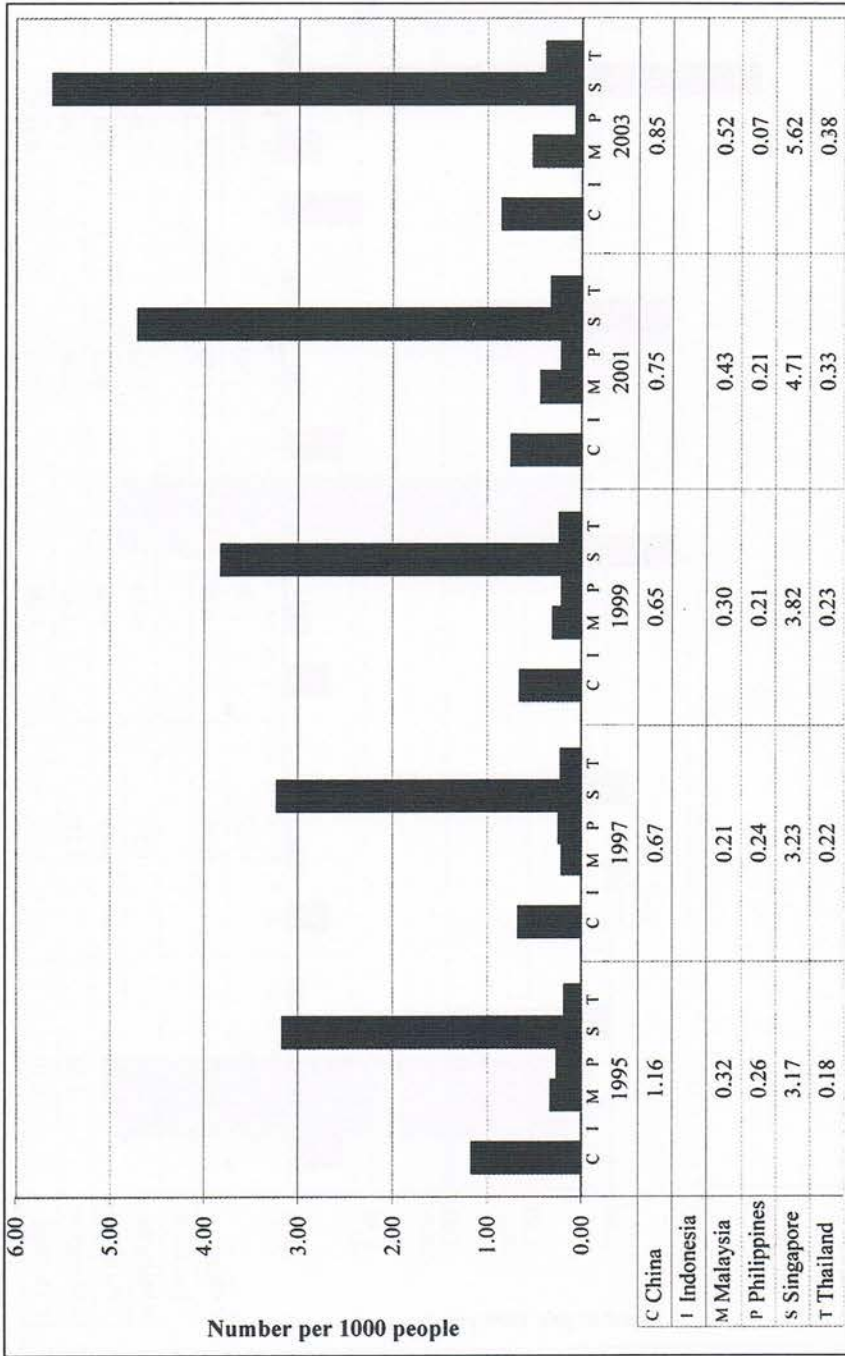Figure 1. Total R&D expenditure per capita for China and ASEAN-5

	1995	1997	1999	2001	2003	2005
C China	2.78	4.70	6.50	9.90	14.40	20.87
I Indonesia	1.43	1.00	1.00	0.30	0.30	0.34
M Malaysia	10.76	9.00	13.00	18.90	26.80	36.53
P Philippines	1.43	1.80	0.70	0.70	1.30	1.62
S Singapore	321.67	378.80	396.70	436.50	469.70	571.05
T Thailand	2.57	4.60	2.40	4.90	5.80	7.65

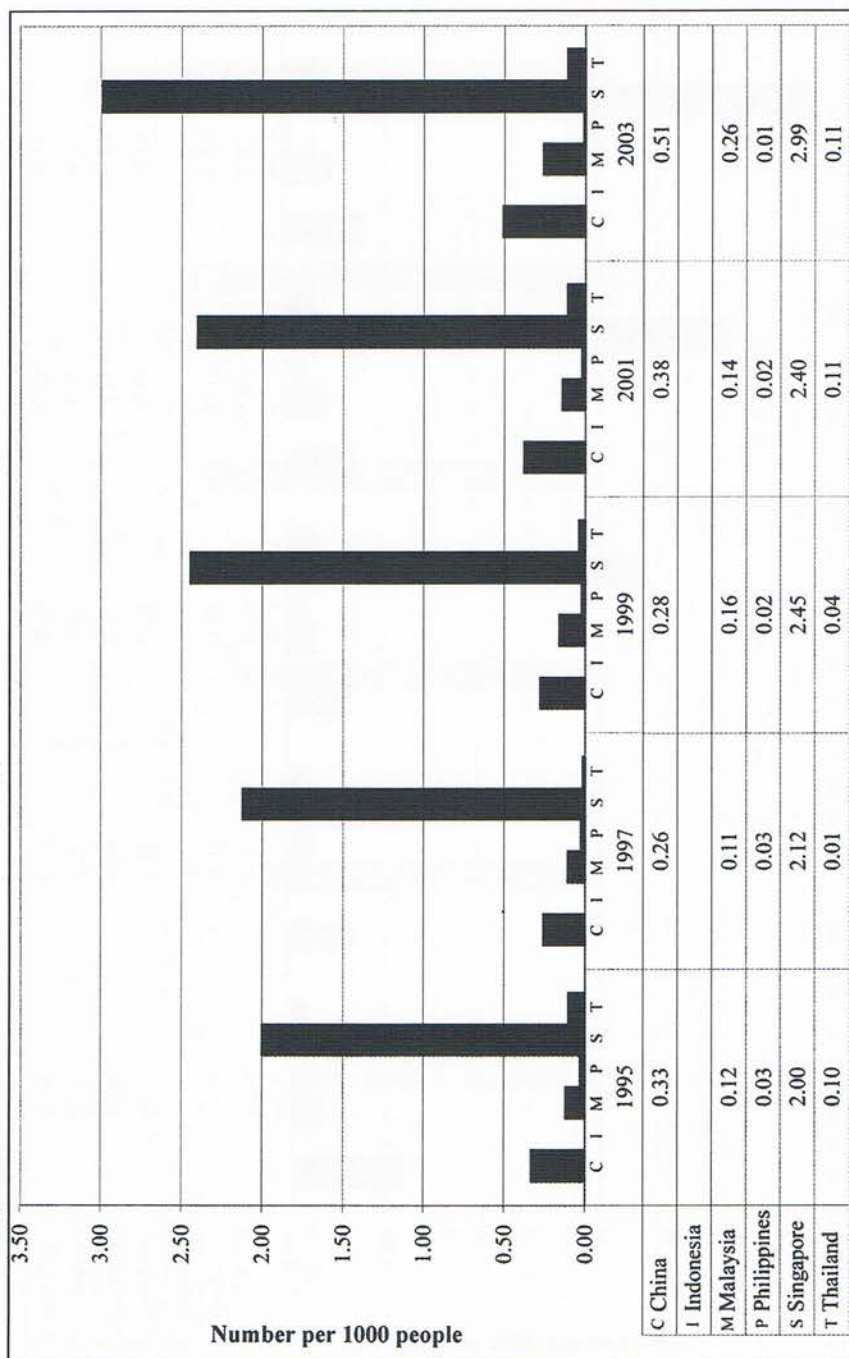Figure 2. Total business R&D expenditure per capita for China and ASEAN-5

	C I M P S T 1995	C I M P S T 1997	C I M P S T 1999	C I M P S T 2001	C I M P S T 2003	C I M P S T 2005
c China	1.61	2.17	3.21	5.96	8.98	14.23
i Indonesia	0.43	0.50	0.48	0.50	0.52	0.52
m Malaysia	5.14	6.56	8.57	10.96	18.06	23.31
p Philippines	0.04	0.04	0.28	0.28	0.89	1.04
s Singapore	207.33	236.59	249.59	276.36	285.43	352.81
t Thailand	0.17	0.71	0.24	1.99	2.23	3.18

Business R&D expenditure per capita in US dollars

Figure 3. Total R&D full-time equivalent personnel nationwide in China and ASEAN-5

	1995	1997	1999	2001	2003
C China	1.16	0.67	0.65	0.75	0.85
I Indonesia					
M Malaysia	0.32	0.21	0.30	0.43	0.52
P Philippines	0.26	0.24	0.21	0.21	0.07
S Singapore	3.17	3.23	3.82	4.71	5.62
T Thailand	0.18	0.22	0.23	0.33	0.38

Note: The data for Indonesia was not available.

Figure 4. Total R&D full-time equivalent personnel in business enterprises in China and ASEAN-5

	1995	1997	1999	2001	2003
C China	0.33	0.26	0.28	0.38	0.51
I Indonesia					
M Malaysia	0.12	0.11	0.16	0.14	0.26
P Philippines	0.03	0.03	0.02	0.02	0.01
S Singapore	2.00	2.12	2.45	2.40	2.99
T Thailand	0.10	0.01	0.04	0.11	0.11

Number per 1000 people

Note: The data for Indonesia was not available.

Figure 5. Number of patents granted to residents of China and ASEAN-5

	2000-02	2002-04
C China	5913	5913
I Indonesia		
M Malaysia	25	27
P Philippines	6	16
s Singapore	174	217
T Thailand	98	60
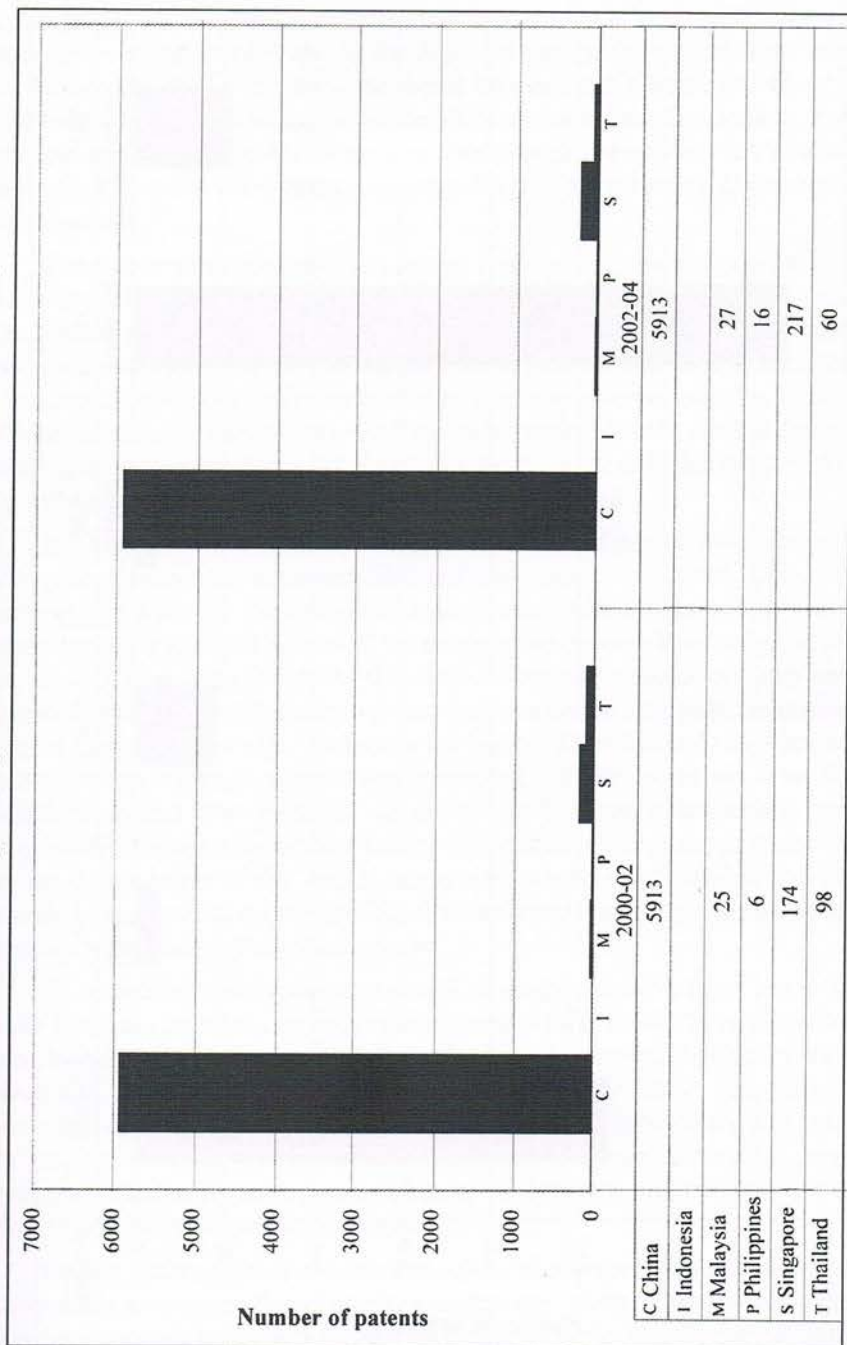
Note: The patents are average for the periods 2000-2002 and 2002-2004. The data for Indonesia were not available.

Figure 6. Number of patents secured abroad by residents of China and ASEAN-5 in 2003

	China	Indonesia	Malaysia	Philippines	Singapore	Thailand
Series1	529	24	90	26	734	109
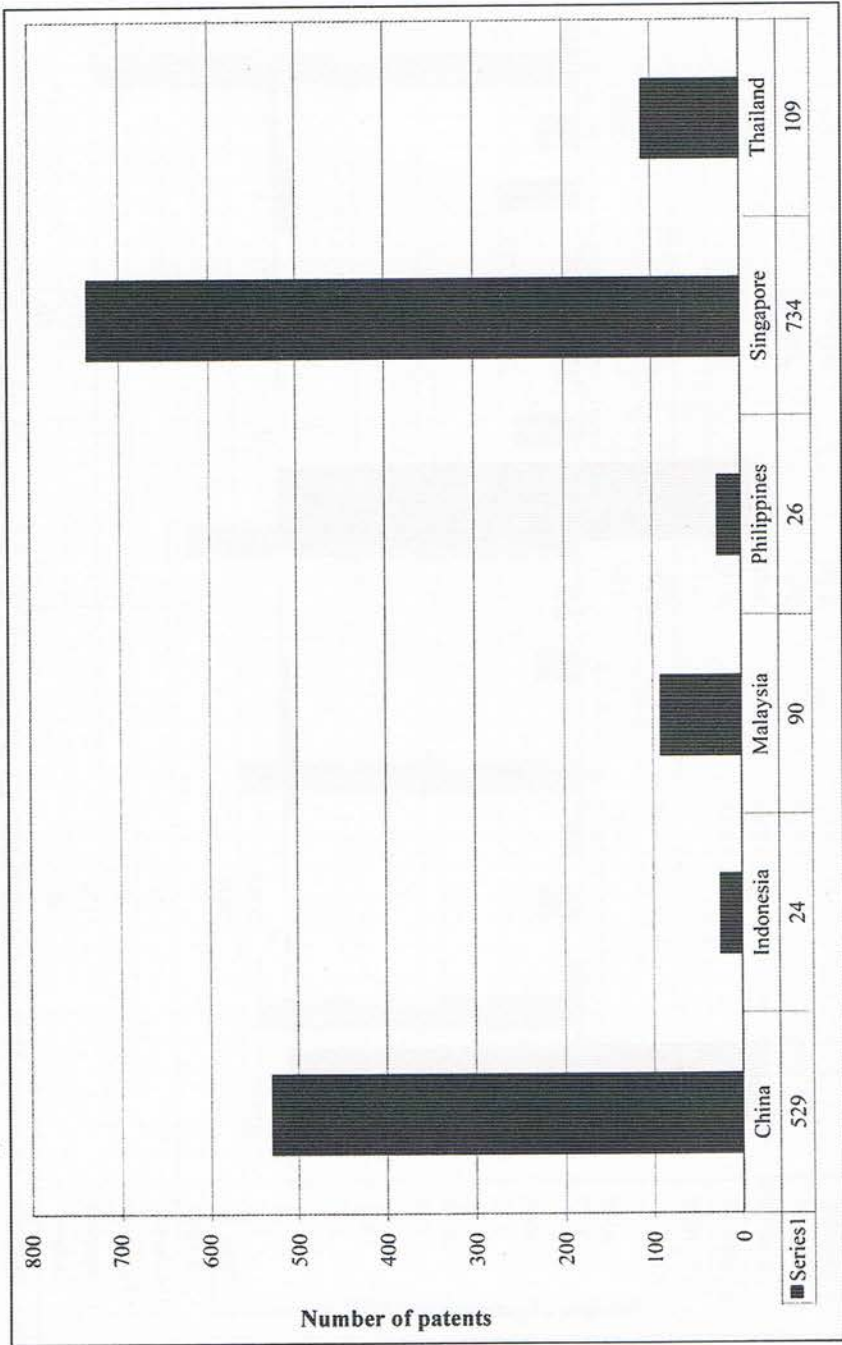
In this section, we discuss the strategies for enhancing the innovative capacity and competitiveness of ASEAN-5, especially in the manufacturing sector. Connectivity in the new economy is vital for economies to achieve economies of scale and economies of scope. In the digital economy, the market is not confined to the borders of the country—the world becomes the market. Moreover, firms and industries are able to source factors of production from the global market at a cheaper and faster pace. Firms are also able to track changes in the global market demand. These can allow firms to adapt quickly to the changing global economic environment.

The information economy can render benefits to firms and nations in terms of increased efficiency and productivity. However, ICT infrastructures in most of the ASEAN countries (except Singapore) are underdeveloped. To overcome this, ASEAN countries should increase access to ICT infrastructure and facilities through the adoption of cost-effective technologies that have emerged over the last decade. These technologies include very small aperture terminal (VSAT), satellite technology, and digital power line (DPL). Efforts should also be made to bridge the digital divide by enhancing content development in the local language.

It is clear from the empirical analysis that most of the ASEAN-5 countries are losing competitiveness in the unskilled and labor-intensive sectors to China. To stay competitive ASEAN-5 must move into more value-added sectors. This will mean transforming traditional sectors of the economy to be more knowledge driven and technology intensive. To achieve this, ASEAN economies should not only invest in increasing the supply of skilled workers, but also create a suitable environment to attract the best knowledge workers to the region. Completion of high school and university-level education should be intensified. Further, incentives in the form of scholarships and other financial support should be given to students to enroll in higher degree research programs (master's and doctor's degrees) in areas strategic to the development of the ASEAN economies. More liberal immigration policies should be enforced to encourage skilled workers and research personnel from other regions to relocate to the ASEAN region.

To attract the best researchers and technology-intensive firms to the region, both fiscal and nonfiscal incentives to undertake R&D should be in place. In most developed countries access to R&D funding and infrastructure support are easily available. With the exception of Singapore, most other ASEAN economies spend very little on R&D efforts. To leapfrog to higher stage of innovation, R&D spending in the ASEAN region should increase to the level comparable to other developed countries. That is, at least 2 percent of the gross domestic product (GDP) per annum should be allocated for R&D activities.

Further, active policies and schemes should be in place to encourage and support innovation among small and medium enterprises (SMEs). One such scheme that has been successful in many developed countries is the Manufacturing Extension Program (MEP), which is modeled after the US program. The primary objective of

the MEP is to foster strong collaboration between the "triple-helix" (universities, government, and industry). Under the MEP, funds are allocated to region-based manufacturing and training centers (which include universities and research laboratories) to be an important one-stop location for firms, especially SMEs, to upgrade their skills and acquire new technology. These centers provide a range of services to firms, which include business proposal development, grant application, technical consulting, hands-on training, technology demonstrations, assistance in selecting appropriate technology, and funding information.

Sustaining creativity and innovation in the new economy is both complex and challenging. Key to managing innovation is the existence of a legislative framework that administers and protects intellectual property (IP). Nations with effective IP policies and enforcement thereof are in a better position to benefit from the outcomes of R&D activities and innovation. One of the factors that contribute to low levels of innovation in many of the ASEAN-5 countries is the inadequate legislative framework to protect IP and weak enforcement of IP regulations. To increase the flow of investment into knowledge-driven and innovation-intensive sectors, ASEAN nations must increase public awareness on innovation, inventions, and IP. Measures on patenting rules and regulations on IP need to be clearly defined and communicated effectively to the public.

6. Conclusion

In this paper, we examined the impact of China on the various industries in the ASEAN-5 countries. The empirical analysis suggests that China is competitive in the unskilled and labor-intensive sectors. The study also showed that China has also been increasing its presence in medium- and high-skilled sectors over the years. This is because China has been enhancing its innovative capacity over the last decade.

China's strategy of enhancing competitiveness in low-, medium-, and high-skilled sectors has significant implications for all nations in the ASEAN region. In this paper, we discussed strategies to reduce the competitiveness gap between China and the ASEAN-5. This study highlights that innovation is key to closing the economic disparities between China and ASEAN-5, especially in the manufacturing sector.

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