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Moving Up the Value Chain in ICT: ASEAN Trade With China

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ABSTRACT

The rise of China increased competition for foreign direct investment and exports for the ASEAN economies. It also increased ASEAN trade with China. But, are ASEAN countries able to move up the value chain in their trade with China? The objectives of this article are to examine upgrading in the information and communications technology (ICT) value chain through changes in the product quality of parts and components (PNC) exports from ASEAN to China and the influence of these changes on their ICT trade with China. The main findings indicate that there is little or no product upgrading in the most important SITC 776 sub-component of the PNC exports from the four major ASEAN economies (ASEAN-4) to China after 2005. It is also found that improvements in product quality are more apparent for SITC 772 but this product group constitutes a small share in total manufactured exports from the ASEAN-4 to China. Lastly, with little or no product upgrading, exporters from the ASEAN-4 have shifted to exports of non-PNC goods to China. This shift has enabled the overall ICT exports from the ASEAN-4 to China to continue to grow for the period of this study.

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The emergence of global value chains (GVCs) implies that developing economies can industrialise by joining GVCs, without having to build a whole industry from scratch. This is facilitated by "headquarter" economies shifting some of their production tasks to "factory" economies.[1] ASEAN and China have both participated in this process by using foreign direct investment (FDI) as a part their development strategies. China has increasingly integrated with the regional production networks that span ASEAN due to large inflows of FDI after the opening of its economy in the late 1970s and its accession to the World Trade Organisation (WTO) in 2001. Thus, while the rise of China has increased competition for FDI and exports for ASEAN, it has also increased ASEAN trade with China, especially with progressive tariff liberalisation under the ASEAN-China Free Trade Agreement (ACFTA) from 2005. In particular, the movement of information and communications technology (ICT) goods, specifically in parts and components (PNC), between ASEAN and China is expedited by the intra-industry

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trade in the region by multinational corporations. Since 1995, trade between China and the members of ASEAN has grown at an average of approximately 20% a year. In 2013, two-way trade rose by 10.9% to US$444 billion. China has become ASEAN's largest trading partner since 2009 while ASEAN has been China's third largest since 2010 (*China Daily*, August 9, 2014).

However, as in the case of other developing countries, ASEAN countries and China aspire to move up the GVC by shifting to higher value added production. A crucial question in the trade relations between the ASEAN countries and China is whether the ASEAN countries have been able to move up the value chain in their trade with China. The objectives of this article are to examine upgrading in the ICT value chain through changes in the product quality of ASEAN ICT exports to China and the influence of these changes on their ICT trade with China. Improvements in quality will imply that ASEAN exports goods are moving up the ICT value chain relative to China, thereby enabling the ASEAN economies to improve their relative competitiveness with China while the converse will hold if product quality deteriorates.

The article is organised as follows. A review of GVCs and upgrading is presented in the next section, followed by a profile of the salient features in ASEAN trade with China. The findings are then presented. The concluding section summarises the key findings of this article and provides some policy suggestions.

Global Value Chains and Upgrading

Technological changes have facilitated fragmentation in the production process, thereby enabling many countries to participate in the production of any manufactured good. According to Baldwin (2012), in the first "unbundling," production is separated from consumption, while the second "unbundling," which occurred after the mid-1980s, spliced the production process itself across countries (offshoring) and across organisations (outsourcing) into different tasks along GVCs. The emergence of GVCs attracts considerable research attention that seeks to explain its characteristics and measurements as well as the main factors that have contributed to its development. The impact of GVCs on the pattern of world investment and trade as well as its role in driving structural change in different countries are other areas that are currently explored (see, for example, Sturgeon and Memedovic 2010; Cattaneo et al., 2013; UNCTAD 2013; Amador and Cabral 2014).

The electronics industry, which is a key component of the ICT industry, is one of the more researched sectors in GVC analysis due to the extent of offshoring and outsourcing activities in this sector. This is in turn attributed to the extensive standardisation and automation of the manufacturing processes in this sector. The electronics industry comprises a broad range of components, intermediates, final goods and services. In particular, the second unbundling has contributed to the growing trade in intermediate goods, especially in PNC. Sturgeon and Kawakami (2010) examine the impact of the global financial crisis (GFC) on the GVC in electronics and find that there are both new challenges and opportunities for latecomers from the developing world in this sector. Challenges come in the form of new barriers created after the crisis, while opportunities are also created for latecomers to leverage on the deep capabilities that have evolved within this sector in the last 20 years.

Some country studies have been conducted to assess the potential for these countries to move up the electronics value chain, namely Costa Rica and the Philippines (Federick and Gereffi 2013; Aldaba 2015). Yamashita and Archanun (2011) use trade data to examine the development of trade patterns of ASEAN with China to illustrate the complementarity between ASEAN exports to China as a result of the latter's integration into the GVC. Although the study covers PNC trade, it does not address upgrading issues in the electronics trade between ASEAN and China.

In the GVC literature, upgrading refers to adding value to production or shifting to higher value added activities in global production operations via six distinct changes: (i) entry into the value chain or when a new firm begins to participate in the value chain; (ii) process upgrading where firms upgrade processes via transforming inputs into outputs more efficiently by reorganising the production system or introducing superior technology; (iii) product upgrading where the firms produce more sophisticated products/higher value products; or products of better quality, and (iv) functional upgrading whereby firms acquire new functions in the chain such as design or marketing; (v) chain upgrading or the entry into a new value chain by leveraging on the knowledge and skills acquired in the current chain; and (vi) end market upgrading which is the shift into new higher value end market segments (Fernandez-Stark, Bamber, and Gereffi, 2012; Humphrey and Schmitz, 2000). Upgrading pursued at the firm level translates into country-level upgrading when a critical mass of firms located within the country achieves upgrading.

Fernandez-Stark, Bamber, and Gereffi (2012) observe that product and process upgrading is more easily attained for developing countries as they require relatively minor adjustments in production and skills development with lower overall investment. For ASEAN, the literature supports evidence of at least some firm-level upgrading in the four older member countries (ASEAN-4, namely the Philippines, Malaysia, Singapore and Thailand) in their respective participation in the electronics GVC. For example, Sturgeon and Kawakami (2010) document supplier upgrading in a case study of Singapore by tracing the evolution of the supplier firm's growth from supplying to American disk drive producers in Singapore and Malaysia to becoming a regional firm with its own vertically integrated electronics manufacturing bases in the region. In the case of Malaysia, earlier studies conducted in the early 2000s indicate limited upgrading in Malysia's electronics due to structural weaknesses in the industry (Ernst 2003; Henderson and Phillips 2007). These structural weaknesses include, among others, a dependence on technology spillovers from the affiliates of multinational corporations operating in the country, lack of a broad and multi-tier base of support industries, skills mismatch, use of affirmative policies as well as the use of unskilled migrant workers.

However, subsequent studies found some evidence of process, product as well as functional upgrading in the electronics cluster in Penang (Edgington and Hayter 2013; Kharas, Zeufack and Majeed, 2010). Firm-level interviews conducted in Penang's electronics cluster in these studies indicate that there is progressive industrial upgrading from 2000 to 2006 following the Asian Financial Crisis in 1998, with multinational corporations increasingly embedding their operations in-situ, through using local skilled labour and supply firms. Archanun and Nipon (2011) also find some evidence of functional and product upgrading in Thailand's hard disk drive industry. Although the electronics industry in the Philippines is concentrated mainly in assembly and

testing at the lowest segment of the GVC, Reyes-Macasaquit's (2010) study of ten electronics firms indicate that there is process upgrading as well as substantial organisational innovation. In addition, some exceptional firms have even managed to move up the value chain into design and more advanced production processes.

While evidence at the firm level is encouraging, work at the country level seems to imply that these countries may not have amassed the necessary critical mass of firms that can shift the country's upgrading trajectory into a higher value added path. For example, Felipe (2012) finds that that although Malaysia and the Philippines made good progress by getting into the electronics cluster in the 1990s, they have not been able to move into the most advanced and well-connected products in his study on the export products from these countries compared to Korea from 1965 to 2005. The inability to shift into more diversified, sophisticated and non-standard baskets of goods for Malaysia is identified by Felipe as the reason for the country to be stuck in the middle-income trap.

In the case of China's trade with ASEAN, Azhar and colleagues (2012) used a new dynamic measure of differentiated intra-industry trade to show the impact of the emergence of China on the quality of exports and imports to and from Malaysia, Singapore and Indonesia to China from 1994 to 2004. Their results suggest that for the most part, China's neighbours have benefitted from China's increasing demand for imported goods as all the three countries in their study have managed to maintain their position as the producer of high quality varieties. Devadason (2009), finds in her studies on Malaysia's network trade with China from 1990 to 2004 that there are improvements in the quality of products destined to China, thereby reflecting a movement up the value chain. However, she cautions that the narrowing between the unit values of exports and imports may imply less product development. Moreover, she also finds that there is evidence of no skill upgrading in Malaysia's trade with China and this may have contributed to the low levels of export values of high-quality varieties in matched trade between Malaysia with China and India (Devadason 2008). For ASEAN, Devadason (2011) finds that although high-quality vertical intra-industry trade dominates the intra-industry trade between ASEAN and China and also intra-ASEAN trade, there is no clear quality advantage for the products traded by Singapore, Malaysia and Thailand with China for the period 1995–2006.

Despite the importance of and aspirations for upgrading, it has not been extensively studied in ASEAN trade relations with China, especially for ICT and PNC trade after the GFC. Rasiah, Yap, and Govindaraju (2014), for example, compared the impact of the two crises, namely the Asian Financial Crisis and the GFC on electronics exports from the founder ASEAN member states. They conclude that the GFC reduced electronics exports from these countries due to the contraction in demand in the US during the crisis. Their detailed analysis, however, does not focus specifically on the trade links between ASEAN and China as this is not within the scope of their article.

Salient Features of Trade Between ASEAN and China

Trade between ASEAN economies and China in the manufacturing sector has increased steadily since the Asian Financial Crisis. Table 1 shows the increasing importance of China as a trading partner with ASEAN countries in manufactured goods. For

Table 1. ASEAN manufactured exports and imports with China as a share to the world (%)*.

Exports	1995	2000	2005	2009	2012	2013
Brunei	n.a.	n.a.	n.a.	n.a.	3.2	3.4
Cambodia	n.a.	1.6	0.4	0.2	1.5	1.1
Indonesia	2.7	3.0	4.4	4.7	5.1	5.8
Malaysia	1.6	2.5	6.2	12.7	14.3	14.2
Philippines	0.3	1.2	10.1	7.1	11.4	10.3
Singapore	1.7	3.7	9.5	10.5	12.3	13.9
Thailand	1.0	3.2	7.5	10.6	10.8	10.2
Vietnam	n.a	0.9	2.6	4.4	7.0	n.a.
Brunei	n.a.	n.a.	n.a.	n.a.	14.7	14.1
Imports	**1995**	**2000**	**2005**	**2009**	**2012**	**2013**
Cambodia	n.a.	10.6	19.6	28.4	40.2	40.0
Indonesia	3.5	5.5	12.7	19.3	22.2	24.2
Malaysia	2.1	3.7	13.1	16.9	20.2	21.6
Philippines	2.9	2.3	7.3	11.0	14.2	16.5
Singapore	3.0	5.4	12.2	13.7	15.5	16.6
Thailand	3.2	6.4	12.7	17.4	21.2	22.3
Vietnam	n.a.	9.6	17.2	26.8	30.3	n.a.

Notes: *This is the share of individual ASEAN countries' manufactured exports and imports to China in their respective countries' total exports and imports to the world; n.a.– not available; there are no data for Laos.
Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014).

Malaysia, Singapore, Thailand and the Philippines (or ASEAN-4), manufactured exports to China accounted for more than 10% of their total manufactured exports to the world by 2012. After the GFC, Malaysia's share of manufactured exports to China with respect to its total manufactured exports to the world is relatively higher than other ASEAN countries. China is clearly an important import partner as its share in the ASEAN-4's total manufactured imports from the world is higher than its export share. Although Malaysia's share of imports from China is also relatively higher than other ASEAN countries, China's manufactured goods are also able to penetrate significantly into the Cambodian, Vietnamese, Indonesian and Thai markets. But, for these countries, manufactured imports are mostly in non-ICT goods, except for Thailand (Table 2).

Table 2 shows that, after 2000, the main product traded between the ASEAN-4 and China is ICT goods.[2] The main ASEAN exporters of ICT goods to China are Malaysia, Singapore, the Philippines, Thailand, and much later, Vietnam. Since 2000, the share of exports of ICT goods in total manufactured exports of Singapore and Malaysia with China has been consistently above 50%. While other ASEAN countries may have a more diversified export portfolio to China, almost 92% of the Philippines' manufactured exports to China were in ICT goods in 2005. However, the share of ICT goods exports in total manufactured exports of the Philippines with China dropped to 58% in 2013 (see Table 2). Since 2012, Malaysia has had the largest share of ICT exports in its total exports with China. Overall, it can also be seen that the share of ICT imports in total imports of Malaysia, the Philippines, Singapore, Thailand and Vietnam are also higher than the other ASEAN countries. Cambodia, which is one of the main importers of manufactured goods from China, only imports 6% of ICT goods in its manufactured imports from China (COMTRADE 2014).

Generally, from Table 2, four countries stand out as ASEAN's main trading partners in ICT goods trade with China – Malaysia, the Philippines, Singapore and Thailand

Table 2. Share of ICT in total manufactured exports and imports with China (%).

ICT Exports	1995	2000	2005	2009	2012	2013
Brunei	n.a.	n.a.	n.a.	n.a.	1.9	0.5
Cambodia	n.a.	0.0	0.0	3.8	0.6	3.1
Indonesia	0.1	5.0	11.1	15.1	9.3	6.5
Malaysia	10.3	58.5	57.8	72.5	63.8	62.5
Philippines	14.0	82.4	91.5	84.1	64.0	57.8
Singapore	32.2	53.0	61.7	54.3	51.8	53.5
Thailand	11.3	45.8	50.7	51.6	33.2	24.4
Vietnam	n.a.	10.1	19.2	23.1	38.9	n.a
ICT Imports	**1995**	**2000**	**2005**	**2009**	**2012**	**2013**
Brunei	n.a.	n.a.	n.a.	n.a.	12.7	17.9
Cambodia	n.a.	2.3	3.7	16.3	4.1	6.2
Indonesia	4.6	6.7	10.2	25.0	23.9	23.7
Malaysia	16.1	47.0	59.1	53.5	42.1	42.2
Philippines	5.5	18.0	47.4	48.0	26.6	22.3
Singapore	31.4	55.7	62.8	56.9	53.2	55.1
Thailand	13.8	35.2	40.1	37.2	33.8	33.2
Vietnam	n.a.	2.5	7.2	23.1	30.8	n.a.

Notes: n.a. – not available; there are no data for Laos.
Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014).

(or the ASEAN-4).[3] The rest of the analysis in this article will therefore focus only on the ASEAN-4's ICT trade with China.

All ASEAN-4 countries have increased their share of exports and imports of ICT goods in total manufacturing exports with China from 1995 to 2013 (Table 2). By 2005, more than half of the ASEAN-4's manufactured exports to China were in ICT goods. Exports of ICT goods from the Philippines to China took up almost 92% of its total manufactured exports to China in 2005. The export share of ICT goods for all ASEAN-4 countries fell progressively after 2009, indicating that these countries are diversifying their exports to China with the fall in demand from the USA and Europe for ICT goods from China as a result of their economic contraction after the GFC. The share of imports of ICT goods in total imports for the ASEAN-4 reached a peak in 2005, after which it fell progressively until 2013, which is not surprising given the extent of intra-industry trade in these goods in the region. Generally, the share of imports of ICT goods in total manufactured imports is lower than the export share, except for certain years for Malaysia and Thailand. There are two striking exceptions. Singapore's share of ICT imports in total manufactured imports from China is higher than its export share, while the converse holds for the Philippines for the entire period shown in Table 3.

In the case of PNC, we observe that up to 2005, the shares of PNC exports in total manufacturing exports were close to the shares of ICT exports (Table 3).[4] This implies PNC goods constitute the bulk of the ASEAN-4's ICT exports to China, except for Thailand. For example, in 2005, the share of ICT in total manufacturing exports for Malaysia, the Philippines and Singapore were respectively 58%, 92% and 62% while the share of PNC exports in total manufacturing exports of these countries were respectively 47%, 74% and 50%. In the case of Thailand, its share of ICT exports in total manufacturing exports was 51% in 2005 while its share of PNC exports in total manufacturing exports was 20%, suggesting that Thailand has diversified to other ICT exports earlier than the other ASEAN-4 countries. Similarly, the import pattern follows the export pattern in that share of PNC imports is close to the share of ICT

Table 3. Export and import of PNC with China (% of total manufacturing export and import to China).

PNC Export	1995	2000	2005	2009	2012	2013
Malaysia	5.6	40.7	46.5	13.2	9.2	8.6
Philippines	11.2	73.9	74.1	51.4	39.6	30.4
Singapore	23.0	40.9	49.9	12.0	8.0	7.4
Thailand	5.6	37.7	20.0	10.1	8.1	7.8
PNC Import	**1995**	**2000**	**2005**	**2009**	**2012**	**2013**
Malaysia	11.2	38.2	44.0	27.2	17.0	16.8
Philippines	3.1	13.2	42.5	40.6	21.6	17.9
Singapore	14.9	36.2	47.1	24.7	20.7	20.6
Thailand	9.3	27.5	26.4	20.3	18.9	17.9

Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014).

imports, implying that the bulk of ICT imports are also in PNC goods, except for Thailand.

However, the close association between the shares of ICT and PNC exports changes from 2009 onwards. While the share of ICT exports and imports in total manufacturing exports and imports of the ASEAN-4 with China fell progressively from 2005 to 2013, the fall in the share of PNC goods in total manufacturing is larger for all the ASEAN-4 countries. It is most apparent for Malaysia and Singapore, while the Philippines is least affected with its share of PNC exports in total manufacturing exports falling by close to 60% from 2005 to 2013, from 74% in 2005 to 30% in 2013. What the divergence shows is that PNC exports no longer dominate ICT exports from the ASEAN-4, implying a diversification in the ICT exports of the ASEAN-4 from PNC goods to non-PNC goods such as semi-finished and finished goods, after the GFC.

We therefore focus our analysis of product upgrading on PNC products in the following section in order to ascertain whether the fall is associated with the lack of product upgrading in PNC goods. It should, however, be noted that PNC constitute only one facet of network trade and GVCs also include final assembly, which is not investigated in this article.

Upgrading in PNC and ICT Trade with China

Product Upgrading in PNC

In this section, we use product upgrading to assess movements up the value chain in the ASEAN-4's PNC exports to China. The relative unit value (RUV) of exports to imports is computed for this purpose. These unit values reflect the respective price of exports and imports and price in turn is taken to be an indicator for quality (Devadason 2008, 2009).[5] The method used for calculating the RUV is shown in Appendix 2. RUVs that are above unity indicate products exported to China have higher quality (as reflected by their higher prices) relative to their corresponding imports. Thus an increase in the number of products with RUV greater than unity over time will indicate improving quality over time.

Overall, all the four countries show improvements in product quality for PNC trade from 1995 to 2000, with the evidence after that varing across countries and products (see Figure 1). Thus, in the case of Malaysia, the number of products with RUV above

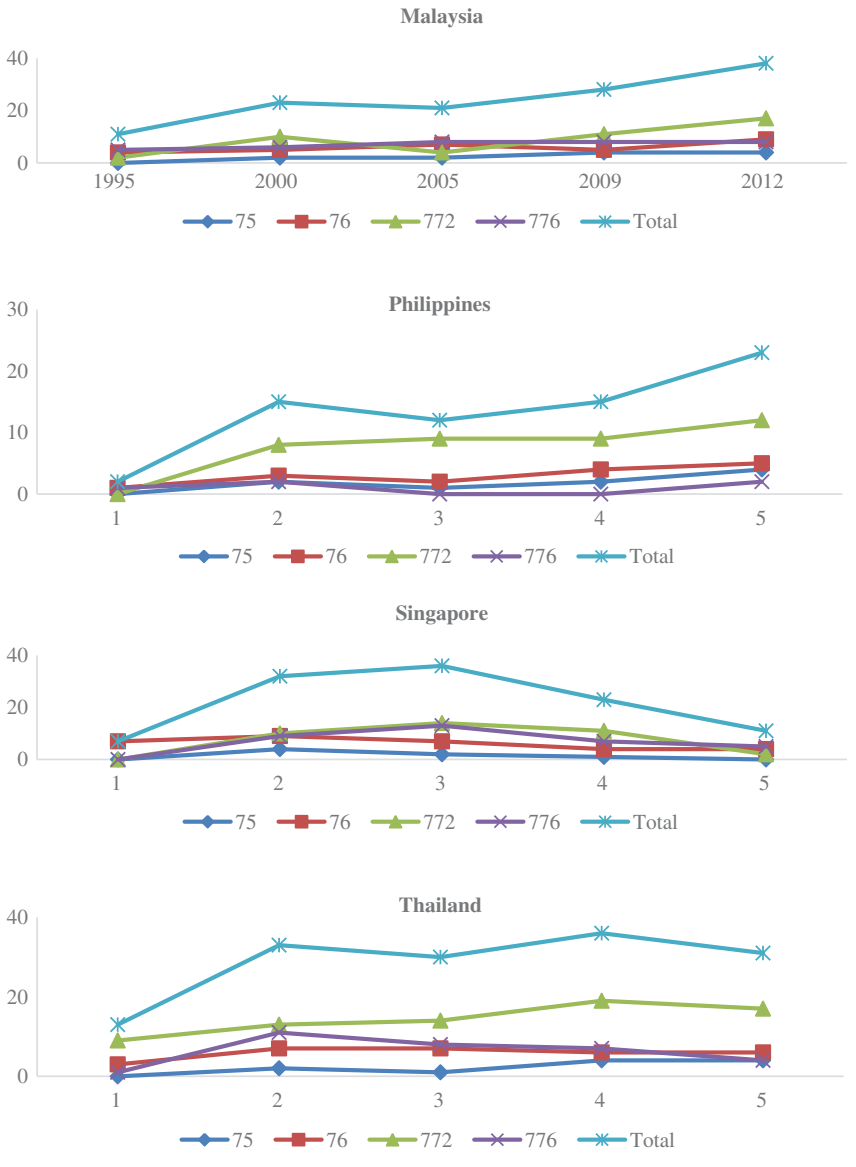

Figure 1. Number of products with RUV greater than unity, 1995–2012.
Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014)

unity increased from 1995 to 2000, before dropping in 2005. It subsequently improved again from 2005 to 2012. The improvements in the number of products with RUV greater than unity can be traced primarily to SITC 772 – Electrical apparatus for switching or protecting electrical circuits or for making connections to or in electrical circuits – while the number of goods with RUV greater than unity for SITC 776 – Thermionic, cold cathode or photo-cathode valves and tubes – remained unchanged from 2005 to 2012. For the Philippines, overall, the number of products with RUV greater than unity increased from 1995 to 2000 before dropping from 2000 to 2005.

From 2009 to 2012, the number of products with RUV greater than unity showed small improvements in all product lines. In Singapore's case, the number of products with RUV greater than unity increased from 1995 to 2005, after which it fell progressively to 2012, due to the drop observed in SITC 772 and SITC 776 (Figure 1). Thailand shows mixed patterns; with improvements in the number of products with RUV greater than unity from 1995 to 2000 before falling slightly in 2005. There was an increase in the number of products with RUV greater than unity in 2009 before dropping in 2012. Improvements in quality are mostly seen for SITC 772 from 1995 to 2009. Figure 1 also shows that SITC 772 shows the highest number of products with RUV greater than unity for all the ASEAN-4 for most of the years from 2000 to 2012.

The observed pattern of change can be explained by several factors, including country-specific reasons. The number of product lines in each of the SITC commodity groups are different. SITC 75 and 76 have the least number of product lines (4 and 11 respectively), while SITC 772 and 776 have the most (23 and 19, respectively). Moreover, the technology intensity of the products differs. Based on the Organisation for Economic Co-operation and Development's (OECD) technology classification of manufacturing industries, SITC 75 and 76 are high-technology manufacturing industries while SITC 772 and 776 are medium- to high-technology industries (Nayak, Aggarwal, and Mann 2013). The skill intensity of SITC 772 and 776 are also different as the former is classified as medium skill while the latter is high skill (Wei and Balasubramanyam 2015). Given that the Philippines and Thailand are at the learning phase of technology development while Malaysia is at the catch-up phase and that there is a shortage of skilled labor in all these countries, improving product quality in SITC 75, 76 and 776 will be harder for these three countries compared to SITC 772 (Wong 2013; Iredale et al., 2014; Rasiah 2014).

Technology development in the Pihlippines, Malaysia and Thailand has been dependent on spillovers from the multinationals operating in these countries and public institutions rather than the private sector (Chu and Hill 2006). Moreover, the policy framework needed to co-ordinate the relationship that is necessary between macro-institutions, meso-organisations and micro-agents for stimulating innovation in these countries is either weak or lacking (Rasiah 2014). In addition, although Malaysia shows greater progress in terms of the number of products with quality improvement over the time period of this study, the country's flexible labor policy through the use of cheap migrant workers may have deterred more local firms from moving up the value chain from assembly to product development (Samel 2012).

The case of Singapore is different as the country is already at the frontier stage of technology development based on Rasiah's (2014) typology. Singapore's policies have focused more on functional upgrading to shift from mere assembly operations to assembly and test, wafer fabrication, R&D support, chip design and R&D. The decline in product quality improvement for Singapore's PNC trade as shown in Figure 1 reflects the declining importance of this segment of ICT trade for Singapore as the country has moved up the GVC towards the higher value-added end.

Table 4 shows the bilateral revealed comparative advantage (RCA) for all the PNC products for the ASEAN-4 with China (see Appendix 2 for method for computing the RCAs). The number of products with RCA greater than 1 for the ASEAN-4 as a group has decreased steadily from 45 in 1995 to 41 in 2013, while conversely the number of

Table 4. Number of products, classified by RCA with China.

	1995		2000		2005		2013	
	RCA>1	RCA<1	RCA>1	RCA<1	RCA>1	RCA<1	RCA>1	RCA<1
Malaysia								
SITC 75	3	0	4	0	3	1	4	0
SITC 76	10	1	9	2	7	4	8	1
SITC772	12	11	14	9	16	7	15	8
SITC776	13	3	14	5	10	9	12	3
TOTAL	38	15	41	16	36	21	39	12
Philippines								
SITC 75	1	0	3	1	2	2	4	0
SITC 76	5	3	2	8	1	10	3	4
SITC772	2	8	4	16	5	16	11	10
SITC776	8	3	8	7	9	7	9	3
TOTAL	16	14	17	32	17	35	27	17
Singapore								
SITC 75	3	0	4	0	4	0	3	1
SITC 76	9	2	4	7	5	6	1	8
SITC772	19	4	18	5	19	4	16	7
SITC776	15	1	15	4	12	7	13	2
TOTAL	46	7	41	16	40	17	33	18
Thailand								
SITC 75	1	2	2	2	1	3	2	2
SITC 76	4	7	1	9	4	7	5	4
SITC772	8	15	15	8	12	11	11	12
SITC776	8	7	13	6	7	12	5	9
TOTAL	21	31	31	25	24	33	23	27
ASEAN								
SITC 75	3	0	4	0	3	1	4	0
SITC 76	9	2	6	5	6	5	5	4
SITC772	18	5	17	6	20	3	18	5
SITC776	15	1	17	2	13	6	14	1
TOTAL	45	8	44	13	42	15	41	10

Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014)

products with RCA less than 1 had increased from 8 to 10. The decrease in the number of products with RCA less than 1 can be observed for each individual country shown in the table from 2000 to 2013, with the exception of the Philippines. In the latter's case, there is an increase in the number of products with RCA greater than 1 from 2005 to 2013 as well as an increase in the number of products with quality improvements for the same period. This indicates the possibility of some association between improvement in quality and the RCA of a country.

ICT and PNC Trade with China

We now investigate whether product upgrading (or the lack of it for some countries) is reflected in the ICT and PNC trade between the ASEAN-4 and China. Figure 2 shows the import and export trends between the ASEAN-4 with China in total ICT goods as well as PNC goods within the ICT sector. Figure 2 shows that ASEAN-4 manufactured exports and imports to China have been increasing since 1995. Within manufacturing, exports and imports of ICT goods have also been increasing since 1995. Progressive tariff liberalisation under the ACFTA starting in 2005 seems to have a positive impact on both total manufactured trade and ICT trade. Although there was a small drop

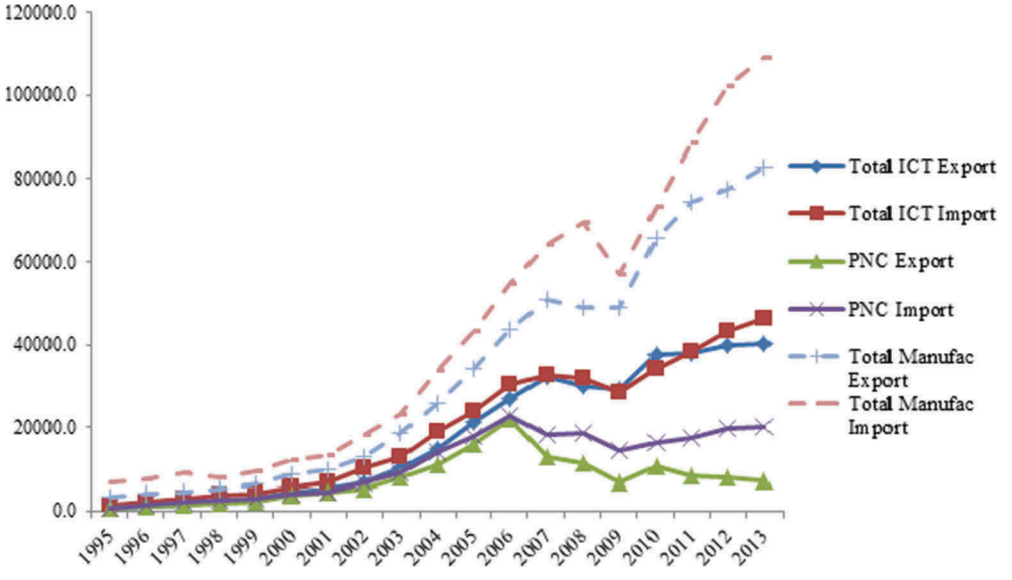

Figure 2. ASEAN-4 imports and exports of total, PNC and final ICT goods with China (USD millions).
Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014)

during the 2007 GFC, exports and imports of manufactured goods, including ICT goods, remained buoyant after 2009.

When decomposing ICT goods into PNC, Figure 2 shows that prior to the GFC, ICT exports and imports of the four ASEAN countries were driven by PNC exports and imports. However, both exports and imports of PNC to China declined after 2007. There was a short recovery period for exports between 2009 and 2010, with PNC imports continuing to increase slowly while exports of PNC goods have been gradually falling since 2005, barring the brief period of recovery between 2009 and 2010. It is important to note the decline started before the onset of the GFC so that the subdued demand in the USA and Europe post-GFC may not be the sole reason for the falling exports of PNC goods with China.[6] Figure 2 also implies that trade liberalisation under the ACFTA in 2005 has little impact on trade in the PNC class of products in ICT goods. One reason may be due to more than half of ASEAN PNC exports to China are already mostly zero-rated due to commitments under the World Trade Organisation-Information Technology Agreement before the implementation of the ACFTA. The other reason can be attributed to the relatively small margin of preference and low utilisation rates of the ACFTA tariff benefits that may have lessened the importance of tariff liberalisation on PNC goods (Tham and Kam 2014).

At the disaggregated level, SITC 776 has the largest share of ICT exports between Malaysia, the Philippines and Singapore with China, with an average share of over 30% in total manufactured exports to China for the period shown (see Table 5). For Malaysia and Singapore, while the share of SITC 776 in PNC exports was also large before 2005, its share fell dramatically from 2005 to 2009 and remained relatively small for the subsequent years shown in Table 4. From Figure 1, it can be observed that the number of products with RUV greater than unity for SITC 776 fell progressively from

Table 5. Export of ICT goods by product composition of the ASEAN-4 countries (%).

	Total ICT Exports*				ICT PNC Export & RUV**			
	Malaysia	Philippines	Singapore	Thailand	Malaysia	Philippines	Singapore	Thailand
SITC 75								
1995	1.0	3.9	10.9	6.6	0.8 (0)	3.2 (0)	7.6 (0)	3.4 (0)
2000	22.0	25.3	25.6	26.2	16.6 (2)	22.1 (2)	15.5 (4)	24.5 (2)
2005	15.7	37.4	18.3	38.6	9.3 (2)	20.4 (1)	7.9 (2)	9.9 (1)
2009	16.7	42.4	10.2	37.9	7.6 (4)	9.8 (2)	3.9 (1)	6.2 (4)
2012	15.7	31.6	5.7	25.9	3.3 (4)	7.5 (4)	1.9 (0)	5.3 (4)
2013	11.7	32.2	4.3	15.7	2.2	6.1	1.3	4.7
Mean	13.8	28.8	12.5	25.2	6.6	11.5	6.4	9.0
SITC 76								
1995	3.3	4.9	11.2	1.6	2.1 (4)	4.5 (1)	6.0 (7)	1.3 (3)
2000	13.7	2.1	2.9	2.6	12.6 (5)	1.9 (3)	2.5 (9)	2.5 (7)
2005	7.4	0.5	2.8	1.7	5.2 (7)	0.5 (2)	2.4 (7)	1.2 (7)
2009	2.7	1.0	1.6	2.7	1.0 (5)	1.0 (4)	0.8 (4)	0.7 (6)
2012	3.1	0.5	1.6	2.8	0.6 (9)	0.3 (5)	0.6 (4)	0.6 (6)
2013	2.1	1.3	1.6	2.9	0.4	1.1	0.7	0.4
Mean	5.4	1.7	3.6	2.4	3.7	1.6	2.2	1.1
SITC 772								
1995	1	1.8	2.8	0.6	0.8 (2)	3.5 (0)	2.3 (0)	0.6 (9)
2000	3.5	6.8	2.3	1.9	0.8 (10)	1.9 (8)	1.7 (10)	0.7 (13)
2005	2.8	0.7	2.8	2.9	1.8 (4)	0.4 (9)	1.7 (14)	1.6 (14)
2009	1.1	0.5	1.5	3.9	1.0 (11)	0.3 (9)	1.3 (11)	2.0 (19)
2012	2.6	0.7	2.2	2	1.5 (17)	0.7 (12)	2.0 (2)	1.6 (17)
2013	2.5	2.2	2	2.7	1	1.2	1.6	1.7
Mean	2.3	2.1	2.3	2.3	1.2	1.3	1.8	1.4
SITC 776								
1995	4.9	3.5	7.3	2.5	1.9 (5)	n.a (1)	7.1(0)	0.3 (1)
2000	19.2	48.2	22.2	15.1	10.6 (6)	48.0(2)	21.2 (9)	9.9 (11)
2005	31.9	52.9	37.9	7.5	30.2 (8)	52.9 (0)	37.9 (13)	7.3 (8)
2009	52.0	40.3	41.0	7.1	3.6 (8)	40.3 (0)	6 (7)	1.1 (7)
2012	42.5	31.1	42.3	2.5	3.8 (8)	31.1(2)	3.4 (5)	0.5 (4)
2013	46.1	22.0	45.7	3.1	5	22	3.7	1
Mean	32.8	33.0	32.7	6.3	9.2	38.9	13.2	3.4

Notes: *Exports of ICT goods as a share of the respective countries' total manufactured exports to China; **show RUV values are in parentheses; 2013 RUV values not computed because of a large number of missing values for quantity.
Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014).

2005 to 2009 for Singapore and Thailand. In the case of Malaysia, there were marginal improvements from 2000 to 2005 but this stagnated from 2005 to 2009. The Philippines' share of PNC exports for this product group fell progressively from 2005 to 2012 and there are no more than two product lines with RUV greater than unity for the whole period shown in Table 5. But it should be noted that all of the Philippines' exports of ICT goods in this product group consist of PNC goods only as the share of ICT and PNC in total manufactured exports to China are almost identical from 1995 to 2012. Hence, while this is the largest sub-sector in PNC exports from the ASEAN-4 to China, there is little product upgrading for this sub-sector.

Moreover, the data in Table 6 show several PNC product lines were no longer exported from Malaysia, Singapore and Thailand to China from 2009 to 2013, but continue to be exported from the Philippines to China. These are namely SITC 76481, 76491, 77641, 77643, 77645 and 77649. These product lines constitute 44%, 54%, 39% and 38% of the total export of PNC goods of from Malaysia, Singapore, Thailand and the Philippines to China in 2005. By 2013, with the exit of Malaysia, Singapore and Thailand from the export of these goods to China, these product lines have assumed a

Table 6. Export value of selected products lines (USD million).

SITC codes	2005	2009	2012	2013
Malaysia				
•76481	0.03 (0.1)*	-	-	-
•76491	26.8 (1.6)	-	-	-
•77641	1,258.6 (22.9)	-	-	-
•77643	271.6 (8.4)	-	-	-
•77645	131.8 (10.7)	-	-	-
•77649	3.8 (0.9)	-	-	-
Total	1692.63 (44.6)			
Philippines				
•76481	-	-	-	-
•76491	0.4 (0.1)	0.1 (0.0)	1.3 (0.1)	4.0 (0.9)
•77641	59.2 (16.8)	35.7 (17.1)	83.4 (6.0)	105.2 (6.7)
•77643	0.0008 (0.0)	15.9 (2.0)	445.1 (35.0)	452.6 (43.6)
•77645	1.3 (0.3)	0.006 (0.0)	0.2 (0.0)	0.2 (0.6)
•77649	331.9 (21.0)	842.6 (41.2)	853.4 (20.3)	220.0 (8.4)
Total	392.8008 (38.2)	894.603 (60.3)	1383.4 (61.4)	782 (60.2)
Singapore				
•76481	1.6 (0.0)	-	-	-
•76491	25.0 (0.7)	-	-	-
•77641	2,069.7 (15.3)	-	-	-
•77643	3,342.8 (32.7)	-	-	-
•77645	338.7 (4.8)	-	-	-
•77649	3.4 (0.2)	-	-	-
Total	81.2 (53.7)			
Thailand				
•76481	0.001 (0.2)	-	-	-
•76491	15.1 (1.4)	-	-	-
•77641	20.4 (7.5)	-	-	-
•77643	294.6 (29.7)	-	-	-
•77645	5.4 (0.1)	-	-	-
•77649	0.6 (0.1)	-	-	-
Total	336.101 (39.0)			

Note: *All numbers appearing in parenthesis show the share of exports of selected product lines to total PNC exports in percentages; - means no exports recorded in UN COMTRADE data.
Source: Calculated by the authors from United Nations Statistical Division, COMTRADE (2014).

share of about 60% of total PNC exports of the Philippines to China (see Table 6). With little or no product upgrading in these products, their production can be easily shifted to another country where the conditions for production are more suited for these products, based on costs. This shift from Malaysia, Singapore and Thailand to the Philippines in the exports of these product lines however, has not been able to compensate for the exit in exports from Malaysia, Singapore and Thailand. This has contributed to the significant drop in the value of PNC exports to China from the ASEAN-4 in total as observed in Figure 2. At the same time, this drop may also reflect that China is increasingly sourcing its intermediate goods domestically and it is less dependent on imported inputs. Pilat, Yamano, and Yashiro (2012), for example, report that Chinese firms are shifting from simple assembly to "full-package" manufacturing where Chinese firms control all stages from material procurement to product design.

The second largest component in ICT exports for Malaysia, the Philippines and Singapore is SITC 75 – Office machines and ADP (see Table 5) – where on average the

share of this product group in total manufactured exports is 14%, 29%, and 13% respectively. It is the largest component of ICT product exported from Thailand to China, averaging 25% for the period shown in Table 5. The share of PNC exports to China in this product group also fell sharply for Malaysia, Singapore and Thailand from 2005 onwards and from 2009 onwards for the Philippines. Figure 1 shows little upgrading in this product group. Similarly, in the case of SITC 76 – Telecommunications and sound recording equipment – there is little product upgrading and the shares of PNC exports of this product group to China also fell sharply for Malaysia as well as for the other countries over time.

The largest number of products with RUV greater than unity and hence higher quality as well as an increase in the number of products with RUV greater than unity is observed for product group SITC 772, for all the ASEAN-4. However, the share of PNC exports in this product group is rather small, averaging less than 1.8 % (Table 5). Singapore shows progressive deterioration in the quality of its exports as the number of products greater than unity fell progressively from 2005 to 2012. Improvements can be observed for the Philippines. However, since this product group is only a small component for PNC exports, it cannot offset the sharp drops in the shares of PNC exports observed in Table 4 for the other sub-components, and hence, there is a significant drop in PNC exports of the ASEAN-4 with China as highlighted in Figure 2.

It is important to note that the changes observed above only refer to product upgrading in PNC goods, as captured by price changes. Other studies, such as Rasiah and Yap (2014), indicate that technological upgrading in terms of horizontal and functional upgrading can be observed in the integrated circuits industry in Malaysia (Penang and Kulim Tech Park). This observed technological upgrading can help to explain the increasing ICT exports from Malaysia to China but not the decline in PNC exports observed after 2005.

Conclusion

ASEAN trade in manufactured goods with China is primarily dominated by the ASEAN-4 countries, namely Malaysia, the Philippines, Singapore and Thailand. This trade is focused mainly in the ICT sector, primarily in PNC trade. However, the share of exports of PNC goods to total manufactured goods fell sharply after 2005. Adverse external circumstances such as the economic impact of the GFC on the final demand countries such as the European Union and the USA have affected the ICT trade of the countries engaged in the GVC in this sector and this has contributed to the economic contraction observed in the ASEAN-4 countries in 2008/09. Post-GFC, the ASEAN-4's growth has recovered and although there are restructuring problems in all these countries, the trade in ICT goods between the ASEAN-4 and China has also recovered, though imports are growing faster than exports after 2011.

There is a noticeable drop in the PNC exports of the ASEAN-4 to China after 2005 that indicates a shift that predates the adverse circumstances of the GFC. The main findings of this study indicate that there is little or no product upgrading in the most important sub-component of the PNC exports from the ASEAN-4 to China, namely SITC 776. Instead, four product lines in SITC 776 are no longer exported from Malaysia, Singapore and Thailand to China, after 2005. It would appear that

Malaysia, Singapore and Thailand are no longer able to compete in exports to China as there have been few improvements in the quality of this group of products that is exported to China for the period of this study. Rising costs of production in these countries have led to the relocation of the production and export of SITC 776 to the Philippines. This is bolstered by the relatively lower wages in the Philippines (Deveonshire-Ellis 2014) and improvements in its economic performance with increased spending on infrastructure post 2010. Therefore, these product lines continue to be exported from the Philippines to China, but their export value in 2013 is considerably less than the aggregate export value of the other three ASEAN countries in 2005. The increase in exports from the Philippines to China is therefore insufficient to compensate for the loss in exports from the Malaysia, Singapore and Thailand to China, leading to a drop in overall PNC exports to China.

Second, improvements in product quality are more apparent for SITC 772 but this product group constitutes a small share in total manufactured exports from the ASEAN-4 to China and hence its impact on overall PNC exports is small and insufficient to compensate for the large drop in exports from SITC 776. Lastly, with little or no product upgrading, especially in SITC 776, exporters from the ASEAN-4 have shifted to exports of non-PNC goods to China. Whether this shift to non-PNC goods which comprises semi-finished and final goods implies downgrading in the GVC for the ASEAN-4 warrants a separate study to investigate the upgrading and changes within this segment of the GVC. Nevertheless, the shift has enabled the overall ICT exports from the ASEAN-4 to China to continue to grow during the time period of this study.

Recent trends indicate renewed investors' interest in ASEAN. Increasing wages, an appreciating Renminbi and a shrinking working population are pushing multinationals to relocate from China (Nguyen 2013). In addition, mounting geopolitical tensions between China and Japan as well as the slowing down of China's economy have also prompted Japan to shift its new investment interests in the next few years to ASEAN in order to hedge the risks of its investment in China (Reuters, April 18, 2014). There is also renewed interest in ASEAN as a regional grouping as 2015 draws closer. Although the lofty aims of the ASEAN Economic Community Blueprints are unlikely to be achieved by this deadline, uncertainty in the external environment as well as limited progress in multilateral liberalisation will press ASEAN to deepen integration from within.

Moreover, the current negotiations under the Regional Comprehensive Economic Partnership Agreement (RCEP) aim to enlarge the regional grouping considerably by drawing in its Plus One Partners. This enlarged and integrated market will add to the attractiveness of the countries of the region as host economies. ASEAN is thus poised to reassume its status as preferred host economies, especially for Japanese direct investment. These future trends indicate another opportunity for Malaysia, Thailand and the Philippines to use FDI to move up the GVC from their current position, especially in non-PNC goods, based on the shift identified in this article. Appropriate policies need to be formulated to take advantage of this new opportunity to increase the value-added content of electronics production in especially Malaysia, the Phillipines and Thailand.

Disclosure statement

No potenatial conflict of interest was reported by the authors.

Notes

1. These are economies whose exports contain very little imports as opposed to "factory" economies whose exports contain a large share of imports of intermediate goods.
2. Based on Athukorala (2010), ICT goods are defined as: Office Machines and ADP (SITC-75); Telecommunications and Sound Recording Equipment (SITC-76); Semiconductor and Semiconductor Devices (SITC 772 – Electrical apparatus for switching or protecting electrical circuits or for making connections to or in electrical circuits (e.g. switches, relays, fuses, lightning arresters, voltage limiters, surge suppressors, plugs and sockets, lamp-holders and junction boxes); electrical resistors (including rheostats and potentiometers), other than heating resistors; printed circuits; boards, panels (including numerical control panels), consoles, desks, cabinets and other bases, equipped with two or more apparatus for switching, protecting or for making connections to or in electrical circuits, for electric control or the distribution of electricity (excluding switching apparatus of subgroup 764.1)); and SITC 776 – Thermionic, cold cathode or photo-cathode valves and tubes (e.g. vacuum or vapour or gas-filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes); diodes, transistors and similar semi-conductor devices; photosensitive semiconductor devices; light-emitting diodes; mounted piezoelectric crystals; electronic integrated circuits and microassemblies; parts thereof).
3. Although Vietnam has increasing trade with China in ICT products, because there are missing data, it is excluded from this study.
4. Refer to Appendix 1 for the list of PNC goods in ICT sectors. Classification is made based on Athukorala (2010).
5. Devadason (2008) notes that, generally, higher-quality products have higher prices, although unit value measures may also be influenced by other factors such as production costs, efficiency and compositional changes.
6. PNC goods exported to China are affected by final demand in the USA and Europe as they are processed into semi-finished or finished goods before export to those markets.

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Appendix 1. List of PNC goods in SITC (Rev. 3) codes

Commodity code	Commodity description
	Parts and accessories (other than covers, carrying cases and the like) suitable for use solely or principally with the machines of subgroups 751.1, 751.2, 751.9 and group 752…
75991	….for the machines of subgroup 751.1
75993	….for the machines of subgroup 751.9
75995	….for the electronic calculating machines of subgroup 751.2
75997	….for the machines of group 752
	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles (including apparatus capable of receiving radio-telephony or radio-telegraphy)…
76211	….incorporating sound-recording or reproducing apparatus
76212	….not incorporating sound-recording or reproducing apparatus
	Other radio-broadcast receivers (including apparatus capable of receiving radio-telephony or radio-telegraphy)…
76281	….incorporating sound-recording or reproducing apparatus
76282	….not incorporating sound-recording or reproducing apparatus but combined with a clock
76289	….not incorporating sound-recording or reproducing apparatus nor with a clock
76432	Transmission apparatus incorporating reception apparatus
76481	Reception apparatus for radio-telephony or radio-telegraphy, n.e.s.
	Parts and accessories suitable for use solely or principally with the apparatus of division 76…
76491	….with the apparatus of subgroup 764.1
76492	….with the apparatus and equipment of subgroup 764.2
76493	…with the apparatus and equipment of groups 761 and 762 and subgroups 764.3 and 764.8
76499	…with the apparatus falling within group 763
77231	Fixed carbon resistors, composition- or film-type
77232	Other fixed resistors
77233	Wire-wound variable resistors (including rheostats and potentiometers)
77235	Other variable resistors (including rheostats and potentiometers)
77238	Parts for the electrical resistors of subgroup 772.3
77241	Fuses for a voltage exceeding 1,000 V
77242	Automatic circuit-breakers for a voltage exceeding 1,000 V but less than
77243	Other automatic circuit-breakers
77244	Isolating switches and make-and-break switches
77245	Lightning arresters, voltage limiters and surge suppressors for a voltage
77249	Other electrical apparatus for switching or protecting electrical circuit
77251	Fuses for a voltage not exceeding 1,000 V
77252	Automatic circuit-breakers for a voltage not exceeding 1,000 V
77253	Other apparatus for protecting electrical circuits, for a voltage not exc
77254	Relays for a voltage not exceeding 1,000 V
77255	Other switches for a voltage not exceeding 1,000 V
77257	Lamp-holders
77258	Plugs and sockets
77259	Other electrical apparatus for switching or protecting electrical circuit
	Boards, panels (including numerical control panels), consoles, desks, cabinets and other bases, equipped with two or more apparatus of subgroup 772.4 or 772.5, for electrical control or the distribution of electricity (including those incorporating instruments or apparatus of groups 774, 881, 884 or of division 87, but excluding the switching apparatus of subgroup 764.1)…
77261	….for a voltage not exceeding 1,000 V
77262	….for a voltage exceeding 1,000 V
77281	Boards, panels, consoles, desks, cabinets and other bases for the goods of subgroup 772.6, not equipped with their apparatus
77282	Other parts
77612	Television picture tubes, cathode-ray (including video monitor cathode-ray tubes) for black and white or other monochrome
77621	Television camera tubes; image converters and intensifiers; other photocathode tubes
77623	Other cathode-ray tubes
77625	Microwave tubes (excluding grid-controlled tubes)
77627	Other valves and tubes

(*Continued*)

(Continued).

Commodity code	Commodity description
77629	Parts of the tubes and valves of subgroups 776.1 and 776.2
77631	Diodes, other than photosensitive or light-emitting diodes
77632	Transistors (excluding photosensitive transistors) with a dissipation rate of less than one watt
77633	Transistors (excluding photosensitive transistors) with a dissipation rate of one watt or more
77635	Thyristors, diacs and triacs (excluding photosensitive devices)
77637	Photosensitive semiconductor devices; light-emitting diodes
77639	Other semiconductor devices
77641	Digital monolithic integrated units
77643	Non-digital monolithic integrated units
77645	Hybrid integrated circuits
77649	Other electronic integrated circuits and microassemblies
77681	Piezoelectric crystals, mounted
77688	Parts of the devices of subgroup 776.3 and of the mounted piezoelectric crystals of item 776.81
77689	Parts of the articles of subgroup 776.4

Source: Based on Athukorala (2010).

Appendix 2. Computation of relative unit value (RUV)

The relative prices of exports to imports, RUV, index

$$RUVk = \frac{UVX_k}{UVM_k}$$

The formula is based on Devadason (2009), where prices are used as an indicator of quality. UVX_k represents the unit price of a product line, *k*, which is derived by dividing its export value with its respective exported units. The denominator UVM_k is obtained as in the case of UVX_k but imported value and imported units are used instead. If the computed RUV is greater than one, then it implies that the exports of a country for that product line are of higher quality relative to imports of the same product line and vice versa when the RUV is less than one. Devadason (2009) points out some limitations in the usage of RUV as an indicator to product upgrading. First, there is a portion of bilateral export-import pairs with zero trade. Second, there are pairs where one or both quantity data are missing. Third, since there are numerous units of measurement, the choice of an appropriate unit of measurement is based on the products which are most heavily traded.

Bilateral RCA: Competitiveness of country i in comparison to country j

$$BRCA^k_{ijw} = \left(\frac{x^k_{iw}}{X_{iw}}\right) \Big/ \left(\frac{x^k_{jw}}{X_{jw}}\right)$$

Where x^k_{iw} represents exports of a product line classified as PNC by country i to the world, and X_{iw} denotes total manufactures exported from country i to the world. Calculations were made for four countries (Malaysia, the Philippines, Singapore and Thailand) and for ASEAN-4. Export for ASEAN-4 is calculated by aggregating the exports of the four countries' product lines. x^k_{jw} represents exports of PNC by China to the world, and X_{jw} denotes total manufactures exported from China to the world.