The dynamics of changing trade structures: export sophistication index

The structure of export commodities in the fast-growing, trade-dependent economy has been moving to more and more sophisticated products which used to be predominantly produced by high-wage countries in the OECD. Theoretically, high-income countries tend to have comparative advantage in more capital- and technology-intensive commodities and enjoy relatively higher wage rates than low-income countries. As emerging Asian countries move upward on the export ladder (Chapter 1), the structure of their export commodities will also become more sophisticated. One way to monitor the shifting trade structures in those developing Asian countries is to examine the changing structures of export commodities based on the degree of product sophistication.

The innovative “export sophistication index” is credited to Lall et al. (2006), who created it to measure the degree of product sophistication for export commodities. The reason that the sophistication of a country’s exports is analyzed is that average income of exporters rises with sophistication (Lall et al., 2006, p. 223). It is rationalized that, in a competitive world market, products from high-wage countries must be “strongly sophisticated,” or with “high quality” relative to those from rivals. Therefore, exports from high-wage countries which could compete with similar products produced by low-wage countries and maintain their market shares must be classified as “highly sophisticated products.”

The sophistication index of exports assigns to each product a number between 0 and 100 on the basis of the weighted average of the exporter’s income, and the maximum as well as the minimum unique sophistication scores of the dollar value for all products is given by:

\[ SI(i) = 100 \frac{US(i) - US(min)}{US(max) - US(min)} \]  

where \( SI(i) \) is the normalized sophistication index of product \( i \), \( US(i) \) is the unique sophistication score as the dollar value of product \( i \), which
is a weighted average of exporters’ income of product $i$. $US_{\text{max}}$ and $US_{\text{min}}$ are the maximum and minimum unique sophistication dollar values for all products. By using the per capita income of the exporting country as a proxy of the degree of sophistication, the sophistication index would, as Lall et al. (2006) argue, include the “embodiment of high-level technology,” as well as other factors such as “transport costs, natural resource availability, marketing, infrastructure quality and the degree of fragmentability [sic] of production” (2006, p. 223). Furthermore, they argue that the sophistication index, which “is an amalgam of these influences and not a specific technological measure” (p. 223), is a reasonably good index of measurement of how a country’s sophistication level differs from its competitors’ in the world market. The scores of each product are ranked from 0 to 100 based on three-digit and four-digit Standard International Trade Classification (SITC) (revision 2). Excluding the primary exports, there are 181 product groups based on three-digit SITC codes and 766 product groups based on four-digit SITC codes. Six levels were created to organize the 181, with level 1 being the most sophisticated and level 6 being the least.

As argued by Lall et al., the aggregate sophistication index for each country can also serve as “an indicator of export similarity with developed countries” (2006, p. 232). Using the sophistication index of 1990 and 2000, the ranking of the weighted average of sophistication index for the ten Asian countries in 1990 and 2000 is reported in Table 5.1.

The absolute value of the weighted average of the sophistication index is less important than the rankings and the changes between 1990 and 2000. One can see from Table 5.1 that, in terms of the aggregate scores of the sophistication index, the rank of Japan and the first tier of the newly

Table 5.1  The weighted average of the sophistication index for ten Asian countries

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>82.63</td>
<td>70.83</td>
</tr>
<tr>
<td>Taiwan</td>
<td>69.03</td>
<td>64.65</td>
</tr>
<tr>
<td>Singapore</td>
<td>68.66</td>
<td>64.28</td>
</tr>
<tr>
<td>Korea</td>
<td>65.21</td>
<td>64.24</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>65.16</td>
<td>57.34</td>
</tr>
<tr>
<td>China</td>
<td>51.41</td>
<td>52.02</td>
</tr>
<tr>
<td>Philippines</td>
<td>50.17</td>
<td>61.52</td>
</tr>
<tr>
<td>Malaysia</td>
<td>50.15</td>
<td>56.14</td>
</tr>
<tr>
<td>Thailand</td>
<td>48.30</td>
<td>52.56</td>
</tr>
<tr>
<td>Indonesia</td>
<td>26.81</td>
<td>37.80</td>
</tr>
</tbody>
</table>
Industrialized countries (NICs) was fairly stable in the decade of the 1990s. Japan was ranked top, followed by Taiwan, Singapore, Korea, and Hong Kong in 1990 and 2000. The first tier of the NICs were ranked higher than China and the Association of Southeast Asian Nations (ASEAN)-4 in 1990 and 2000. Furthermore, the ranking of the product sophistication did not change between 1990 and 2000, even though the four Little Tigers were on the heels of Japan because of their export promotion strategy, which was shortly afterward replicated by China and the ASEAN-4. China was ranked higher than the Philippines, Malaysia, and Thailand in 1990 but was surpassed by all three in 2000. Indonesia was ranked the least sophisticated exporter in 1990 and 2000. A final thing to observe in Table 5.1 is the decreasing product sophistication in Japan and the NICs and the increasing product sophistication in China and the ASEAN-4. This is the thesis of “de-sophistication” of world trade in that more and more low-income countries penetrated the world market in high-quality products, a topic that is discussed in sections 5.3 and 5.5.

To observe the path of product development in terms of export sophistication, it is best to construct the sophistication index for each year to reflect the shifting structures of export commodities of each country over time. Unfortunately, the annual sophistication index for all export commodities is not available. Therefore, the sophistication index of 1990 and 2000 from Lall et al. (2006) is used here to illustrate the shifting composition of export commodities by the percentage distribution of the 181 exports commodities in total exports to the world.

5.1 THE WEIGHTED AVERAGE OF SOPHISTICATION INDEX SCORES BETWEEN 1990 AND 2000

Based on the sophistication index of 1990 and 2000, the weighted average scores of sophistication index for Japan and the four Little Tigers are reported in Figures 5.1 and 5.2. One can see that exports from Japan were much more sophisticated than those of all the NICs. But the gap of sophistication has become narrower because the NICs have substantially shifted their export commodities toward more sophisticated exports over time. Furthermore, though Korea started its economic development after Taiwan, in terms of the degree of product sophistication, Korea caught up with Taiwan within a short period of time in the 1960s. After the mid-1970s, the degree of product sophistication between Korea and Taiwan was virtually identical, as Figures 5.1 and 5.2 show. Meanwhile, the trend of “de-sophistication” can be identified by comparing the scale in 1990
The dynamics of changing trade structures

and 2000; the sophistication index of export commodities for Japan as well as the NICs decreased over time.

Looking at Figures 5.3 and 5.4, one can see that the gap of export sophistication between Japan and ASEAN as well as China is much wider than that between Japan and the four NICs. Nevertheless, due to the foreign direct investment (FDI)–trade nexus and the proliferation of outsourcing, China and ASEAN caught up much faster after the mid-1980s.
Among the ASEAN-4, the country with the least development of product sophistication is Indonesia.

5.2 THE PERCENTAGE DISTRIBUTION OF MANUFACTURED EXPORTS BY LEVELS OF PRODUCT SOPHISTICATION

The above section illustrates the overall development of product sophistication over time. Whether based on the scores of the 1990 or 2000...
The dynamics of changing trade structures

Sophistication index, all developing East Asian countries shared a “similar trend” of development. To understand better the changing composition of export commodities in terms of degree of sophistication, it is necessary to look at the shifting components of each of the six levels of export commodities sophistication based on the composition of exports and their respective sophistication index.

In this section, the 1990 sophistication index based on the three-digit SITC codes is used to calculate the percentage distribution of manufactured exports in the six levels of product sophistication over time. The sophistication index of 1990 of each export commodity is multiplied by the share of each product in total exports each year. Of course, using the 1990 sophistication index as a benchmark for time series data would be biased because “there is widespread (but not universal) de-sophistication of manufactured products,” as argued by Lall et al. (2006, p. 235). However, the purpose here is to show the time trend of shifting structures of export commodities for all countries over time. Hence, the following figures could still serve as a reference for inter-temporal comparisons for each country’s export structures.

As is typical for an industrialized country, Japan’s export commodities are highly sophisticated (levels 1 and 2) (Figure 5.5) with steady growth over time in those top products at levels 1 and 2. Growth was most significant in the aftermath of the first energy crisis in the second half of the 1970s and accelerated with the appreciation of the yen following the Plaza Accord of 1985. On the other hand, the percentage shares of low-sophisticated exports (levels 5

Figure 5.5 Distribution of level 6 product sophistication in Japan’s exports

Japan (1990 sophistication index)
Trade and industrial development in East Asia

and 6) have steadily declined. This development provided room for the NICs to penetrate in the world market as the “flying geese” pattern had dictated.

Hong Kong experienced the most significant decline in the share of the lowest level of product sophistication (level 6) over time (Figure 5.6). The least sophisticated products (level 6) dominated Hong Kong’s exports by accounting for more than 50% of its total exports until the end of the 1970s. Yet their percentage share in total exports dropped to less than 20% after 2002. There is also a significant, though less resilient, trend of the declining share of level 5 in Hong Kong’s exports. But the percentage share of highly sophisticated products only had modest growth in Hong Kong’s export structure.

Korea has had a significant trend of declining shares of low-sophisticated exports (levels 5 and 6) in its total exports (Figure 5.7). But Korean export commodities experienced much more significant growth in the medium and high levels of export sophistication. Moreover, Korea gained significant progress in the most sophisticated products (level 1), which accounted for more than 20% of total exports by 2006.

Singapore’s path of development of product sophistication is similar to that of other NICs: there is a significant decline in the share of the least sophisticated products (level 6) in its exports (Figure 5.8). But there is also a significant increasing trend in the share of the medium level of sophisticated products (level 3) and to a lesser extent of those products at level 4. The percentage share of medium-level sophisticated products exceeded that of the least sophisticated ones after 1990.

Figure 5.6 Distribution of level 6 product sophistication in Hong Kong’s exports
The dynamics of changing trade structures

Taiwan’s export structure went through several stages of export substitution from low to high levels of sophistication. While the least sophisticated products (levels 5 and 6) dominated its exports in the 1960s and the 1970s, the stage of the “golden cross-over” occurred in the late 1980s when the share of medium levels of sophisticated products (level 3) exceeded that of the low-sophisticated products (level 6). After the second half of the 1980s, the medium levels of sophisticated products (levels 3 and 4) dominated the share of its total exports in the world market (Figure 5.9).

Figure 5.7 Distribution of level 6 product sophistication in Korean exports

Figure 5.8 Distribution of level 6 product sophistication in Singaporean exports
Nevertheless, the most sophisticated products (level 1) accounted for less than 10% of Taiwan’s exports, a much smaller figure than that seen in Korea.

China’s exports were predominated by the least sophisticated products; the least sophisticated products: goods of levels 5 and 6 were the major exports for China during the three decades from the 1960s to the 1980s (Figure 5.10). The percentage share of the “second to least” sophisticated
products (level 5) was exceeded by the medium level of 3 at the end of the 20th century, and the least sophisticated products (level 6) were the most important export commodities until 2002, when they were replaced by medium level goods. Nevertheless, China made modest progress in its gains of export shares in the most sophisticated products (levels 1 and 2) after the second half of the 1980s.

Indonesia’s export structure was dominated by the least sophisticated...
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The shares of the least sophisticated products in its total exports, though they declined in the 1960s and 1970s, increased again in the 1980s and have maintained their dominance ever since. There is only spotty evidence that the shares of its most sophisticated products (levels 1 and 2) increased after the 1990s.

Malaysia has a clear pattern of product development in the increasing shares of the most sophisticated products (levels 1 and 2) (Figure 5.12).
But its developments in the medium (levels 3 and 4) and low levels (levels 5 and 6) of sophisticated products fluctuated from time to time, except for level 5 of sophisticated product, which had a significant decline after the mid-1980s.

Product development in the Philippines (Figure 5.13) shows that the steady decline of its least sophisticated products (level 6) was replaced by an increasing share of a medium level of sophistication (level 4). The other identifiable trend is that level 5 commodities in total exports were replaced by those of level 3. But there is only limited progress for the most sophisticated products (levels 1 and 2) for their shares in total exports.

Different from that of Malaysia, the structure of export commodities in Thailand (Figure 5.14) has a clear path in which, except for the declining share of the least sophisticated products (level 6), the shares of all other levels of sophisticated products had an increasing trend after the mid-1980s.

5.3 MANUFACTURING FRAGMENTATION AND THE SHIFTING COMPARATIVE ADVANTAGE

To demonstrate further the shifting comparative advantage in those developing countries over time, one can cross-classify the manufactured products by both the levels of production technology (Lall, 2000) and product sophistication (Lall et al., 2006). Since the score of product sophistication ranges from 100 to 0, it is easy to classify all 181 manufactured product groups by three-digit SITC into only two categories: one containing the product groups with a sophistication index greater than 50, and the other containing the groups with a “low” sophistication index below 50. Export commodities based on production technology are classified by Lall into two categories of high-tech (electronic and electric for HT1; others for HT2), three categories of medium-tech (automotive for MT1; process for MT2; engineering for MT3), two categories of low-tech (textile, garment, and footwear for LT1; others for LT2) and two categories of resource-based (agro-based for RB1; others for RB2). One way to examine the shifting comparative advantage for trade-dependent Asian economies is to examine the changing market shares of their exports in each product category by cross-classifying export commodities based on production technology and degree of product sophistication. Empirical study in this section will also illustrate whether there is a trend of “de-sophistication” after the spread of the global production network since the 1980s.

Table 5.2 decomposes the export commodities by the scores of the
Table 5.2  Cross-classification of export commodities by levels of technology and the sophistication index

<table>
<thead>
<tr>
<th>Low sophistication index (&lt;50)</th>
<th>High sophistication index (&gt;50)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HT</strong>  High-tech products which are outsourced and relocated to low-wage countries due to FDI/fragmentation process</td>
<td>High-tech products without being threatened by fragmentation process. Comparative advantages in high-wage countries are being enjoyed monopolistically or oligopolistically in industrialized countries due to high quality and/or high technology.</td>
</tr>
<tr>
<td><strong>MT</strong>  Medium level of technological products at which the low-wage countries have comparative advantage in the world market due to technology transfer and/or outsourcing from high-wage countries</td>
<td>Products with a medium level of technology for which high-wage countries still enjoy comparative advantage in the world market</td>
</tr>
<tr>
<td><strong>LT</strong>  Low-tech products which were shifted from high- to low-wage countries due to technological catching-up process in the low-wage countries</td>
<td>Low-tech products for which high-wage countries have comparative advantage due to specific factor endowments, brand names, or high quality, and/or distorting trade policies</td>
</tr>
<tr>
<td><strong>RB</strong>  Resource-based products, where low-wage countries have comparative advantage in the world market</td>
<td>Unique natural resources-based products for which high-wage countries enjoy comparative advantage in the world market and/or protection of trade distortion policies</td>
</tr>
</tbody>
</table>

sophistication index based on three-digit SITC into high and low sophistication (greater than and less than 50) as well as different levels of production technology and resource-based by Lall (2000).

The product groups with high sophistication (sophistication index score greater than 50) in the high-tech sector reflect the phenomenon that technologically advanced products had no fragmentation process or outsourcing. These product groups probably belong to the high wage domain of the Organisation for Economic Co-operation and Development (OECD), which, despite the spreading out of the global production network, had maintained their strong comparative advantage. For those high-tech products with low sophistication level (sophistication index
score less than 50), the theoretical argument is that these product groups are the potential candidates for outsourcing to low-wage countries. Yet by comparing the sophistication index in 1990 and 2000, the only high-tech product that shifted from high-wage to low-wage countries is SITC 761, television receivers.

A similar yet stronger argument could also apply to the product groups at the medium levels of technology; the development of fragmentation of the manufacturing production process enabled some product groups with a medium level of production technology to shift to low-wage countries. The likelihood of shifting medium-level technological products to low-wage countries is even higher than for high-tech products. Empirically, there are three medium-tech product groups which shifted from high-wage to low-wage countries between 1990 and 2000. They are SITC 653 (woven man-made fibers, fabric), SITC 671 (pig iron) and SITC 762 (radio broadcast receivers).

For high-wage countries to produce low-technological products and enjoy their comparative advantages in the world market, they must possess very unique factor endowments, enjoy brand names, and adopt highly protective trade policies to keep their market shares of those low-tech products in high-wage countries. Obviously, low-tech products with low sophistication scores are the most likely product groups where emerging markets would have the comparative advantages with the strongest potential to penetrate into the world market. Between 1990 and 2000, 17 low-tech product groups shifted from high-wage to low-wage countries. Most of them are textiles, garments and footwear (SITC 611–13, 651–52, 658, 831, 842–48, 851), pottery (SITC 666) and base metal household equipment (SITC 697).

For the resource-based products, whether they belong to the specialty of high-wage or low-wage countries, their comparative advantages probably depend on factor endowments and/or trade distortion policies by the exporting countries. With the rapid growth of input trade, it is not surprising that between 1990 and 2000 14 resource-based products shifted from high-wage to low-wage countries. They were agricultural-based product groups such as fish (SITC 037), vegetables preserved/prepared (SITC 056), fruit preserved/prepared (SITC 058), sugar/honey (SITC 061), jute/other textile-based fibers (SITC 264), and fixed vegetables/vegetable oils (SITC 423–24). Others include iron ore (SITC 281), uranium, thorium ore (SITC 286), base metals (SITC 287), precious metal ores (SITC 289), briquette coke (SITC 323), lime, cement building products (SITC 661), and mineral manufactures (SITC 663). The product lists for the cross-classification of technology level and the 1990 and 2000 sophistication index are reported in Appendix Table A5.1.
5.4 THE SHIFTING TRADE SECTORS DUE TO FRAGMENTATION OF MANUFACTURING PRODUCTION BETWEEN 1990 AND 2000

The purpose of this and the following sections is to illustrate the shifting market shares in low- and high-sophistication exports due to fragmentation of manufacturing production and the trend of “de-sophistication” in those developing Asian countries at the industrial levels. By calculating the market shares of each of the eight categories of product groups cross-classified by sophistication index (three-digit SITC) and technology levels between 1990 and 2000, one can find the shifting export structures in terms of changing market shares of product sophistication in each of the ten Asian countries during the decade of the 1990s, as Table 5.3 reports.

Because more product groups shifted from high- to low-sophistication categories, the gains of the market shares in Table 5.3 include both the increase of the coverage of products as well as the market shares. Analysis of the sources of export growth by the decomposition of market effect and product composition effect by a new method of “constant market share” will be carried out in Chapter 6.

The increase in the market share of manufactured products in the low-wage countries is mainly due to globalization and the fragmentation of the global manufacturing process. Therefore, there was a shift from high- to low-sophistication products over time. For example, television receivers (SITC 761) were shifted from a high- to a low-sophistication product category in 2000. Looking at the shifting comparative advantage, Malaysia had a market share on the high-tech, low-sophistication products of 6.99% in 2000, followed by 5.5% in Korea, 4.51% in China, 3.8% in Thailand, 2.0% in Singapore, 1.74% in Taiwan, 1.66% in Hong Kong, 1.09% in Indonesia, and 0.28% in the Philippines. It is interesting to point out that Japan, as a highly industrialized country and the world leader of TV manufacturing in the late 1970s, still had a market share of 11.58% for television receivers (SITC 761) in 2000. This probably reflects the product differentiation and quality dispersion of this product group, which needs to be further studied by the relative price indexes in the world market.

Among those medium levels of technology which shifted to low-wage countries between 1990 and 2000, radio broadcast receivers (SITC 762) is the most significant product category in which Asian countries gained market share in the decade of the 1990s. In 2000, Asian countries gained more than two-thirds of the market share of world exports of radio broadcast receivers (SITC 762). Among them, Hong Kong, China, and Malaysia gained the most of the world market share, with 17.45%, 15.25% and 13.26% respectively in 2000. Other countries such as Singapore
### Table 5.3  Shifting market shares in the low-sophisticated exports between 1990 and 2000

<table>
<thead>
<tr>
<th>Low sophistication index (&lt;50)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HT</strong></td>
</tr>
<tr>
<td>Japan (+11.58%)</td>
</tr>
<tr>
<td>Malaysia (+6.99%)</td>
</tr>
<tr>
<td>Korea (+5.50%)</td>
</tr>
<tr>
<td>China (+4.51%)</td>
</tr>
<tr>
<td>Thailand (+3.8%)</td>
</tr>
<tr>
<td>Singapore (+2%)</td>
</tr>
<tr>
<td>Taiwan (+1.74%)</td>
</tr>
<tr>
<td>Hong Kong (+1.66%)</td>
</tr>
<tr>
<td>Indonesia (+1.09%)</td>
</tr>
<tr>
<td>Philippines (+0.28%)</td>
</tr>
<tr>
<td><strong>MT</strong></td>
</tr>
<tr>
<td>MT3 (SITC 762)</td>
</tr>
<tr>
<td>Radio broadcast receivers</td>
</tr>
<tr>
<td>Hong Kong (+17.45%)</td>
</tr>
<tr>
<td>China (+15.25%)</td>
</tr>
<tr>
<td>Malaysia (+13.26%)</td>
</tr>
<tr>
<td>Japan (+5.80%)</td>
</tr>
<tr>
<td>Singapore (+5.31%)</td>
</tr>
<tr>
<td>Indonesia (+3.14%)</td>
</tr>
<tr>
<td>Korea (+2.90%)</td>
</tr>
<tr>
<td>Thailand (+1.94%)</td>
</tr>
<tr>
<td>Taiwan (+0.83%)</td>
</tr>
<tr>
<td>Philippines (+0.65%)</td>
</tr>
<tr>
<td>MT2 (SITC 653, 671)</td>
</tr>
<tr>
<td>Woven man-made fiber fabric, pig iron</td>
</tr>
<tr>
<td>Hong Kong (+10.74%)</td>
</tr>
<tr>
<td>China (+10.34%)</td>
</tr>
<tr>
<td>Taiwan (+8.87%)</td>
</tr>
<tr>
<td>Japan (+6.27%)</td>
</tr>
<tr>
<td>Hong Kong (+5.26%)</td>
</tr>
<tr>
<td>Indonesia (+3.10%)</td>
</tr>
<tr>
<td>Thailand (+1.40%)</td>
</tr>
<tr>
<td>Malaysia (+0.92%)</td>
</tr>
<tr>
<td>Singapore (+0.58%)</td>
</tr>
<tr>
<td>Philippines (+0.12%)</td>
</tr>
<tr>
<td><strong>RB</strong></td>
</tr>
<tr>
<td>RB2 (others)</td>
</tr>
<tr>
<td>China (+3.3%)</td>
</tr>
<tr>
<td>Indonesia (+2.26%)</td>
</tr>
<tr>
<td>Japan (+1.18%)</td>
</tr>
<tr>
<td>Thailand (+0.66%)</td>
</tr>
<tr>
<td>Taiwan (+0.47%)</td>
</tr>
<tr>
<td>Korea (+0.3%)</td>
</tr>
<tr>
<td>Hong Kong (+0.28%)</td>
</tr>
<tr>
<td>Singapore (+0.081%)</td>
</tr>
<tr>
<td>RB1 (agro-based)</td>
</tr>
<tr>
<td>China (+4.42%)</td>
</tr>
<tr>
<td>Thailand (+2.84%)</td>
</tr>
<tr>
<td>Japan (+0.41%)</td>
</tr>
<tr>
<td>Hong Kong (+0.33%)</td>
</tr>
<tr>
<td>Korea (+0.13%)</td>
</tr>
<tr>
<td>***</td>
</tr>
<tr>
<td>Taiwan (-0.41%)</td>
</tr>
<tr>
<td>Singapore (-0.86%)</td>
</tr>
<tr>
<td>Philippines (-1.01%)</td>
</tr>
<tr>
<td>***</td>
</tr>
<tr>
<td>Philippines (-1.32%)</td>
</tr>
<tr>
<td>Malaysia (-1.59%)</td>
</tr>
<tr>
<td>Indonesia (-0.39%)</td>
</tr>
</tbody>
</table>
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Table 5.3 (continued)

<table>
<thead>
<tr>
<th>LT</th>
<th>Low sophistication index (&lt;50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textile, garment, footwear</td>
<td>Others</td>
</tr>
<tr>
<td>Hong Kong (+6.39%)</td>
<td>China (+18.18%)</td>
</tr>
<tr>
<td>China (+2.53%)</td>
<td>Hong Kong (+7.68%)</td>
</tr>
<tr>
<td>Indonesia (+1.03%)</td>
<td>Taiwan (+4.12%)</td>
</tr>
<tr>
<td>Japan (+0.41%)</td>
<td>Korea (+2.78%)</td>
</tr>
<tr>
<td>***</td>
<td>Thailand (+2.46%)</td>
</tr>
<tr>
<td>Korea (−6.61%)</td>
<td>Japan (+2.39%)</td>
</tr>
<tr>
<td>Taiwan (−2.88%)</td>
<td>Indonesia (+1.41%)</td>
</tr>
<tr>
<td>Malaysia (−0.41%)</td>
<td>Malaysia (+0.42%)</td>
</tr>
<tr>
<td>Thailand (−0.37%)</td>
<td>Philippines (+0.39%)</td>
</tr>
<tr>
<td>Philippines (−0.23%)</td>
<td>Singapore (+0.28%)</td>
</tr>
<tr>
<td>Singapore (−0.09%)</td>
<td></td>
</tr>
</tbody>
</table>

(5.31%), Indonesia (3.14%), Korea (2.9%), and Thailand (1.94%) also gained market shares. Altogether, Asian countries gained 66.53% of the market share of world exports in radio broadcast receivers in 2000. It is interesting to note that Japan gained 5.81% of the market share in radio broadcast receivers in 2000 as well. Probably, product differentiation on low-market versus high-market goods (Grossman, 1982) could explain this interesting phenomenon.

Among the processed products (MT2), both SITC 653 (woven man-made fiber fabric) and SITC 671 (pig iron) were the two product groups which shifted to low-wage countries between 1990 and 2000. Korea gained a market share of 10.74% in 2000, followed by China (10.34%), Taiwan (8.8%), Hong Kong (5.26%), and Indonesia (3.10%). Other Asian countries gained less than 1% in this product group. It is noted that Japan had gained 6.12% of market share mainly because Japan maintained its comparative advantage in quality products of man-made fiber fabric.

Low-sophistication product groups with simple production technology are mainly in textiles, garments and footwear (LT1) and others (LT2). China and Hong Kong had the largest gain of their respective market shares in LT1 product groups, with 16.95% and 12.51% respectively in 2000, followed by Korea (2.89%), Taiwan (2.49%), Indonesia (2.475%), and Thailand (1.84%). Others had less than 1% of market share in this product category.
The dynamics of changing trade structures

For other low-sophistication products with simple technology, China and Hong Kong also lead the gains in world market shares with 18.18% and 7.68%, respectively. Taiwan (4.12%), Korea (2.78%), and Thailand (2.46%) also gained market shares. It is also noted that Japan gained 2.39% of market share in those low-sophistication products with simple product technology, plausibly because of its unique techniques in pottery (SITC 666) and base metal household equipment (SITC 697).

There are two major categories of low-sophistication index in resource-based products which shifted to low-wage countries. For agro-based products, there is a significant gain in the world market shares for those resource-rich countries such as China (6.18%), Thailand (6.32%), Malaysia (5.25%), Indonesia (3.48%), and the Philippines (1.44%). For resource-poor countries such as Japan (0.62%), Taiwan (0.50%), Hong Kong (0.45%), Korea (0.94%), and Singapore (0.47%), the gains of market shares in the agro-based products are not significant.

For other mineral-related resource-based products, Indonesia and China took the lead in gaining their respective world market shares by 4.56% and 4.18% respectively in 2000. All others have less than 1% of the world market, except for Japan which had 1.18% of the world market.

In general, Table 5.3 shows that apart from Japan, all other Asian countries had gained market shares in all product groups in the decade of the 1990s. Fragmentation of manufacturing production had enabled all Asian countries to become the winners of outsourcing in the drive of globalization between 1990 and 2000.

5.5 THE CHANGING MARKET SHARES IN HIGH-SOPHISTICATION PRODUCTS: THE TREND OF “DE-SOPHISTICATION”

Conceptually, high-wage countries tend to have comparative advantage in the highly sophisticated products. Yet in a competitive world market, comparative advantage is dynamically shifting from high- to low-wage countries, and even among industries within the same group of countries at a similar level of development. The 1990s coincided with the Uruguay Round of trade liberalization, for example. Under a freer trading environment in the world market, trade performance in the low-wage countries may be able to outperform that of their competitive rivals. Hence, with much less trade distortion in the world market, the dynamic comparative advantage in the more competitive world market after the Uruguay Round of trade liberalization can be better reflected by actual trade growth.
It is interesting to examine whether there is a significant shift in the market shares for those high-sophistication products (sophistication index greater than 50) between 1990 and 2000, i.e. how significant is the trend of “de-sophistication” in those Asian countries to gain their market shares in these product groups. Even though 146 of the 181 products on three-digit SITC remained as highly sophisticated products with the scores of sophistication greater than 50 between 1990 and 2000, one can still monitor the trend of “de-sophistication” by examining the shifts of market shares in some product categories during the 1990s. In other words, if these emerging Asian economies gained their market shares in those highly sophisticated products relative to industrialized OECD countries, then the argument of global “de-sophistication” can be supported. In that regard, Japan could serve as a benchmark by comparing its trade performances relative to other emerging Asian economies.

Since the purpose in this section is to monitor the general trend of “de-sophistication” in manufacturing exports by relative export performances in high-sophistication products between 1990 and 2000, the high-sophistication export commodities are further classified by different levels of technology and resource intensity. Table 5.4 reports the changing market shares in the high-sophistication products.

Before discussing the changing market shares in the high-sophistication products in each country, one has to point out that there is a changing component in those product groups; for example, while television receivers (SITC 761) were classified as high-sophistication products in 1990, they were shifted to low-sophistication products in 2000. Because Japan had a market share of 11.58% of SITC 761 in 2000, which were counted as high-sophistication products in 1990, Japan’s overall market share in the high-tech, high-sophistication product group declined by 6.79% between 1990 and 2000.

However, in spite of the shifting elements of the high-sophistication products, one can see from Table 5.4 that all other Asian countries gained market share in the high-tech, high-sophistication product group between 1990 and 2000. Virtually all Asian countries gained market share in electronic products with Hong Kong taking the lead with a gain of 2.65%, followed by China (2.51%), Singapore (2.25%), Taiwan (2.05%), Malaysia (1.84%), Korea (1.67%), Thailand (0.71%), and Indonesia (0.45%). There are two major categories in high-tech exports: the first one is electronic and electric products (HT1), and the second is other products (HT2) such as radioactive material (SITC 524), medicinal/pharmaceutical products (SITC 541), steam engines/turbines (SITC 712), aircraft (SITC 792), optimal/measuring/controlling instruments (SITC 871, 874) and photo equipment (SITC 881).
Table 5.4  The changes of market shares in high-sophistication exports, 1990–2000

<table>
<thead>
<tr>
<th>High sophistication index (&gt;50)</th>
<th>China</th>
<th>Hong Kong</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea Rep.</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Singapore</th>
<th>Taiwan</th>
<th>Thailand</th>
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<tbody>
<tr>
<td>High-tech</td>
<td>+2.51%</td>
<td>+2.65%</td>
<td>+0.45%</td>
<td>−6.79%</td>
<td>+1.67%</td>
<td>+1.84%</td>
<td>+1.34%</td>
<td>+2.25%</td>
<td>+2.05%</td>
<td>+0.71%</td>
</tr>
<tr>
<td>Medium-tech</td>
<td>+0.97%</td>
<td>+0.90%</td>
<td>+0.17%</td>
<td>−2.23%</td>
<td>+1.23%</td>
<td>+0.27%</td>
<td>+0.16%</td>
<td>+0.42%</td>
<td>+0.51%</td>
<td>+0.48%</td>
</tr>
<tr>
<td>Low-tech</td>
<td>+0.23%</td>
<td>+2.88%</td>
<td>+0.30%</td>
<td>−1.65%</td>
<td>−0.15%</td>
<td>+0.45%</td>
<td>−0.12%</td>
<td>+0.46%</td>
<td>−0.23%</td>
<td>+0.03%</td>
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<tr>
<td>Resource-based</td>
<td>+0.82%</td>
<td>+0.87%</td>
<td>+0.60%</td>
<td>+0.23%</td>
<td>+1.55%</td>
<td>−0.12%</td>
<td>+0.04%</td>
<td>−0.30%</td>
<td>−0.17%</td>
<td>+0.26%</td>
</tr>
</tbody>
</table>
Production technology in electronic and electric products has become more standardized. Their components and parts have also become more separable. Hence, the production process of electronic and electric products became more and more fragmented, based on cost advantages in each country. The fragmentation of the production process in electronic and electric products has been reinforced by the FDI–trade nexus since the mid-1980s. The resulting global production network enabled developing Asian countries to gain market share in those products after the mid-1980s.

The fragmentation of the production process of consumer electronics and computers was accelerated by the outward FDI from Japan, Korea, and Taiwan and by the reduction of transportation costs. Therefore, by the mid-1990s, East and South East Asian countries became the leading suppliers of consumer electronic production and accounted for two-thirds of world production in consumer electronics. Hence, in spite of less coverage of product group in the high-tech product category, there are significant gains of market share in this product group in developing Asian countries. The development that low-wage countries gained market share in these high-tech, high-sophistication products further supports the argument of “de-sophistication” in the world market during the decade of the 1990s.

The second product group is the medium-tech with high sophistication index. Japan reduced its market share by 2.23% in the decade of the 1990s in this product category. Nevertheless, among the medium-tech product groups of processed and engineering products in MT2, woven man-made fiber fabric (SITC 653) and pig iron (SITC 671) were shifted from the high- to the low-sophistication product category in 2000. Japan had market share of 6.27% of MT2 in 2000 (Appendix Table A5.2). Also, radio broadcast receivers (SITC 762) were shifted to the low-sophistication product category in 2000. Japan also had 5.8% of market share in 2000 (Appendix Table A5.2). For automotive products (MT1), Japan lost its market share in the decade of the 1990s with a drop from 22.91% of market share in 1990 to 16.34% in 2000 (Appendix Table A5.2), a net loss of 6.57% in the world market share for automotives between 1990 and 2000. This resulted from the legacy of the “voluntary export restraint” on the import of automobile products imposed by the US since the late 1980s. Hence, the overall loss of Japan’s market share in the medium-tech but high-sophistication product group was due to the shifting components of product group coverage as well as to its outsourcing of auto parts, process products such as man-made fibers, and radio broadcast receivers.

Other Asian countries gained market share in medium-tech products;
Korea ranked as the largest winner of “de-sophistication” by gaining 1.23% of market share between 1990 and 2000, followed by China (0.97%), Hong Kong (0.90%), Taiwan (0.51%), Thailand (0.48%), Singapore (0.28%), Malaysia (0.27%), Indonesia (0.17%), and the Philippines (0.16%).

The third product group is simple technology with high sophistication index. Japan had a net loss of 1.65% of its market share in this product group in the decade of the 1990s. Among those low-tech products with high sophistication index, Japan still gained 1.06% of its market share in textiles, garments and others (LT1), but lost 3.32% in other low-tech products. Taiwan lost world market share in the low-tech but highly sophisticated products by 0.23%, Korea lost 0.15%, and the Philippines lost 0.12%.

In fact, Taiwan gained 2.88% of market share in textiles, garments and footwear (LT1), but lost 0.54% of market share in other low-tech products (Appendix Table A5.2). Korea also gained market share in textiles, garments and footwear by 5% but lost market share in other low-tech products by 0.38%. In other words, in spite of the structural transformation in their economies, Japan, Korea, and Taiwan still gained respective market shares in textiles, garments and footwear in the decade of the 1990s. On the other hand, China, and the ASEAN-4, with the exception of the Philippines, all lost market share in LT1 (textiles, garments and footwear) but gained in other low-tech products (LT2) during the 1990s. The Philippines lost market share in all low-tech products in the decade of the 1990s.

For the highly sophisticated resource-based products, Japan lost 0.16% of market share in agro-based products but gained 0.5% in others. Taiwan lost 0.25% of market share in agro-based products, but gained 0.15% in others. The Philippines lost 0.01% in agro-based products yet gained 0.08% in others. Indonesia lost 0.07% in market share of other resource-based products but gained 1.47% in agro-based products.

In summary, Table 5.4 shows the gain and loss of market shares in each high-sophistication product group for all countries between 1990 and 2000. At all high-, medium- and low-technology levels, all Asian countries, except for industrialized Japan, gained market share in the world between 1990 and 2000. This tendency is consistent with the “de-sophistication” of world manufactured exports in the decade of the 1990s. The declining market shares of Japan, but the increasing market shares of other Asian countries with relatively low per capita income in the highly sophisticated products in the world market, further confirm that fragmentation of production of manufactured products led those developing Asian countries to climb up the ladder in the global value chain as the level of industrial development accelerated.
5.6 SHIFTING SOPHISTICATION OF EXPORT COMMODITIES IN A DISAGGREGATE INDEX BY FOUR-DIGIT SITC

In general, the three-digit SITC classification provides information about the industry level rather than the product level. To investigate specifically the shifting product sophistication of the export commodities at the product level, it is necessary to examine the dynamics of shifting product sophistication at a disaggregate level. In this section, export commodities will be cross-classified by the sophistication index at four-digit SITC and various levels of production technology. The changes in the sophistication index between 1990 and 2000 could further demonstrate the trend of “desophistication” at a more disaggregate level than that seen in the previous sections.

By comparing the low-sophistication products in 1990 in the left column in Table 5.5 with those in 2000 in the left column in Table 5.6, one can see that there are two high-tech products: SITC 5249 (other radioactive and associated materials) and SITC 7611 (television receivers, color) which shifted from high- to low-sophistication level between 1990 and 2000. For medium levels of technology, 11 products at four-digit SITC level had shifted from the high- to low-sophistication product categories between 1990 and 2000. Among them, SITC 7852 (non-motorized cycles) in MT1 shifted from high- to low-sophistication products between 1990 and 2000. For MT2, which are processed products, SITC 2667 (synthetic fibers, carded, combed or other), SITC 5621 (mineral or chemical fertilizers), SITC 6531 (fabrics, woven of continuous synthetic), SITC 6534 (fabrics, woven of continuous synthetic), SITC 6536 (fabrics, woven contain 85% of discon.), SITC 6725 (blooms, billets, slabs and sheet bars), and SITC 7861 (trailers and specially designed conta.) also shifted from the high- to low-sophistication product category in the same period. For MT3, engineering products, three products shifted to the low-sophistication product category in the decade of the 1990s: SITC 7621 (radio-broadcast receivers of mortor), 7631 (gramophones and record players, electric), and 8122 (sinks, wash basins, bidets, water closets).

For low-tech products, 23 products in LT1 (textiles, garments, and footwear) and eight products in LT2 (other products) fell from the high- to low-sophistication product category between 1990 and 2000. Textiles, garments, and footwear became less and less sophisticated products because their production technology is fairly standardized and the wage bill accounted for a great percentage of the total production cost. Hence, it is not surprising that more products in LT1 fell to low-wage countries. This is the product category in which the less developed countries
Table 5.5  Disaggregate manufactured products cross-classified by technology level and sophistication index of 1990 based on four-digit SITC (revision 2)

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Table 5.6  Disaggregate manufactured products cross-classified by technology level and sophistication index of 2000 based on four-digit SITC (revision 2)

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(LDCs) gained most of their market shares due to the global trend of “de-sophistication”.

For resource-based products, there were nine commodities in the RB2 category in 1990 but 17 in 2000, which were classified as low-sophistication products. But one product, SITC 2814 (roasted iron pyrites), shifted from the low- to the high-sophistication product category. The nine commodities which shifted from the high- to the low-sophistication product category between 1990 and 2000 are the following: SITC 2873 (common salt, rock salt, sea salt), 2879 (ores concentrated of other non-ferrous materials), 2890 (ores and concentrates of precious metals), 3232 (coke and semi-coke of coal of lignite), 3345 (lubricating petrol, oils and other heating fuels), 6613 (building and monumental stone, worked), 6624 (non-reflecting ceramic bricks, tiles), 6643 (drawn or blown glass, unworked), 6673 (other precious and semi-precious stones).

Interestingly enough, there are significant shifts in status of product sophistication in some of the agro-based products, RB1 category. Among them, nine agro-based resources products shifted from the low- to the high-sophistication product category between 1990 and 2000: SITC 0141 (meat extracts and meat juices; fish), SITC 0564 (flours, meals and potato flakes), SITC 0565 (vegetables, prepared or preserved), SITC 0585 (juice, fruit and vegetable), SITC 2472 (sawlogs and veneer logs), SITC 2483 (wood of non-coniferous species, sawn), SITC 4236 (sunflower seed oil), SITC 4241 (linseed oil), and SITC 6349 (wood, simply shaped, n.es.). Obviously, one could reasonably attribute that the shifting sophistication level of these agro-based products from low- to high-wage countries was plausibly due to the trade protection policies undertaken by the industrialized countries. The analysis of shifting sophistication index for four-digit SITC product classification could be interesting to practitioners and/or policy-makers in international business in many of those developing Asian countries.

5.7 SUMMARY

Export sophistication is one of the indicators that reveal the dynamic changes of export commodities produced by developing Asian countries. By cross-classifying the export commodities with the levels of product technology and the degree of product sophistication, one can observe the significant trend of “de-sophistication” of manufactured goods during the decade of the 1990s.

The shifts of product sophistication at the three-digit SITC level reflect the changing status of exports at the industry level, whereas those at the
Trade and industrial development in East Asia

four-digit SITC level show the similar phenomenon at the disaggregate product level. The analysis conducted in this chapter provides us with a vivid picture of the development of export industries and commodities for the ten Asian countries in the decade of the 1990s. As noted before, the changing market shares of each product group analyzed in this chapter include the product-changing coverage of product groups as well as the shifting competitiveness. To differentiate the market share effect from that of commodity composition, the methodology of constant market analysis is followed in the next chapter.

NOTES

1. This formula is similar to that used in the Human Development Index, which was constructed by the United Nations Development Program (UNDP).
2. In fact, Lall et al. divided the exporting countries for each product into ten income groups, and multiplied the share of each product for each income group by the group’s average income to derive the dollar value for each product (2006, p. 224).
3. I would like to express my gratitude to John Weiss and Jinkang Zhang for their generosity in providing me with the scores of product sophistication at three- and four-digit SITC.
4. Of course, one may argue that the time series of weighted average index of product sophistication, either based on 1990 or 2000 scores, is biased. However, the purpose of those figures is to examine the trend of overall path of development in product sophistication. Hence, those figures could still serve for that particular objective.
5. Ideally, it is better to have the sophistication index in the mid-period of the time series. Given the constraint of having the index only in 1990 and 2000, it is much better to use the 1990 index rather than the 2000 index.
6. Primary commodities are excluded from the product list in this study.

REFERENCES

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### APPENDIX A5.1

*Table A5.1  181 manufactured products cross-classified by technology level and sophistication index of 1990 and 2000 based on three-digit SITC (revision 2)*

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### Table A5.2 The changing world market shares of manufactured products between 1990 and 2000: cross-classification of levels of the technology and sophistication index

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The dynamics of changing trade structures

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<tbody>
<tr>
<td>China (0%, 18.18%)</td>
<td>China (5.03%, 7.13%)</td>
</tr>
<tr>
<td>HK (0%, 7.68%)</td>
<td>HK (2.03%, 6.07%)</td>
</tr>
<tr>
<td>Indonesia (0%, 1.41%)</td>
<td>Indonesia (0.3%, 0.84%)</td>
</tr>
<tr>
<td>Japan (0%, 2.39%)</td>
<td>Japan (8.98%, 5.66%)</td>
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<tr>
<td>Korea (0%, 2.78%)</td>
<td>Korea (2.78%, 2.4%)</td>
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<tr>
<td>Malaysia (0%, 0.42%)</td>
<td>Malaysia (0.46%, 1%)</td>
</tr>
<tr>
<td>Philippines (0%, 0.39%)</td>
<td>Philippines (0.26%, 0.22%)</td>
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<tr>
<td>Singapore (0%, 0.28%)</td>
<td>Singapore (0.77%, 1.19%)</td>
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<tr>
<td>Taiwan (0%, 4.12%)</td>
<td>Taiwan (4.66%, 4.12%)</td>
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<tr>
<td>Thailand (0%, 2.46%)</td>
<td>Thailand (0.85%, 1.04%)</td>
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<td>China (14.42%, 16.95%)</td>
<td>China (10.83%, 6.56%)</td>
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<tr>
<td>HK (6.12%, 12.51%)</td>
<td>HK (6.25%, 7.62%)</td>
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<tr>
<td>Indonesia (1.44%, 2.47%)</td>
<td>Indonesia (0.98%, 0.5%)</td>
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<tr>
<td>Japan (0.44%, 0.85%)</td>
<td>Japan (3.18%, 4.24%)</td>
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<tr>
<td>Korea Rep. (9.5%, 2.89%)</td>
<td>Korea Rep. (4.39%, 9.39%)</td>
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<tr>
<td>Malaysia (1.29%, 0.88%)</td>
<td>Malaysia (0.5%, 0.34%)</td>
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<tr>
<td>Philippines (1.1%, 0.87%)</td>
<td>Philippines (0.52%, 0.18%)</td>
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<tr>
<td>Singapore (0.79%, 0.7%)</td>
<td>Singapore (0.41%, 0.49%)</td>
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<tr>
<td>Taiwan (5.37%, 2.49%)</td>
<td>Taiwan (4.94%, 7.82%)</td>
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<tr>
<td>Thailand (2.21%, 1.84%)</td>
<td>Thailand (1.22%, 0.63%)</td>
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<tbody>
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<td>China (0.88%, 4.18%)</td>
<td>China (1.39%, 2.34%)</td>
</tr>
<tr>
<td>HK (0.02%, 0.3%)</td>
<td>HK (0.51%, 1.23%)</td>
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<td>Indonesia (2.3%, 4.56%)</td>
<td>Indonesia (0.75%, 0.68%)</td>
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<td>Japan (0.3%, 1.48%)</td>
<td>Japan (3.65%, 4.15%)</td>
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<td>Korea (0.06%, 0.36%)</td>
<td>Korea (0.76%, 3.2%)</td>
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<td>Malaysia (0.37%, 0.22%)</td>
<td>Malaysia (0.29%, 0.66%)</td>
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### Table A5.2  (continued)

<table>
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<tr>
<td>Philippines (1.81%, 0.49%)</td>
<td>Philippines (0.09%, 0.17%)</td>
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<td>Singapore (0.03%, 0.11%)</td>
<td>Singapore (3.76%, 3.04%)</td>
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<tr>
<td>Taiwan (0.02%, 0.49%)</td>
<td>Taiwan (0.46%, 0.63%)</td>
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<tr>
<td>Thailand (0.08%, 0.74%)</td>
<td>Thailand (0.51%, 0.88%)</td>
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<tr>
<td>China (1.76%, 6.18%)</td>
<td>China (1.16%, 1.81%)</td>
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<tr>
<td>HK (0.12%, 0.45%)</td>
<td>HK (0.36%, 1.42%)</td>
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<tr>
<td>Indonesia (9.87%, 3.48%)</td>
<td>Indonesia (0.59%, 2.06%)</td>
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<tr>
<td>Japan (0.21%, 0.62%)</td>
<td>Japan (2.92%, 2.76%)</td>
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<tr>
<td>Korea Rep. (0.81%, 0.94%)</td>
<td>Korea Rep. (0.93%, 1.34%)</td>
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<tr>
<td>Malaysia (6.84%, 5.25%)</td>
<td>Malaysia (2.29%, 1.63%)</td>
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<tr>
<td>Philippines (2.45%, 1.44%)</td>
<td>Philippines (0.19%, 0.18%)</td>
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<tr>
<td>Singapore (1.33%, 0.47%)</td>
<td>Singapore (0.65%, 0.75%)</td>
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<tr>
<td>Taiwan (0.91%, 0.5%)</td>
<td>Taiwan (1.03%, 0.78%)</td>
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<tr>
<td>Thailand (3.48%, 6.32%)</td>
<td>Thailand (0.74%, 0.88%)</td>
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</tbody>
</table>

*Source:* Calculated by the author.