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Analysis of Intra- and Inter-regional Trade in East Asia: Comparative Advantage Structures and Dynamic Interdependency in Trade Flows

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ANALYSIS OF INTRA- AND INTER-REGIONAL TRADE IN EAST ASIA: COMPARATIVE ADVANTAGE STRUCTURES AND DYNAMIC INTERDEPENDENCY IN TRADE FLOWS†

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This paper analyses the trade relationships within East Asia and between East Asia and the US and Japan, with particular emphasis on the structural changes that occurred during the 1990s. The main purpose of the analysis is to gain a better understanding of the potential global impact of these changes. The analysis of revealed comparative advantage patterns underlines the strong trading position of East Asia in the ICT sector, with the simultaneous gain in "comparative advantage" on the export and on the import side during the 1990s suggesting an increasing role of East Asian countries as a processing and production center. In order to study the consequences of the increasing internationalization of the production process in East Asia a VAR of inter- and intra-regional trade flows is estimated. The main finding is that there are quantitatively significant indirect international transmission channels of country-specific shocks along the international production chain, with substantial differences in the exposure to such shocks between Japan and the US.

† The views expressed in this paper are those of the authors and do not necessarily reflect those of Bank of Japan or the European Central Bank. The paper is the result of a joint project conducted by the International Department of Bank of Japan and the External Developments Division of the European Central Bank. Comments by Bruno Carrasco, Filippo di Mauro and Eiji Hirano are greatly appreciated.
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Summary

- The rapid changes that occurred in the economic structure of the East Asian region over recent decades has resulted in stronger trade interdependencies between Japan, the US and East Asia and within East Asia. This is largely due to the role that East Asia plays as a production base for Japanese and US companies – especially in the field of information technology goods, where East Asia has become the "global supply center". This integration of East Asia into the international production process appears to have been driven to a large extent by the significant flows of foreign direct investment – especially from Japan – into the area over the past decade.
- Most of the countries of East Asia have a "revealed comparative advantage" (RCA) in product categories containing a high share of IT-related goods (especially "Office machines and automatic data-processing machines" and "Electrical machinery"). In many cases, an RCA is associated with a "revealed comparative disadvantage" on the import side. Thus in many East Asian countries imports and exports of IT-related product categories comprise a larger share of overall imports and exports than in average world trade flows. This suggests that rather than having a comparative advantage in the production of entire products and thus specializing in the production of that product, East Asian countries specialize in certain downstream stages of the production process, resulting in simultaneous imports and exports in the associated broadly defined product categories.
- This comparative-advantage pattern has become increasingly pronounced during the 1990s, as the East Asian countries have substantially increased their RCA on the export side, while at the same time often increasing their RCDA on the import side.
- The increasing participation of East Asian countries in the global production process is also reflected in the high degree of intra-industry trade. Among the East Asian economies, intra-industry trade, as measured by Aquino's generalized index of intra-industry trade – is highest in the newly industrialized economies (NIEs), followed by the ASEAN economies and China. In line with the increased trade and production integration the degree of intra-industry trade has increased throughout the 1990s, especially in the SITC 1-digit sub-category "Machinery and Transport Equipment", with the Philippines and China experiencing particularly large increases in intra-industry trade.
- The effects of the observed increasing internationalization of the production process on the international transmission of country-specific developments is likely to be rather complex, going beyond the mere effects of a diversion of trade to other trading partners. In order to study these transmission channels a VAR of inter- and intra-regional trade flows is estimated, yielding three main findings:

- First, the estimation results are consistent with quantitatively significant indirect shock transmission channels along the international production chain. For example, an increase in East Asian exports to the US is preceded by an increase in intra-regional trade, which in turn is preceded by an increase in exports of Japan to other East Asian countries.
- Second, an important asymmetry in the relationship between Japan and East Asia and between the US and East Asia exists. While Japanese exports to East Asia "cause" significant inter-regional trade and ultimately exports to the US by East Asia, the reverse pattern for US exports to East Asia receives relatively little support by the data. Only East Asian exports back to the US appear to be affected by changes in US exports to East Asia. Thus, it appears that Japanese companies utilize East Asian countries as a production *and export* platform, whereas for US companies they are a production platform.
- Third, the role of East Asia as a production base in combination with comparatively small independent domestic demand factors in the region creates a situation in which intra-regional trade flows within East Asia are largely driven by developments abroad, as indicated by the variance decomposition analysis. Furthermore, the effect of trade with Japan is considerably more pronounced than trade with the US, underlining the strength of the Japan-East Asia trade linkage.

1. Preface

The rapid changes that occurred in the economic structure of the East Asian region over recent decades has resulted in strong trade interdependencies between Japan, the US and East Asia and within East Asia. These changes have been partly driven by the fact that Japanese direct investments in East Asia began to increase substantially in the late 1980s as many Japanese manufacturers started moving operations to the region in order to counter the effects of the strong yen. Today, East Asia accounts for a high share of global IT production and is rightly considered the "global supply center" for IT components. Similar to Japanese firms, US companies also have a large number of IT-related production centers in East Asia, especially in Singapore and Malaysia, while Taiwan supplies "OEM <Original Equipment Manufacturing>" products for leading US firms. Partly as a consequence, the US represents the largest export market for the highly export-dependent East Asian economies. In addition, trade among East Asian countries themselves has also increased substantially, reflecting in part an increasing division of labor within the region.

Although many of these developments are well known, relatively little systematic evidence on the structure of East Asian trading relationships and of the trade links with countries outside the region is currently available. A thorough understanding of the nature of these trade linkages and of the interdependencies created by the rapid trade expansion in East Asia is, however, of crucial importance. Not only does such an understanding aid in assessing the prospects of future growth prospects in the region, but it also helps to analyze international interdependencies, for example in the context of the international propagation of shocks or business cycle developments. Of particular importance in that respect is the distinction between trade links that are created as the result of a division of labor along the traditional product dimension and links that are the result of specialization in certain segments of the production chain.

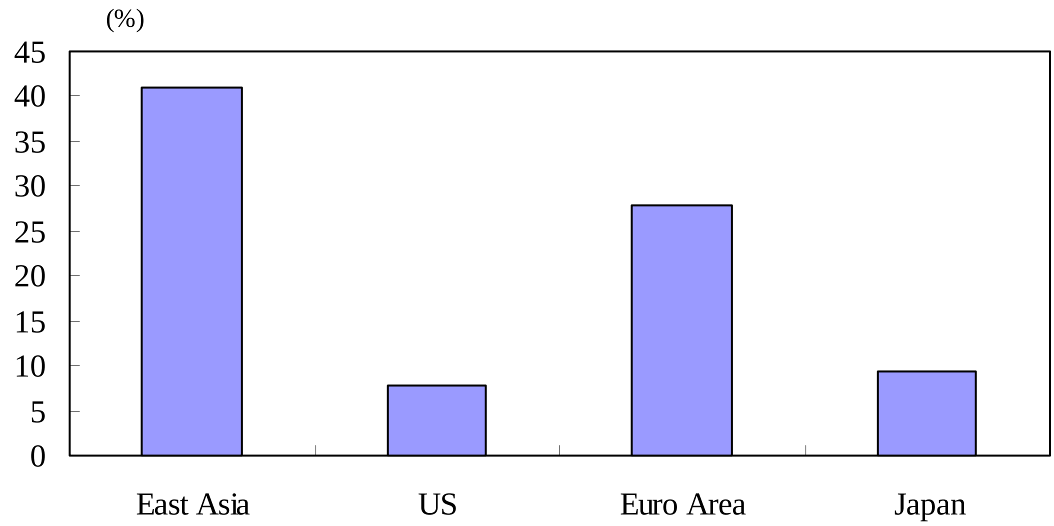
In an attempt to fill this gap, this study provides a general and systematic analysis of trade relationships within East Asian and between East Asian and Japan and the US. It focuses, in particular, on the changes that occurred during the 1990s and on the nature of the dynamic trade interdependencies created by the increasing integration of the East Asian region into the global trading and production system. As a first step, Chapter 2 reviews the principal characteristics of intra-regional and inter-regional trade in East Asia. The analysis in Chapter 3 takes a closer look at the product composition of trade flows. In particular, it tries to identify areas of comparative advantage and disadvantage, combining information from the export and import side by constructing indices of “revealed comparative advantage”. In addition, indices of intra-industry trade are calculated – for overall trade and for certain subcategories – and analyzed. The analysis provides strong evidence for the increasing role of

East Asia as a production and processing center in certain product categories – especially in IT-related ones – and for an increasing "internationalization" of the production process, i.e. a segmentation of the production process, with the different stages of production being distributed across national borders. As this type of division of labor may create strong interdependencies among different trade flows, Chapter 4 studies the dynamic structure of East Asian trading relationship by estimating a small VAR model with the various trade flows as endogenous variables. For the purpose of this analysis, trade flows within East Asia and between East Asia and the US and Japan are interpreted as being determined largely by the input-output relationships along the production chain. Concluding thoughts are in Chapter 5.

2. Main features of trade in East Asia[1]

Compared to the US, the euro area and Japan, East Asian economies are highly dependent on exports, with an overall share of exports to GDP of 41.1% over the 1995-2000 period (see Charts 1 and 2). The export share of the Newly Industrialized Economies (NIEs) is particularly high – more than 10 percentage points higher than the export share of the ASEAN4 countries[2] – although part of that share can be attributed to the importance of re-exporting in the case of Hong Kong and Singapore. Although these export figures provide only an imperfect measure of the contribution of the external sector to the regions overall GDP, which would more appropriately be measured by the domestic value-added contained in exports, they nonetheless illustrate the high exposure of East Asia to fluctuations in export market demand. Regarding the geographical breakdown, the US are by far the most important

(Chart 1) Exposure to Export (Total Export/Nominal GDP)



* 1995-2000 average (Euro Area 1997-2000average)
East Asia: Total of NIEs,ASEAN4,China
** Figures include intra-regional trade. Export excluding intra-regional trade in Euro Area divided by the total nominal GDP is 14.0% for the average of 1997-2000.

Source:IFS,CEIC

[1] This section relies primarily on information contained in Takashi Isogai and Shunichi Shibanuma. 2000. "East Asia's Intra- and Inter-Regional Economic Relations - Data Analyses on Trade, Direct Investments and Currency Transactions" (International Department Working Paper Series 00-E-4).
[2] The ASEAN4 countries are Indonesia, Malaysia, the Philippines and Thailand.

(Chart 2) Exposure to export in East Asia
(Total Export/Nominal GDP)

(%)

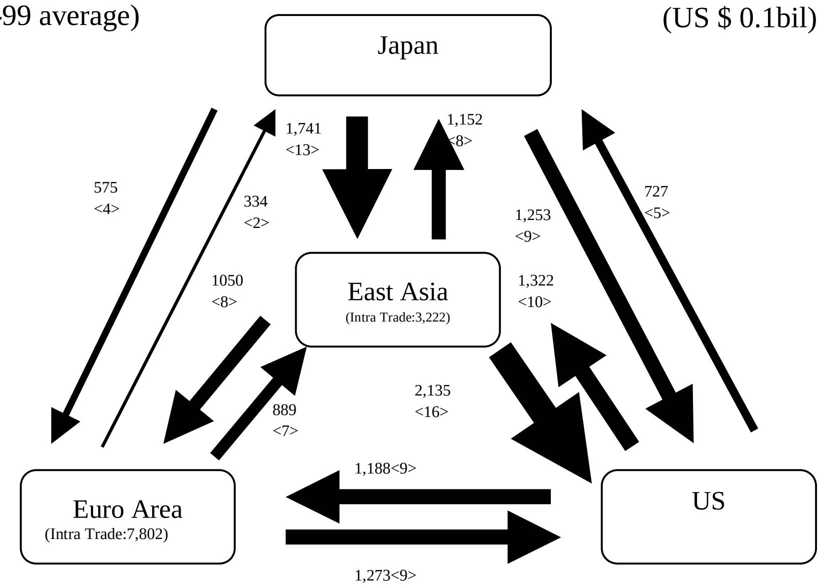
EAST ASIA			41.1
	NIEs		58.3
		SOUTH KOREA	32.3
		TAIWAN	42.9
		HONG KONG	115.6
		SINGAPORE	138.5
	ASEAN4		47.4
		THAILAND	42.5
		INDONESIA	32.6
		MALAYSIA	93.0
		PHILIPPINES	36.9
	CHINA		20.4

* 1995-2000 AVERAGE

Source:IFS,CEIC

(Chart 3) Trade among Japan, East Asia and the U.S.

(1996-99 average) (US $ 0.1bil)

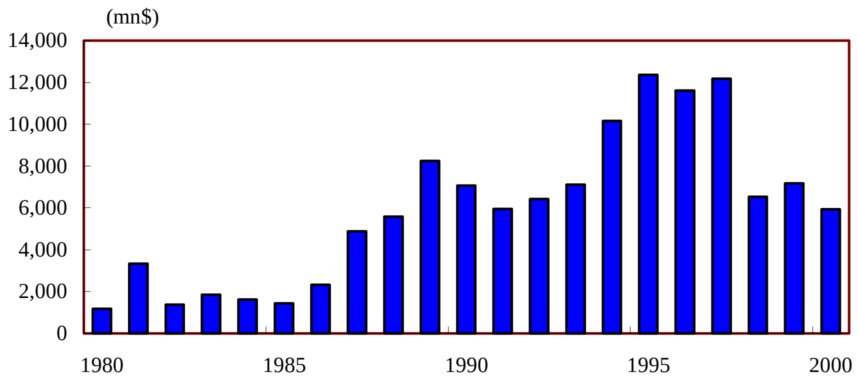


Source: IMF, Direction of Trade Statistics
Notes: East Asia= NIES, ASEAN 4, China. The size of the arrow reflects the figure in the corresponding < >, which is share of respective regions' trade in total trade.

destination of East Asian export, absorbing almost twice the amount of exports as Japan, the second most important export destination (Chart 3). Exports to the euro area come in third, only slightly below exports to Japan.

The high export dependence of East Asian economies is to a considerable degree the result of the increase of foreign direct investment flows into the region originating from Japan, the US and other countries outside of the region, which began in the late 1980s (Chart 4). While some of this investment may have been undertaken with the intention to serve domestic markets in the region, the majority of investment appears to be export-oriented, boosting the presence of East Asian countries as processing and production bases. This development has been particularly evident in the IT sector, thereby giving rise to a highly unbalanced production-demand structure for IT-related goods in East Asia (see Charts 5 and 6). While the NIEs accounted for only 3% of global demand for IT products, their share in the world production of IT products was 14% - almost 5 times more than demand. This “production surplus” in East Asia is mirrored by a corresponding “production deficit” in Japan, the US and the EU, where demand exceeds production. The increasing role of East Asia as a production base for IT-related products is evidenced by the time profile of production shares, which show that production capacity has shifted towards East Asian countries especially during the first half of the 1990s. Over the entire period from 1990 to 1998, the share of the NIES and the ASEAN4 countries in global IT production has increased from 12% to 19%. As overall production has also increased substantially over this period these figures understate the overall growth of the East Asian IT-sector. While the production shares of the US and the EU have stayed more or less constant – with a small increase for the US and a small decrease for the EU – the relative importance of Japan as a producer of IT-products has seen a more

(Chart 4) Foreign Direct Investment of Japan into Asia



* Fiscal year (from April to March of next calendar year) base
** "Asia" consists of 24 Asian countries, including the 9 East Asian countries in Chart2.
source: Ministry of Finance

(Chart 5) World IT Production by Region

(Share,%)

		1990	1995	1998
Japan		29	28	22
US		29	29	33
EU		24	20	22
NIEs,ASEAN4 Total		12	19	19
	NIEs	10	14	14
	ASEAN4	2	5	5
Others		5	4	4

Source:OECD Information Technology Outlook(1999)
Reed Electronics Research(1999)

(Chart 6) Global Demand for IT products by Region

(Share,%)

	1994	1998
Japan	17	13
US	45	44
EU	19	25
NIEs	1	3
ASEAN	N.A.	N.A.

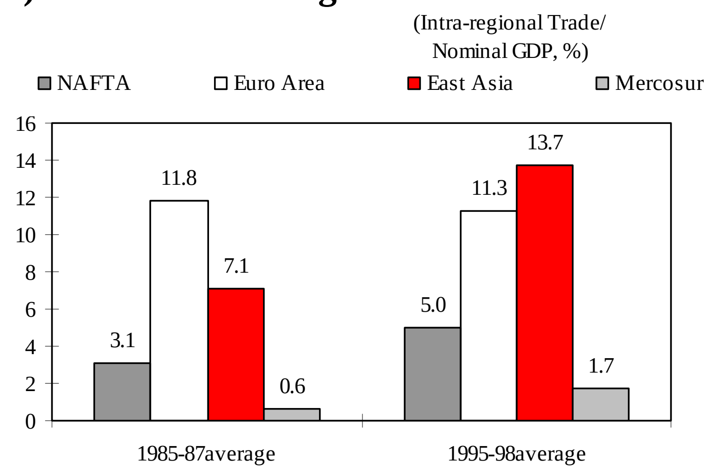
Source: OECD Information Technology Outlook(1999)

noticeable decline, from 29% in 1990 to 22% in 1998. This suggests that some of the increase in IT production in East Asia represents a shift of production capacity by Japanese firms from Japan to East Asian countries.

The increased role of East Asia as a production and processing base is also evident in the high proportion of imports of intermediates and capital goods from outside the region. Despite its secondary role as a destination of East Asian exports, Japan provides most of the imports to the East Asian region, followed by the US and the euro area (see Chart 3). The strong imports of East Asia from Japan in combination with the significant exports of East Asia to the US are consistent with the hypothesis that Japanese firms, who have shifted production capacity to East Asia, provide inputs to the production process and export directly from the East Asian production locations to the US – and to a lesser extent back to Japan. Taking into account such indirect trading relationships between Japan and the US the "extended" trade deficit in US with Japan, consisting of direct and indirect trade flows, may be substantially more sizeable. A similar pattern of off-shore export production may apply, on a smaller scale, to the activities of US manufacturers. Moreover, while foreign direct investment appears to have played an important role, some of the increased production capacity in East Asia has undoubtedly been financed domestically. While this may affect the associated income flows, the effect on trade flows will be similar, as these domestic firms are also likely to import a significant part of their inputs from abroad.

Thus, whether FDI-related or not, the resulting trade flows will reflect the increasing internationalization of the production process, thereby leading to an overall increase in the volume of international trade and creating new – and more complex – channels for the international transmission of shocks. The trade-creating effect is illustrated by the strong increase in intra-regional trade (see Chart 7). While NAFTA and Mercosur have also seen noticeable increases in the importance of inter-regional trade relative to overall regional activity, the increase is most pronounced for East Asia. The share of inter-regional trade in regional GDP in East Asia has increased from 7.1% over the 1985 to 1987 period to 13.7% over the 1995 to 1998 period, despite the fact that the latter period was characterized by severe economic turbulence. The increased intra-regional division of labor, as the region establishes itself as the "global supply center" for IT-related goods, has certainly contributed to this exceptional rise of East Asian trade integration.[3]

(Chart 7) Share of Intra-regional trade



Source: IMF Direction of Trade Statistics

[3] These developments also have important implications for the interpretation of global export market shares as an indicator of a region's or country's competitiveness. In principle, the spreading of the production process across different countries merely creates trade flows, which previously had taken place within a country and were thus not recorded in international trade statistics. Thus, in a sense, the resulting increase of a region's share in global trade is a statistical artifact. At the same time, however, such processes tend to increase the efficiency of the production process, thereby leading to an increase in international competitiveness. The separation of this true competitiveness and the merely statistical effect is, however, extremely difficult.

3. Trade structures of East Asian countries by type of good (comparative advantage, intra-industry trade)

The preceding general overview illustrates the strong inter- and intra-regional trade integration of East Asia and underlines the significant changes that have occurred over recent years. While the evidence presented is consistent with an increased internationalization of the production process in East Asia – especially in the IT sector – a more disaggregated analysis focussing on the product structure of trade is necessary to shed light on the concrete driving forces behind East Asian trade integration. To that end, this section uses two summary measures of a country's trade structure: an index of revealed comparative advantage/disadvantage and an index of intra-industry (or horizontal) trade.

(1) Comparative advantage structures in East Asian countries by type of good

According to traditional trade theory, a country will export those goods for the production of which it has a comparative advantage and will import those goods associated with a comparative disadvantage. While specialization on the production side is complete in the case of linear or "Ricardian" production technologies, in the more realistic case of convex production possibility frontiers specialization will not necessarily be complete and countries will only produce more of the comparative advantage good than in a situation of autarchy. There are various ways of identifying comparative advantage patterns empirically. As the direct comparison of autarchy price ratios is generally not feasible, observed trade flows are often used for that purpose. The measures of comparative advantage derived in that way are thus *revealed* measures. The interpretation of such measures as *actual* comparative advantage is complicated by the fact that trade is often influenced by other factors as well. Most importantly, economies of scale may play an important role – especially with respect to intra-industry trade flows – and government policies may distort trade flows through various tariff and non-tariff measures. These caveats notwithstanding, actual trade flows may contain important information about a countries comparative advantage situation – and changes thereof over time – and may, in particular, provide insights into the internationalization of the production process.

Indices of revealed comparative advantage/disadvantage (RCA, RCDA and RTA)

In order to measure the Revealed Comparative Advantage (RCA) of a country in a certain product category, we compare the share of that product category in that country's exports to the share of that product category in overall world exports. Thus, this measure captures to what extent a country exports more of a product than the average country. Algebraically, the RCA measure employed can be written as follows:

$$RCA_{ij} = \left(\frac{X_{ij} / X_j}{X_{iw} / X_w} - 1 \right) \times 100$$

Where,

X_{ij} = Country *j*'s exports of good *i*

X_j = Total exports of country *j*

X_{iw} = Worldwide exports of good *i*

X_w = Total worldwide exports

A value of RCA > 0 (<0) indicates that the share of product i in country j's exports (X_{ij} / X_j) is greater (smaller) than the share of product i in overall world exports (X_{iw} / X_w), suggesting that the country has a comparative advantage (disadvantage) in the production of that good. The larger the RCA value, the higher the degree of comparative advantage. A value of RCA = 0 indicates a country has neither a comparative advantage nor a comparative disadvantage on the export side for that good.

Similar to the export pattern, the structure of a country's imports may likewise contain useful information about a country's comparative-disadvantage situation. Therefore, we calculated a similar index for a country's import side, which we call index of Revealed Comparative Disadvantage (RCDA)[4]:

[4] Of course, both the RCA and the RCDA contain simultaneously information on the comparative advantage and disadvantage. According to the standard trade model, above-average exports (imports) indicate a comparative advantage (disadvantage) in the same way as below-average imports (exports). Alternatively, we could have therefore called the two indexes export-side and import-side RCA.

$$RCDA_{ij} = \left(\frac{M_{ij} / M_j}{M_{iw} / M_w} - 1 \right) \times 100$$

Where,

M_{ij} = Country *j*'s imports of good *i*

M_j = Total imports of country *j*

M_{iw} = World wide imports of good *i*

M_w = Total worldwide imports

A value of RCDA > 0 (<0) indicates that the share of product i in country j's imports (M_{ij} / M_j) is greater (smaller) than the share of product i in overall world imports (M_{iw} / M_w), suggesting that the country has a comparative disadvantage (advantage) in the production of that good.

According to the standard textbook trade model, a country exports its comparative-advantage good and imports its comparative-disadvantage good. This would imply that for a certain product category one of two measures is positive, while the other is negative. However, in reality countries often import and export goods from the same product category. Nonetheless, one would expect that a country’s tendency to import its comparative advantage good should be less pronounced than its tendency to export it. Thus one would expect above-average exports to be paired with below-average imports – or, alternatively, in terms of the above measures that RCA>0 and RCDA<0 – and vice versa.

In the case of such traditional comparative advantage patterns all necessary information could therefore be obtained from the analysis of one of the indicators alone. A simultaneous analysis of both the RCA and the RCDA becomes, however, important in the case that a country – like many East Asian countries – performs an important role as a processing and production center for certain products. This would, for example, be the case if that country does not have a comparative advantage in the entire production of a certain product, but only at certain stages of the production process, which may differ by their relative factor intensities. With high costs of international trade, a country may have to specialize in the production of the entire good, for which it has on average, over the various stages of production, a comparative advantage. As the costs of international trade are reduced, the various stages of production can be spread over various countries more easily, allowing specialization according to comparative advantage patterns at the various stages of production. In the process, economic efficiency will increase and additional international trade flows, especially intra-industry flows, will be created. In the course of further globalization, these kinds of trade flows are likely to gain increasingly in importance. In terms of measures of comparative advantage this implies that cases may become more common where countries import a certain product more than world average, while at the same time also exporting it more than average. Although such a trade pattern would be difficult to explain in terms of a theory of comparative advantage applied to entire products, it is perfectly compatible with comparative advantage at certain stages of production.

For these reasons we analyze the RCA and the RCDA jointly. In addition to a graphical juxtaposition of the two measures, we follow Rooyen, Esterhuizen and Doyer [2000] and calculate a Relative Revealed Comparative Trade Advantage (RTA) by subtracting RCDA from RCA:

$$RTA_{ij} = RCA_{ij} - RCDA_{ij}$$

On the one hand, the RTA provides an overall measure of comparative advantage in a certain product category by combining the information on the export and the import side of a country's trading relationships. According to this interpretation, a positive value of RTA indicates an overall comparative advantage, with the degree of comparative advantage increasing with the numerical value of the RTA. On the other hand, the RTA could be interpreted as a measure of the importance of comparative advantage considerations on the processing stage along the lines of the previous discussion. A drawback of this measure, however, is that it does not allow any inferences about the degree of comparative advantage in this respect as it does not take into consideration whether a country imports and exports more or less than the world average in a given product category.

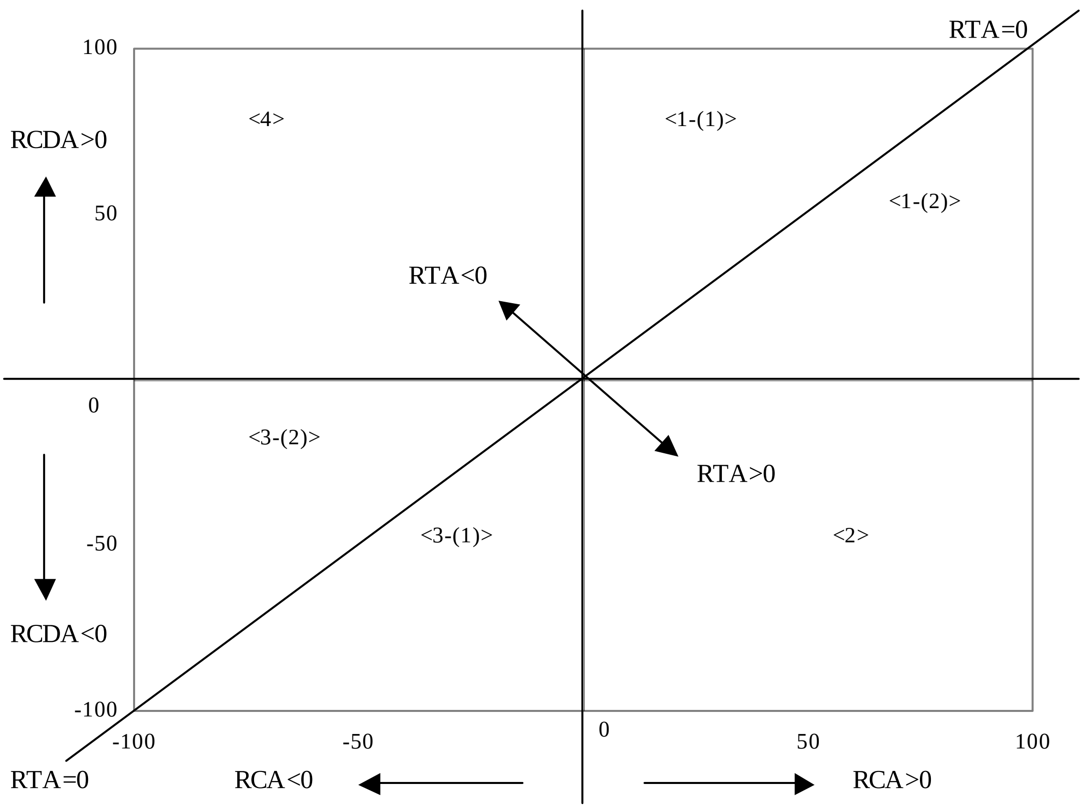
Comparative advantage/disadvantage structures in East Asian countries

We use the United Nations "COMTRADE" (CD-ROM database) to calculate the three measures of revealed comparative advantage-disadvantage – RCA, RCDA and RTA – for a variety of goods, which are of particular interest for the East Asian region, for eight East Asian countries [5] (South Korea, Hong Kong, Singapore, Thailand, Indonesia, Malaysia, Philippines and China), the US and Japan.

Chart 8 provides a stylized illustration of the graphic representation chosen for the analysis and Chart 9 contains the product categories (SITC categories) used. In the graphic representation, the RCA is shown along the horizontal axis, while the RCDA is shown along the vertical axis. Thus a typical comparative advantage case would be expected to lie in the lower right quadrant of the chart, indicating a comparative advantage on the export side

[5] The United Nations database does not contain data for Taiwan.

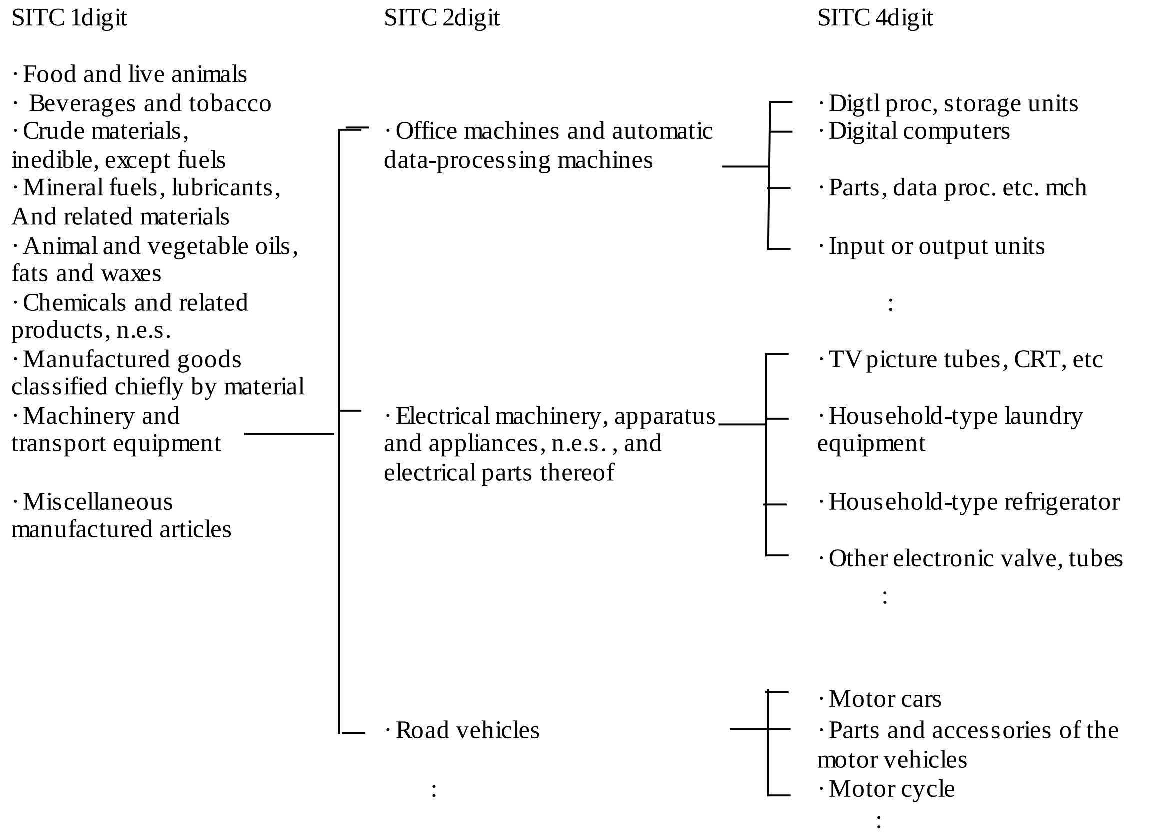
(Chart 8) About RCA,RCDA,RTA



* RTA=RCA-RCDA, the value of RTA equals the horizontal distance from the diagonal line (RTA=0, RCA=RCDA)

<table>
<tr><th></th><th>Export side (RCA)</th><th>Import side (RCDA)</th><th>Expot/Import Joint (RTA)</th><th colspan="2"></th></tr>
<tr><td>1-(1)</td><td rowspan="2">Advantage (+)</td><td rowspan="2">Disadvantage (+)</td><td>Disadvantage (-)</td><td rowspan="2">Having a bigger share than world average both in export and import of a commodity (Open Economy Type)</td><td>Comparative Disadvantage, when export and import side are combined, as the extent of excess of a share in export of a commodity is below that of excess of a share in import of the commodity</td></tr>
<tr><td>1-(2)</td><td>Advantage (+)</td><td>Comparative Advantage, when export and import side are combined, as the extent of excess of a share in export of a commodity is above that of excess of a share in import of the commodity</td></tr>
<tr><td>2</td><td>Advantage (+)</td><td>Advantage (-)</td><td>Advantage (+)</td><td colspan="2">Having a bigger share than world average in export of a commodity and a smaller share than world average in import of the commodity (Comparative Advantage type)</td></tr>
<tr><td>3-(1)</td><td rowspan="2">Disadvantage (-)</td><td rowspan="2">Advantage (-)</td><td>Advantage (+)</td><td rowspan="2">Having a smaller share than world average both in export and import of a commodity (Closed Economy type, Lower dependency on external trade)</td><td>Comparative Advantage, when export and import side are combined, as the extent of shortage of a share in export of a commodity is below that of shortage of a share in import of the commodity</td></tr>
<tr><td>3-(2)</td><td>Disadvantage (-)</td><td>Comparative Disadvantage, when export and import side are combined, as the extent of shortage of a share in export of a commodity is above that of shortage of a share in import of the commodity</td></tr>
<tr><td>4</td><td>Disadvantage (-)</td><td>Disadvantage (+)</td><td>Disadvantage (-)</td><td colspan="2">Having a smaller share than world average in export of a commodity and a bigger share than world average in import of the commodity (Comparative Disadvantage type)</td></tr>
</table>

(Chart 9) Outline of the SITC Classification



1. SITC(Standard International Trade Classification)is a system of classification of commodities by United Nations.
2. SITC 3digits are omitted. As data of SITC 3digits is not easy to obtain from the COMTRADE(CD-ROM Database) employed at this analysis, They are not employed in this paper.

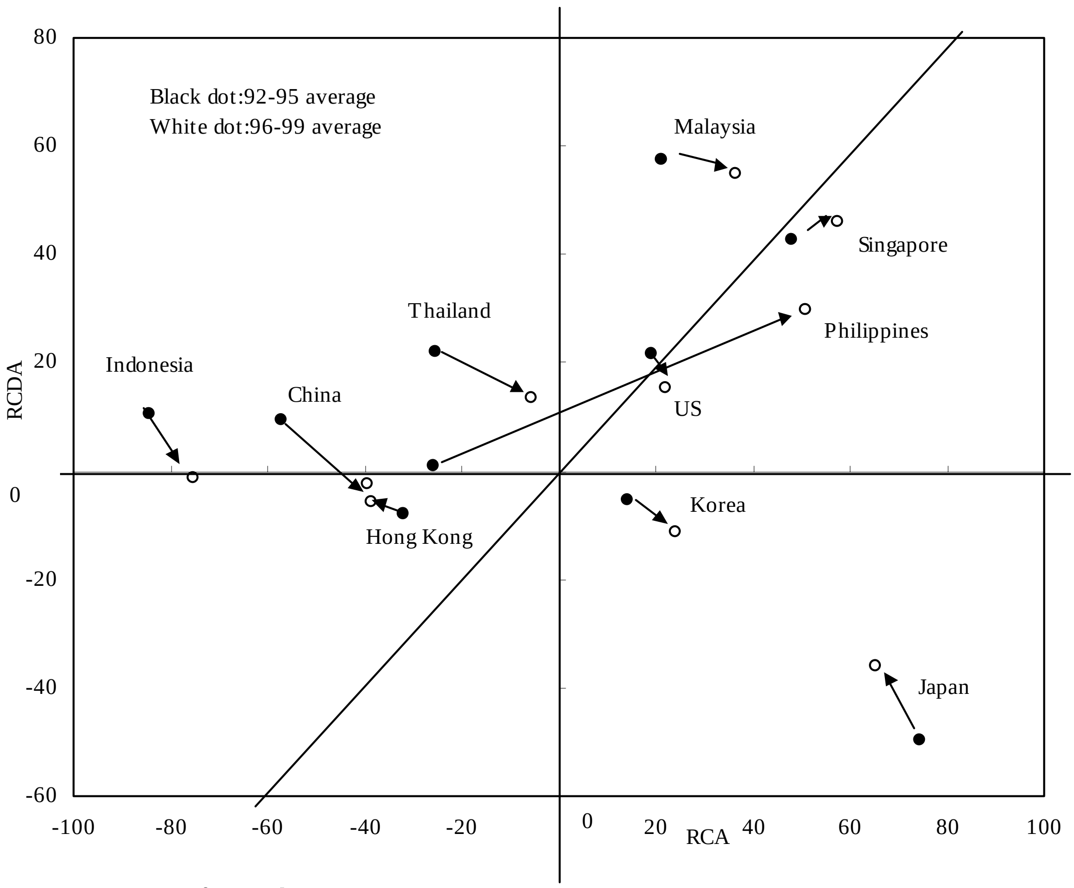
(RCA>0) and on the import side (RCDA<0). The typical comparative disadvantage case would accordingly be found in the upper left quadrant. Particularly interesting are cases in which countries are in the upper right quadrant, indicating a simultaneous comparative advantage on the export side and comparative disadvantage on the import side for the same product. Such cases may contain useful information on the importance of East Asian countries as a production and processing center for certain products[6]. In the analysis of these charts, we focus on two main aspects: the general location of a country's trade pattern and the direction and magnitude of changes in this location over time.

We begin by considering the comparative advantage/disadvantage structure for machinery and transportation equipment (SITC 1 digit category), which includes – among others – IT-

[6] For a more detailed discussion of the interpretation of this graphical representation please see Appendix I.

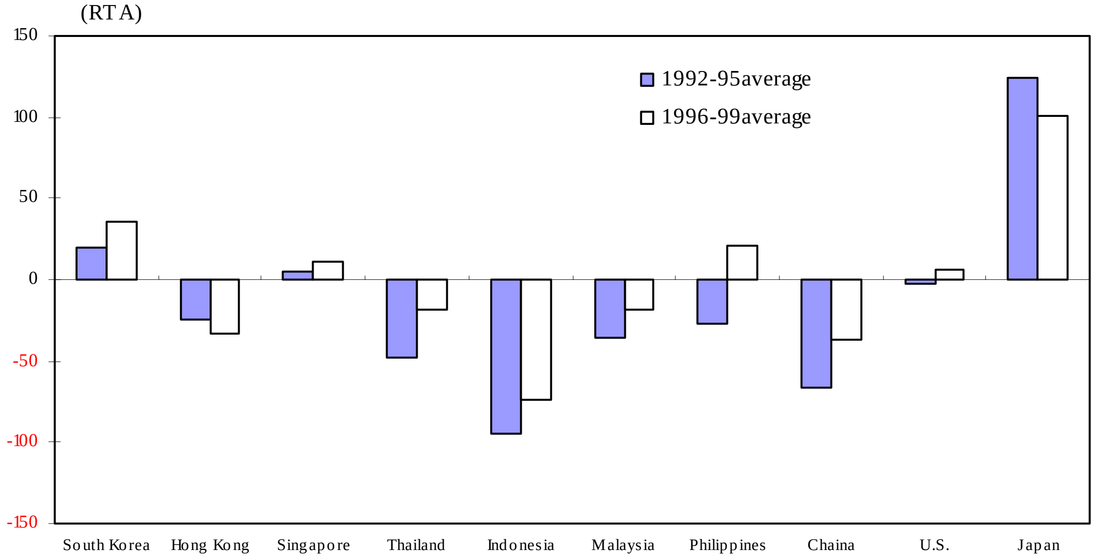
related goods and automobiles (Chart 10). Overall, most East Asian countries appear to have a comparative disadvantage on the import side, with only the two NIEs Hong Kong and Korea as well as Japan importing less than the world average. On the export side, the comparative advantage situation exhibits much larger variations, ranging from a strong disadvantage in the case of Indonesia to a strong advantage in the case of Singapore and Japan. Taking import and export side information together, Indonesia, China and Thailand can be said to have a traditional comparative disadvantage in the production of machinery and transport equipment, while Korea and Japan are standard cases of a comparative advantage in this product category. Malaysia, Singapore, the US and the Philippines, since the second half of the 1990s, are located in the upper right quadrant, suggesting that these countries may be an important part of the international production chain in these product categories. In the case of Singapore and Malaysia the primary factor determining their position may be their increasing specialization in IT-related goods, which raised export and import shares for office equipment and electrical equipment. In terms of the RTA (see Chart 11), only Japan and two of the NIEs had a positive RTA throughout the 1990s, with Japan's RTA being particularly large, reflecting the strong traditional comparative advantage pattern.

(Chart 10) Revealed Comparative Advantage/Disadvantage in Machinery and Transport Equipment



* Refer to Chart 8

(Chart 11) RTA (Relative Revealed Comparative Trade Advantage) in Machinery and Transport Equipment



Concerning the dynamics of trading relationships in the East Asian region, the change in the RCA/RCDA pattern occurring between the first and second half of the 1990s is particularly interesting. For most countries, the 1990s were characterized by a movement towards developing a comparative advantage in machinery and transport equipment, i.e. a shift toward the "south-east" in the RCA-RCDA space. Notable exceptions to this general trend are Japan and Hong Kong, which experienced the opposite development, and Singapore and the Philippines, which saw an increase in both, the RCA and the RCDA. These developments are also reflected in the dynamics of the RTA (see Chart 11), which declined from the early through late 1990s in the case of Japan, while it increased in all East Asian countries except Hong Kong[7]. Presumably, direct investments and production transfers from Japan and the US resulted in increasing international competitiveness, leading to an increase in the share of exports of machinery and transport equipment in most East Asian countries' overall exports. At the same time, increasing local production caused a relative decline in the share of imports of machinery and transportation equipment for most countries. One important change, apparent from Reference chart 1, is the decline in the RCA for other manufactured goods, which was probably due to the shift in East Asian countries away from low value-added

[7] The decline in Hong Kong's RCA for machinery and transportation equipment is probably due to the increased proportion of Chinese-made electrical equipment and IT-related export goods bypassing Hong Kong, which somewhat reduced its role as a port. At the same time the increase in Hong Kong's RCDA and decline in the RTA may be due to the strong domestic demand before the integration with China (1996-1997). Hong Kong's RTA in office equipment likewise declined.

products like toys and apparel towards higher value-added machinery and transportation equipment (in which IT-related goods are included).

In this respect it is useful to distinguish between different possibilities for an international shift in the production base. If the entire production process is moved to another country, the recipient country will see its imports decrease, as demand can now be satisfied through local production. At the same time exports will increase, as the country previously producing the product will now have to import the final product from the new producer. In addition, the external demand of the previous producer will have to be satisfied from the new production base[8]. Thus, a shift of the entire production process is likely to result in the observed "south-east" shift in the recipient countries, while leading to a "north-west" movement of the country, from which the production shift originates.

A more limited shift of only selected stages of the production process may have different implications for the revealed comparative advantage measures, with the implication depending on the concrete production stages. In the case that early stages of the production process are relocated, the imports in the affected product category are likely to be unaffected. Additional imports of inputs may not be required at early production stages – either not at all or just not in the same product category – and the final product would still have to be imported as before. In the case that an intermediate stage of production is relocated, the new producer is likely to see both exports and imports in that product category increase. Inputs have to be imported and are more likely than at earlier production stages to be in the same product category, while the finished intermediate product will be exported. Again the final product will still have to be imported, resulting in a net addition to overall imports. Finally, if the final stages of production are relocated, exports are again likely to increase, while the impact on imports is, in principle, ambiguous. On the one hand, additional imports are necessary as input to the production process. On the other hand, fewer final products will have to be imported, as demand can be satisfied out of domestic production. If production is only targeted towards domestic demand, the latter is likely to dominate the former, resulting in an overall reduction of imports. In the more realistic case that part of the production is also exported, giving rise to additional imports of inputs, the net effect depends on the relative size of foreign and domestic demand and the domestic value added in the production chain. These ambiguities notwithstanding, the change in the comparative advantage pattern may thus in some cases also contain relevant information about the concrete stages of production that have been established in a country.

[8] To simplify the discussion the overall level of demand is held constant. In reality, the gain in efficiency associated with the internationalization of the production process is likely to lead to an increase in the overall quantity demanded. Furthermore, the international reallocation of production income is likely to alter the international distribution of demand for the final product and thus trade flows. Similarly, the level of overall trade is held constant for ease of exposition, although additional trade is, of course, generally created in the process of such shifts in the production base – especially if only certain stages of production are affected.

Thus, the tendency of a "south-east" movement of a large number of East Asian countries is consistent with a shift in the production base for machinery and transport equipment – in relative or absolute terms – towards these countries. According to the preceding discussion this shift is most likely to have occurred with respect to the entire production process or at the final stage of production, if production is mainly targeted toward the domestic market. The simultaneous "north-west" shift of Japan is consistent with Japanese manufacturers being one of the driving forces behind this shift in the production base[9]. The shift in the trading pattern of the Philippines and Singapore, on the other hand, may rather reflect a shift at more downstream stages of production – either intermediate or final – as both, the relative weight of machinery and transport equipment in those countries' exports and imports, increased during the 1990s. This would, for example, be consistent with an increased role of Singapore as a re-exporting hub, but could also indicate more substantial contributions to the production chain.

(Chart 12) Direct Investment Position of US and Japan

(US $)

		Japan	US
World		2,623	9,533
	East Asia	663	789
	<Share, %>	<25.3>	<8.3>

*Average from end of 1996 to 99
Source: BOJ, US Department of Commerce

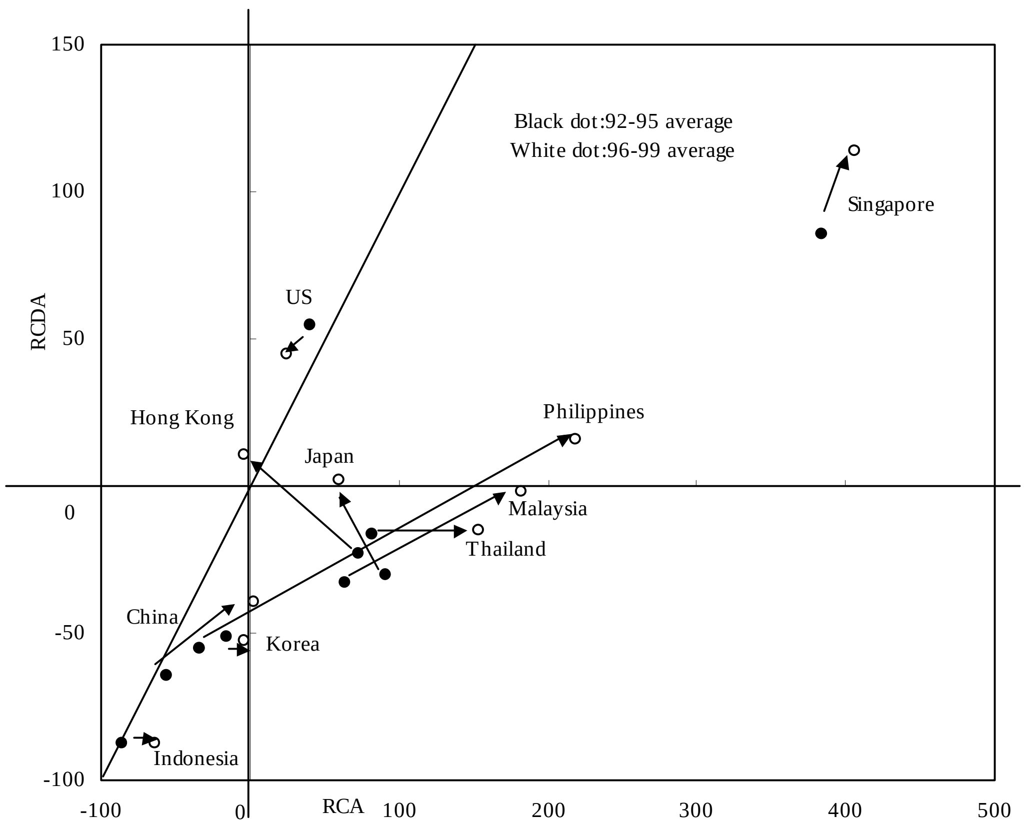
The substantial shift in the position of the Philippines, from being a comparative-disadvantage country to being a country with a very open trade structure in the upper right quadrant, is particularly noteworthy. In the case of the Philippines the substantial transfer of production from Japan, the US and other countries increased the production and exports of IT-related goods and other machinery, while necessitating at the same time a significant increase in the imports of intermediate goods. This process may have been accelerated by the fact that, while many of the other Asian countries experienced currency crises in the late nineties, the Philippines escaped the worst effects. Regarding the magnitude of the variation in RCA and RCDA of other countries, it seems that those countries with a more mature trade structure, such as the NIEs, Japan and the US experienced less pronounced shifts in their trading patterns. The smaller change of the US trading pattern during the 1990s relative to that of Japan may be an indication that US firms have been quicker than their Japanese counterparts to move production abroad to countries such as Mexico.

[9] See Chart 12 regarding direct investment in East Asia by Japan and US.

As the SITC category Machinery and Transport Equipment is relatively broad, encompassing a large number of diverse products, a few more detailed 2-digit SITC categories are analyzed as well[10]. In particular, we consider the IT-intensive categories 75 (Office Machines and Automatic Data-processing Machines), 76 (Electrical Machinery, Apparatus and Appliances), as well as the similarly important – albeit less IT-intensive – category 78 (Road Vehicles).

Turning first to Office Machines and Automatic Data-processing Machines (Chart 13), all East Asian countries, except for Singapore, had a comparative advantage on the import side (RCDA<0) at the beginning of the 1990s. In a substantial number of these countries this was associated with a comparative advantage on the export side as well. Even for those countries with a comparative disadvantage on the export side, this was outweighed by the magnitude of the import-side advantage, leaving them with a positive overall RTA. Thus, the East Asian region enjoyed a clear revealed comparative advantage in the production of office machinery and computers. This comparative advantage was generally even increased during the second half of the 1990s, as, for example indicated

(Chart 13) Revealed Comparative Advantage/Disadvantage in Office Machines and automatic data-processing machines

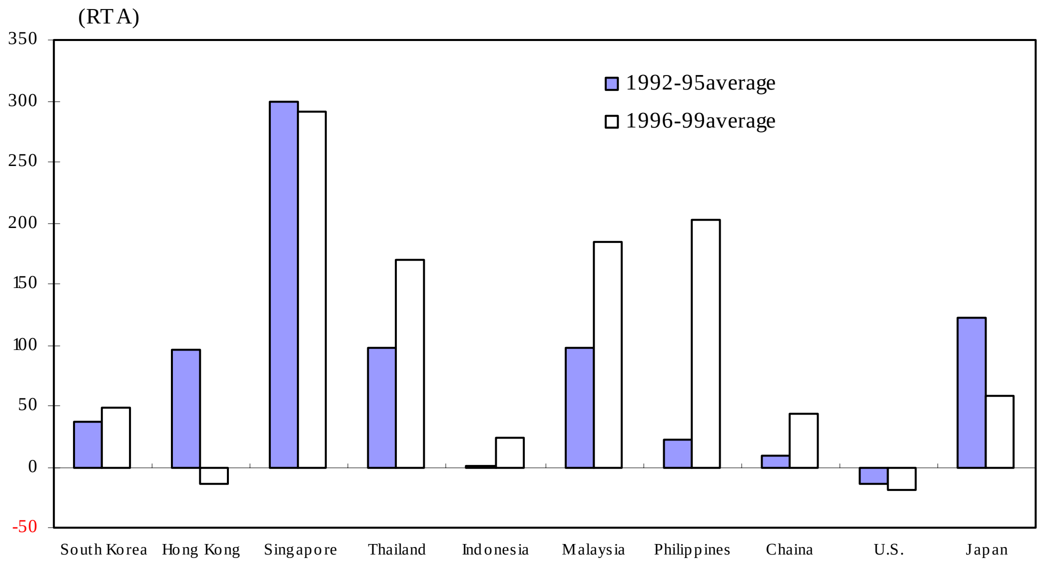


* Refer to Chart 8

[10] Information for other the other SITC-2 categories can be found in Reference Tables 4-6.

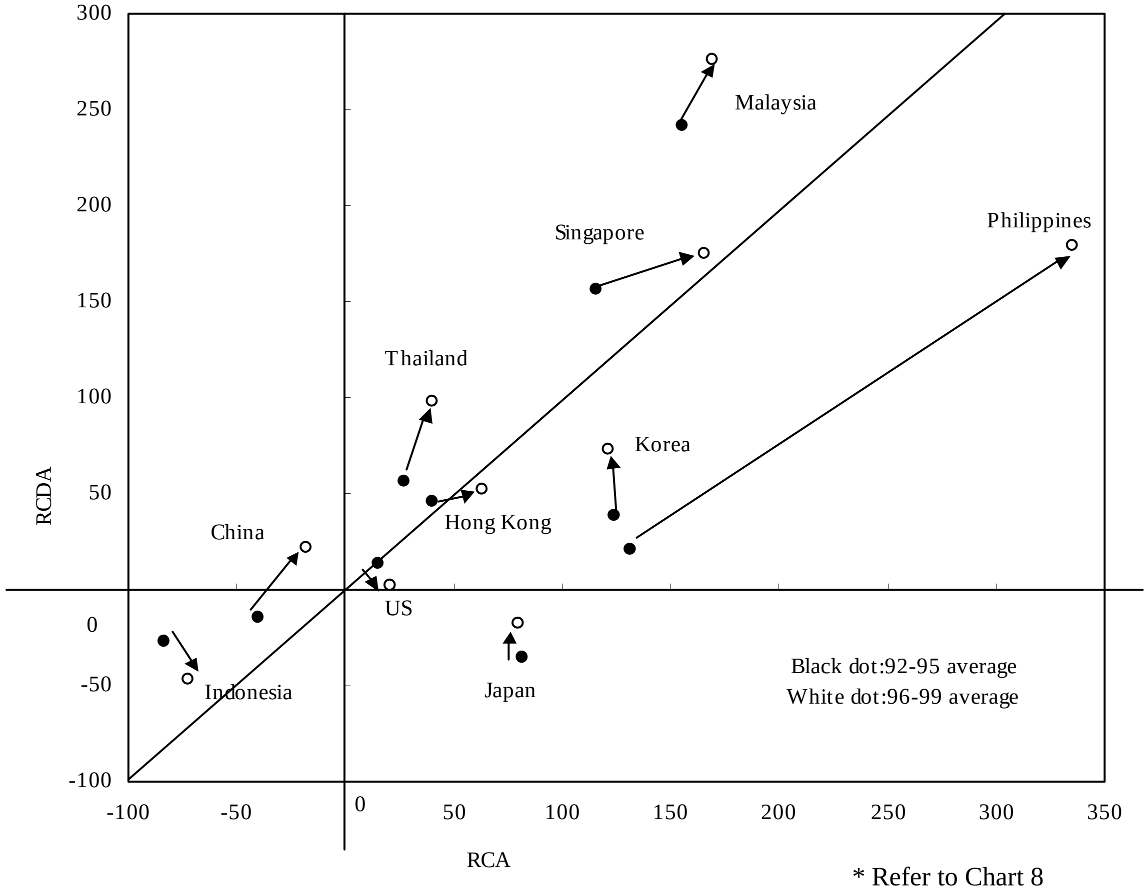
by the increase in the RTA for most countries (see Chart 14). The Philippines, Malaysia and Thailand enjoyed particularly large increases, bringing them closer to the level of Singapore, the only country with a higher RTA value. The decline of the RTA in the case of Hong Kong and Japan was brought about by a standard loss of competitiveness, i.e. the RCA decreased, while the RCDA increased. This was, however, not in general matched by a corresponding move of those countries which experienced a gain in their RTA. These countries rather exhibit a tendency to observe a simultaneous increase in RCA and RCDA, consistent with an increasing role of East Asia as a production and processing center in this sector, possibly driven by an increase in direct investment. Again, the shift of the Philippines is particularly marked, although Malaysia also experienced a substantial change.

(Chart 14) RTA(Relative Revealed Comparative Trade Advantage) in Office Machines and automatic data-processing machines



Turning to trade in electrical machinery, which includes consumer electronics (Chart 15), it is interesting to note that only Japan exhibits the traditional comparative advantage pattern of above-average exports and below-average imports. Most of the other East Asian countries – the exception being Indonesia and China – are located in the upper right quadrant, indicating an open trade structure with above-average imports and exports. This suggests that East Asian countries have a strong presence as production centers for electrical equipment, which they were even able to expand during the 1990s, as evidenced by the general tendency of a "north-east" shift.

(Chart 15) Revealed Comparative Advantage/Disadvantage in Electrical Machinery, apparatus and appliances

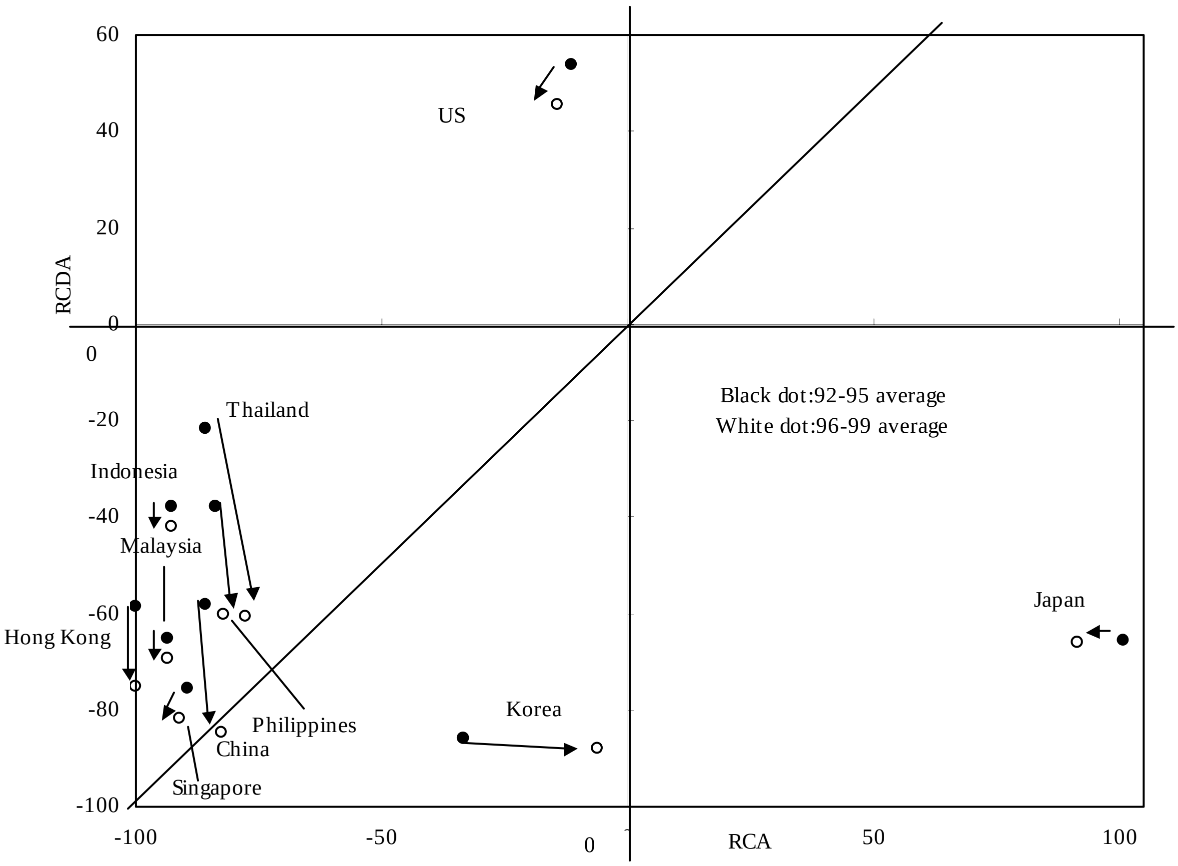


* Refer to Chart 8

Taking a more detailed look specifically at some IT-related goods at the 4-digit SITC level among categories 75 (Office Machinery and Automatic Data-processing Machines), 76 (Telecommunications and others) and 77 (Electrical Machinery), it can be seen that, on the export side, East Asia does not enjoy a comparative advantage in high value-added chips (category 7523 <Digital processing units, storage units>, see Reference Table 7). However, with the exception of Indonesia and China, East Asian countries exhibit a comparative advantage in general purpose chips (category 7763 <Diodes, transistors, etc>), network-related equipment (category 7764 <Electronic microcircuits>) and other relatively high value-added goods. For memory units (category 7527 <Storage units>) and certain other kinds of goods, the number of countries in the region with a comparative advantage increased during the 1990s, as the IT industry spread farther into East Asia. An analysis of the RCDA situation (see Reference Chart 8) indicates that many countries in the region exhibit a comparative disadvantages in general purpose chips, network-related equipment and other relatively high value-added goods, and that the number of countries with positive RCDA values increased from the early through late nineties. This again suggests that intermediate imports rose in conjunction with higher production and exports of IT-related goods. The RCDA is also high for relatively low value-added goods such as general-purpose personal computer components (category 7599 <Parts and accessories>), and telephone and audio components (category 7649 <Parts of telecommunication equipment>). Again, imports of these low value-added goods appear to be the result of the need for imported inputs by processing industries. In addition, of course, increases in internal demand in East Asia contribute to the high and rising RCDA values.

In addition to IT-related goods, production of and trade in road vehicles constitutes an important aspect of the East Asian economies – especially for Japan and Korea. An analysis of the RCA-RCDA pattern in this sector shows that Japan is again, as in the case of electrical machinery, the only country with a tradition comparative advantage, with the US being the only standard comparative-disadvantage case (see Chart 16). All other countries are located in the lower left quadrant with below-average imports and exports. Of these countries only South Korea has a positive RTA, i.e. on balance a comparative advantage. This overall pattern contrasts starkly with that observed in the other two analyzed

(Chart 16) Revealed Comparative Advantage/Disadvantage in Road Vehicles



* Refer to Chart 8

categories, suggesting a fundamentally different structure of production and trade in the more IT-intensive sectors. Important differences also exist with respect to the dynamics of the trade patterns throughout the 1990s.

In general the shifts observed for road vehicles have a predominantly horizontal or vertical orientation, rather than the diagonal moves typical for the other categories. Japan and Korea are the only two countries, which experienced a horizontal shift, i.e. only a change in the RCA, while the RCDA remained largely unchanged. However, while the Japanese RCA declined, that for Korea increased noticeably, possibly as a result of a gain in competitiveness attributable to the improvement in the quality of South Korean automobiles throughout the 1990s. The decline of Japan's RCA is most likely due to increased local production of automobiles and other transportation equipment by East Asian economies, partly as a result of the transfer of production operations from Japan. Such an increase in local production is also suggested by the vertical downward shift of other East Asian countries. As the decline in the share of road vehicles in these countries' imports – relative to the world average – was not matched by a simultaneous increase in export shares, local production appears to have been targeted mainly for the domestic market. Thus, unlike in the case of the other product categories analyzed, East Asia does not seem to perform the role of a processing and production center for the world market in this sector.

In summary, although for the machinery and transport equipment sector as a whole the East Asian countries appear to conform to the standard gain-in-comparative-advantage story, this aggregate view conceals a number of diverging trends on a more disaggregated level. The analysis of three concrete subcategories suggests that the aggregate picture may be the result of increased self-sufficiency in the category "Road Vehicles" combined with an increased role as a production and processing center in the IT-sector, represented by the categories "Office Machines and Automatic Data-processing Machines" and "Electrical Machinery".

(2) Intra-industry trade

The evidence on revealed comparative advantage structures in East Asia presented above is consistent with higher foreign direct investment flows and transfers of production by multinational companies contributing to a greater role for intra-industry division of labor (horizontal division of labor) in the region. This has partly supplanted inter-industry division of labor (vertical division of labor)[11]. As such shifts in the production structure have implications for the relative importance of inter-industry and intra-industry trade flows, we analyze the role of intra-industry trade in East Asia in this section. For that purpose we

[11] Nakagawa [1997].

calculate generalized indices of intra-industry trade for different regions and countries. In addition to providing a general documentation of trends in intra-industry trade flows in East Asia, such an analysis also complements the preceding discussion on revealed comparative advantage patterns. In particular, it allows us to check whether a simultaneous increase in the RCA and RCDA is associated with increased imports and exports in the same subcategories. In principle, increased imports and exports of Machinery and Transport Equipment could be the result of traditional comparative advantage considerations, if, for example, the imports occur in the category "Road vehicles", while the exports are mainly in the category "Metalworking Machinery". The index of intra-industry trade offers a convenient summary measure of the general tendency of trade to take place within the same sub-categories.

A generalized intra-industry trade index (Aquino's Q)

The degree of intra-industry trade is commonly measured by Grubel and Lloyd's "B"[12], with country *j*'s intra-industry trade index B_j being defined as follows:

$$B_j = \left\{ 1 - \frac{\sum_i \left| X_{ij} - M_{ij} \right|}{\sum_i \left(X_{ij} + M_{ij} \right)} \right\} \times 100 ,$$

where

X_{ij} = Country *j*'s exports of good *i*

M_{ij} = Country *j*'s imports of good *i*

However, this measure is subject to serious distortions, when a country's trade is not balanced, i.e., when exports and imports differ[13]. We therefore calculated a more general index, Aquino's "Q", which removes this distortion in B, as described in Aquino [1978]. The intra-industry trade index of country *j*, Q_j, is defined as follows:

[12] Grubel and Lloyd [1971, 1975]

[13] Aquino [1978], Fontagne and Freudenberg [1997]. See Appendix II for a comparison of the two indices, illustrating the distortion associated with the Grubel and Lloyd measure.

$$Q_j = \left\{ 1 - \frac{\sum_i \left| X_{ij}^e - M_{ij}^e \right|}{\sum_i \left(X_{ij}^e + M_{ij}^e \right)} \right\} \times 100$$

$$\mathrm{X}_{\mathrm{ij}}^{\mathrm{e}} = \mathrm{X}_{\mathrm{ij}} \times \frac{\sum_{\mathrm{i}} \left(\mathrm{X}_{\mathrm{ij}} + \mathrm{M}_{\mathrm{ij}} \right)}{\sum_{\mathrm{i}} \left(\mathrm{X}_{\mathrm{ij}} + \mathrm{X}_{\mathrm{ij}} \right)} \qquad \mathrm{M}_{\mathrm{ij}}^{\mathrm{e}} = \mathrm{M}_{\mathrm{ij}} \times \frac{\sum_{\mathrm{i}} \left(\mathrm{X}_{\mathrm{ij}} + \mathrm{M}_{\mathrm{ij}} \right)}{\sum_{\mathrm{i}} \left(\mathrm{M}_{\mathrm{ij}} + \mathrm{M}_{\mathrm{ij}} \right)}$$

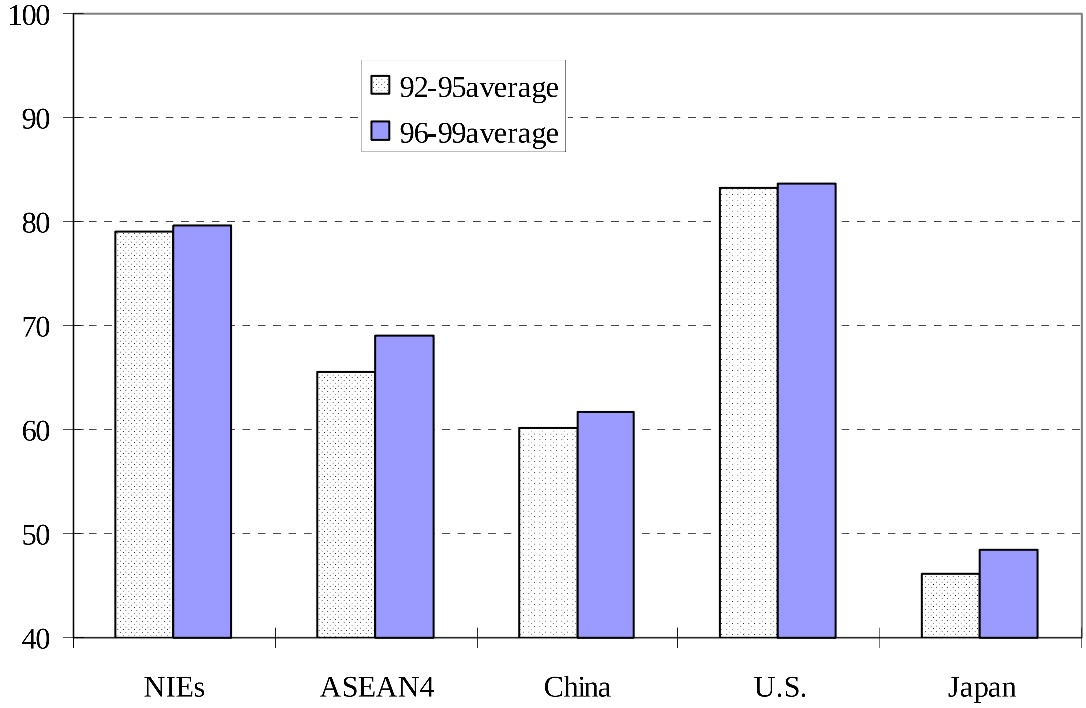
This index can take values between 0 and 100, with the degree of intra-industry trade increasing with the value of the index. Again, the data come from the United Nations COMTRADE database.

Intra-industry trade in East Asia

The overall index of intra-industry trade on an all-industry basis for different countries and country groups is depicted in Chart 17.[14] The chart illustrates the high importance of intra-industry trade for East Asia. In particular, for the NIEs, which are relatively far along in the industrialization process, intra-industry trade represents a large share of overall trade, followed by the ASEAN 4 and China, broadly in line with their relative degree of industrialization. The degree of intra-industry trade is particularly high in Singapore, Malaysia, Hong Kong, and South Korea, with Indonesia having by far the lowest level of intra-industry trade (see Chart 18).

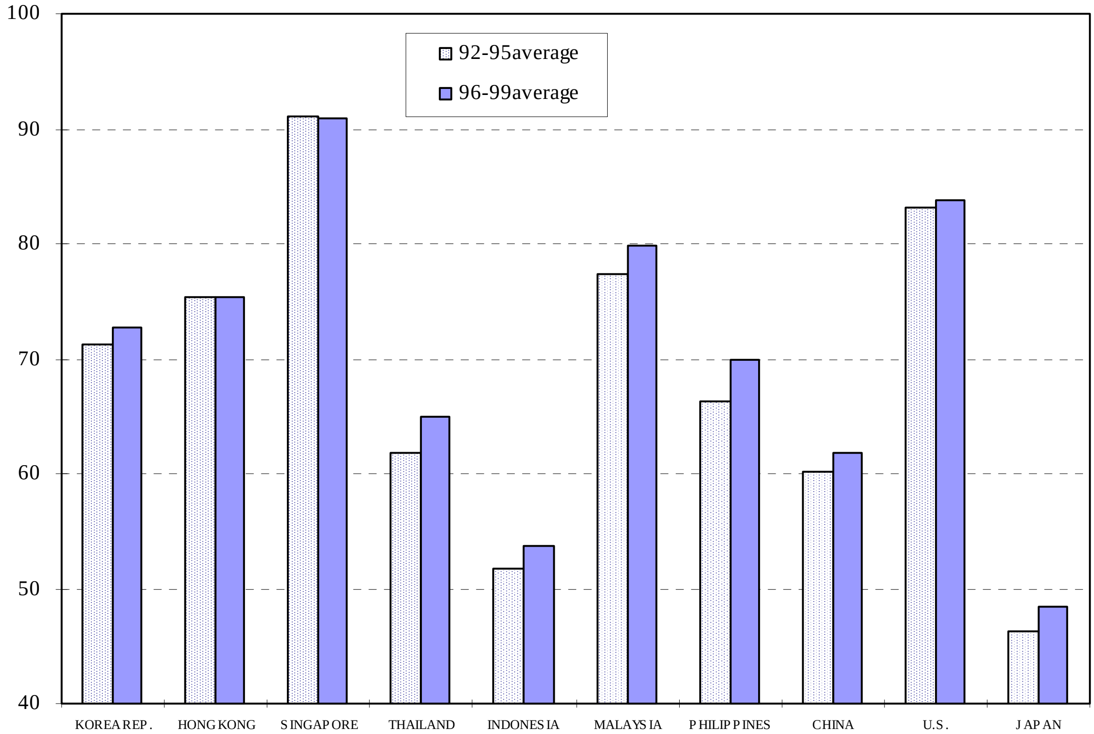
[14] The all-industries index is calculated by using SITC 1-digit categories as the relevant industry classification.

(Chart 17) Intra-Industry Trade Index by Region
(Aquino's 'Q', All Industry,SITC 1digit base)



* NIEs,ASEAN4:Averages of Intra-Industry Trade Index of their members, weighted by each member's total trade (export +import)

(Chart 18) Intra-Industry Trade Index by Country
(Aquino's 'Q', All Industry,SITC 1digit base)



Somewhat surprisingly, the index for Japan is the lowest among the countries analyzed. This may partly reflect the dependence of Japan on imports of crude oil and other fossil fuels, as well as of agricultural products. As several of the other East Asian economies are also characterized by a relatively high dependence on energy imports, the degree of intra-industry trade tends to be lower in this region than in the US, which has a relatively low dependence on imported fossil fuels.

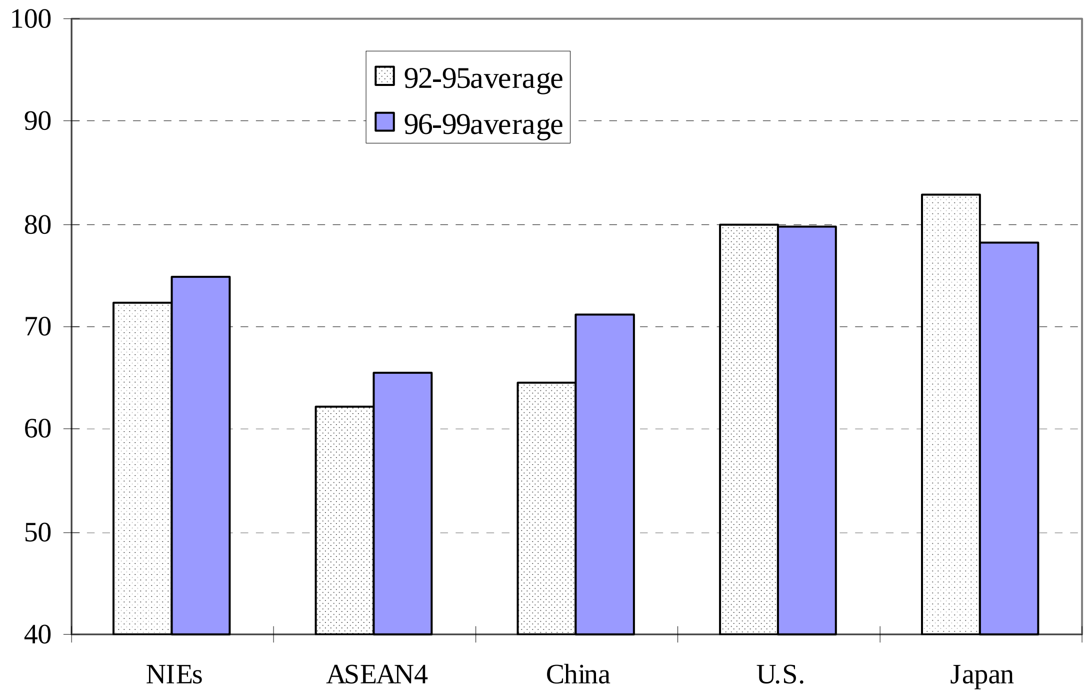
As to the evolution of the index of intra-industry trade throughout the 1990s, all countries and country groupings experienced a slight increase. The increase has been most pronounced for the ASEAN4, with the increase for the NIEs and the US being almost negligible. Among the East Asian countries, Hong Kong and Singapore saw virtually no change in the importance of intra-industry trade, possibly indicating an unchanged role as re-exporting centers throughout the 1990s. The very small increase for China may be an indication that the increased trade integration of China is currently largely driven by traditional comparative advantage considerations. Economies of scale and the integration into the international chain of production – both factors which may give rise to intra-industry trade – appear to play over all only a secondary role. For the ASEAN4, however, advances in the horizontal division of labor apparently caused an increase in trade within individual industries. Again, the direct investment and transfer of production from Japan, the US, and also South Korea and Taiwan to ASEAN and other East Asian countries was to a large extent responsible for this increased division of labor. This resulted in an increase in exports and imports of intermediate goods categorized within the same industry.

As the horizontal division of labor appears to be particularly pronounced in the IT-sector, the same indices are calculated for trade in machinery and transportation equipment[15]. Chart 19 illustrates the high importance of intra-industry trade in this sector[16]. Japan's much higher index value in this sector compared to its all-industry indexis particularly striking. Instead of having the lowest index value, as in the case of the all-industry index, Japan's intra-industry trade index is at par with that of the US. The relative positions are again broadly consistent with the level of industrialization, with the possible exception of China, which has a higher index level than the ASEAN4. In terms of changes over the 1990s, China experienced the largest increase, followed by the ASEAN4 and the NIEs. Among the East Asian economies,

[15] Such sub-indexes for individual SITC 1-digit categories is calculated by using SITC 2-digit categories as the relevant industry classification

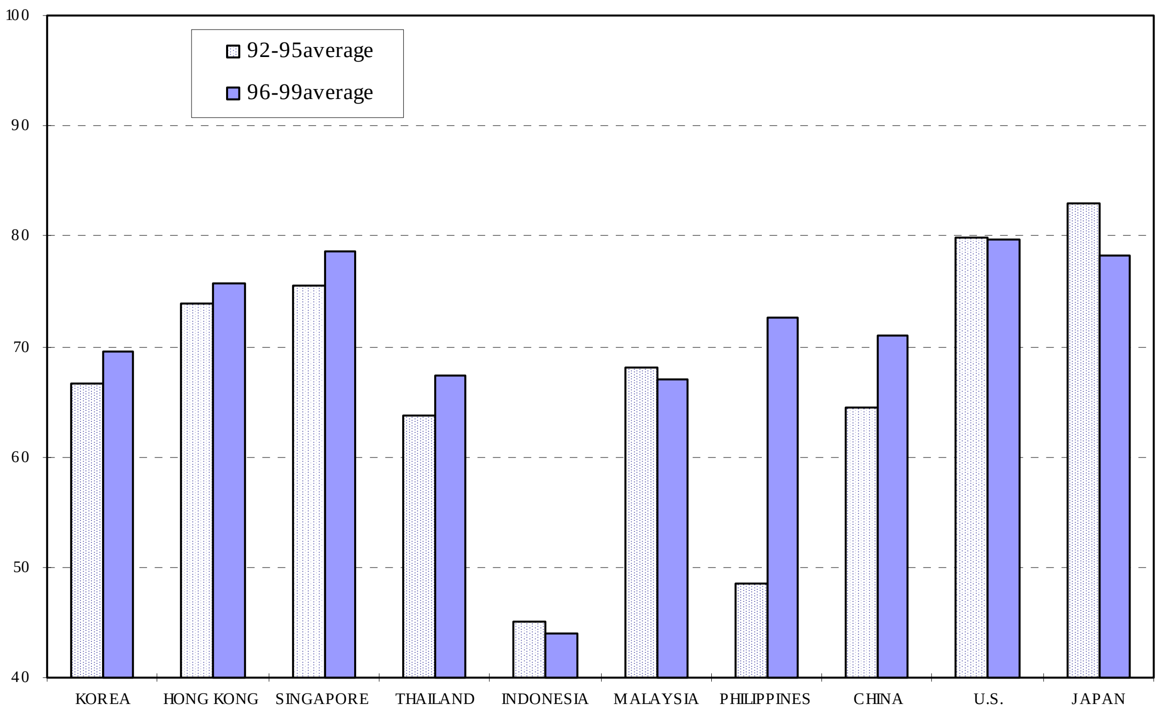
[16] The magnitude of the indices should not be directly compared to the index based on all industries, as the latter is calculated on broader industry classifications (SITC 1). In general, the index can be expected to decline as the definition of the industry definition is narrowed, as more trade is automatically classified as being inter-industry in narrower categories. Thus, the similarly high index values for the sector "Machines and Transport Equipment" (based on narrower SITC 2 industry classifications) as for the all-industries index (based on broader SITC 1 industry classifications) can be interpreted as particularly strong evidence for the importance of intra-industry trade in the machinery industry.

(Chart 19) Intra-Industry Trade Index by Region
(Aquino's 'Q', Machines, Transport Equipment, SITC 2digit base)



only Indonesia and Malaysia experienced a decline in the index level, with the index for the Philippines increasing by more than 20 – corresponding to similarly large changes in the revealed comparative advantage pattern (see Chart 20). Throughout the 1990s, East Asia's exports and production of IT-related goods rose, and it is likely that the increase in production brought about a greater horizontal division of labor within the region, which boosted the degree of intra-industry trade. The importance of intra-industry for Japan declined noticeably throughout the 1990s, at least partly reflecting the transfer of production to East Asia. This led, among others, to a considerable increase in the share of office equipment in machinery and transportation equipment imports without a commensurate increase in office equipment's share of exports.

(Chart 20) Intra-Industry Trade Index by Country (Aquino's 'Q', Machines, Transport Equipment, SITC 2digit base)



Conclusions

Using four different measures to characterize the structure of trading relationships (RCA, RCDA, RTA and Aquino's Q), this section analyzed the comparative advantage pattern and the importance of intra-industry trade in the East Asian region, with particular emphasis on the changes occurring throughout the 1990s. Overall, the analysis suggests that East Asia plays an important role as a processing and production center for IT-related goods (see Chart 21).

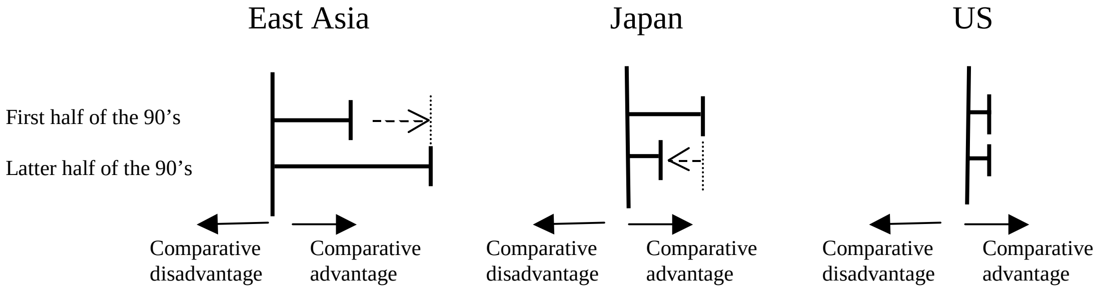
In the machinery and transportation equipment sector as a whole, most East Asian countries experienced an increase in their comparative advantage, while Japan saw a decline in its comparative advantage. On a more disaggregated level, an improvement in the export-side comparative advantage can be especially observed for the categories "Office Equipment" and "Electrical Machinery". At the same time, the trade pattern of many countries developed in the direction of a greater comparative disadvantage on the import side. This behavior on the import side, which contrasts with the development in the category "Machinery and Transport Equipment" as a whole, is consistent with a greater internationalization of the production process in East Asia. This process of greater internationalization was to a large extent driven by Japanese companies shifting production capacity abroad through foreign direct investment.

(Chart 21) Comparative advantage structure and Intra-Industry trade

1.Comparative advantage/disadvantage in IT related goods (Image Charts)
- for detailed data, see Chart 13,14 and reference table 4,5,6

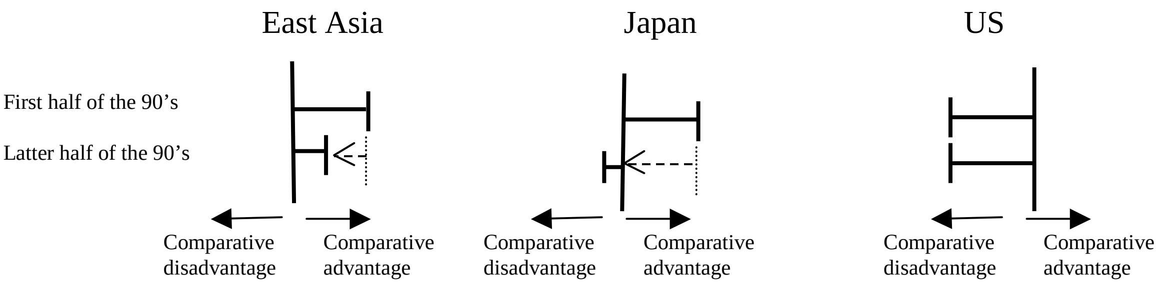
(1) Export side

Japan and East Asia had greater comparative advantage than US. Throughout the 90’ s, comparative advantage in East Asia rose while that of Japan fell. Comparative advantage in US experienced little change.



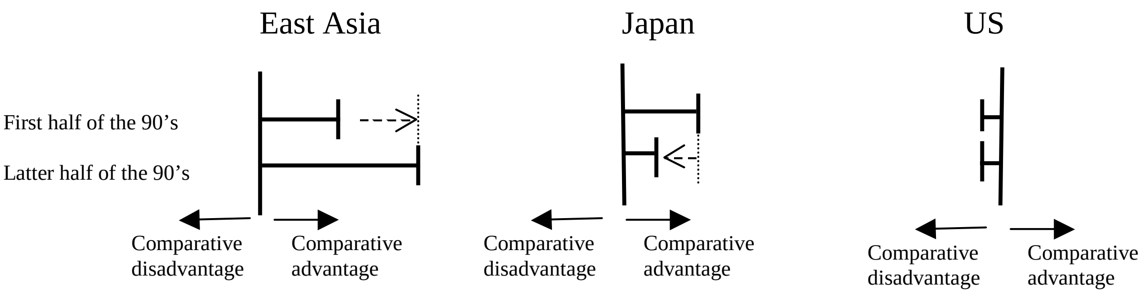
(2) Import side

East Asia had comparative advantage, while US had comparative disadvantage. Throughout 90’s, East Asia and Japan experienced a fall in comparative advantage- Japan experienced a shift to comparative disadvantage. This is because East Asia imported more medium goods when the production of IT- related goods increased. On the other hand, Japan became more dependent on East Asia in IT-related goods.



(3) Export/Import Joint

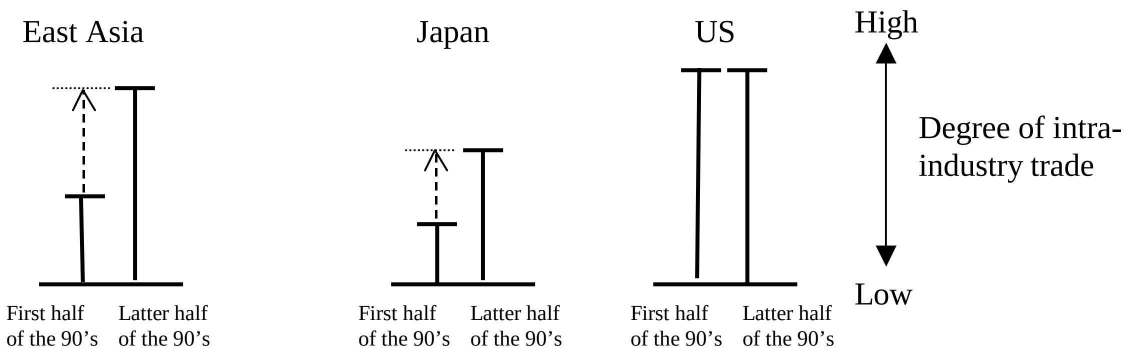
East Asia and Japan had comparative advantage, while US had comparative disadvantage. Throughout 90’s, East Asia experienced a rise in comparative advantage while Japan experienced a fall in comparative advantage. Comparative advantage of US experienced little change.



* Office Machines and automatic data-processing machines are regarded as IT-related goods.

2.Intra-Industry Trade in East Asia, US, and Japan (Image Charts) - for detailed data, see Chart 17

Advances in the division of labor within East Asia and movement of operation of Japanese manufacturers to East Asia caused a rise in intra-industry trade in East Asia and Japan throughout 90's. On the other hand, degree of intra-industry trade didn't change much in part because US manufacturers started moving operations outside US vigorously earlier than 90's.



The structure in Japan is to be dependent on imports of oil and other fossil fuels on the one hand and export manufactured goods on the other. That is why the composition of goods in export and import are far different from each other. Thus, degree of intra-industry trade is relatively low.

United States have relatively low dependence on imported fossil fuels and the share of manufactured goods in total import is relatively high. Then, the composition of goods in export and that of import resemble each other. Thus, degree of intra-industry trade is relatively high.

Regarding East Asia, the structure in many countries is to be dependent on imports of oil and other fossil fuels on the one hand and export manufactured goods on the other. That is why degree of intra-industry trade is lower than that of US. However, as horizontal division of labor was developed in the region, the degree of intra-industry trade is higher than that of Japan.

This is reflected in a general shift toward a greater comparative disadvantage – in particular, on the import side – in those sectors particularly affected. In contrast, the comparative advantage structure of the US remained relatively unchanged throughout the 1990s, partly because US manufacturers started to move operations abroad already before. The trade pattern for road vehicles contrasts starkly with these findings, indicating that the observed patterns in the IT-heavy sectors are not a general trend but highly sector specific.

These shifts in the trade pattern and the greater internationalization of the production process are also reflected in the evolution of intra-industry trade in East Asia. The degree of intra-industry trade in East Asia rose from the early through late nineties, an indication of the progress made in the horizontal division of labor within the East Asian region. There was a particularly marked decline in Japan's intra-industry trade index for machinery and transportation equipment, matched by an increase in the index for East Asia. This is believed to be a result of growth in imports due to the transfer of production from Japan to East Asia.

4. Interdependence of Japanese, US and East Asian trade flows

The dramatic changes occurring in East Asian production patterns and trading relationships over recent decades – and, in particular, during the 1990s, as documented in the previous section – have a number of important implications. In addition to the general impact on the growth performance of the region, the regional distribution of income and on the overall efficiency of global production, this process has changed the nature of interdependencies between countries within East Asia and between these countries and countries outside the region. This in turn has altered the way in which developments in one country are transmitted internationally. Of particular interest in this respect are developments in the US and their impact on East Asia. The heavy reliance of the East Asian economies on the US as a major destination of their IT-intensive exports has become particularly evident during the recent US downturn, which has especially affected East Asia, due to the concentration of the downturn in IT-related investment spending.

A downturn in the US affects other countries through a number of channels of which the trade channel is the most easily identifiable and quantifiable. The observed changes in East Asian trade and production patterns have on the one hand spread the effect of a US slowdown more evenly among the East Asian countries, as many countries have substantially increased their export presence. On the other hand, these shifts have created numerous complex indirect trade effects through the increasing internationalization of the production process. A slowdown in US demand will lead to reduced exports by East Asian countries to the US. This, in turn, will lead to reduced imports by these countries. Besides the reduction associated with the general decline in these countries income, there will also be a production-related decline, as the reduced production of export products leads to a reduced need for imported capital goods and intermediate inputs. As domestic demand for the final product is in many countries still comparatively minor relative to export demand, this latter effect may be expected to be quantitatively quite important. Such indirect effects through the demand for imported inputs may be particularly important for Japan and the US, given the tendency of manufacturers in these countries to shift their production – and especially processing – base to countries in the East Asian region through increased FDI activity.

This section tries to identify these direct and indirect trading effects empirically. For that purpose a VAR model is estimated, which tries to identify the dynamic interdependencies between inter-regional trade flows and trade between East Asian countries and Japan and the US.

(1) Construction of VAR model of intra- and inter-regional exports

Construction of VAR model

In order to analyze the dynamic interdependencies among trade flows in East Asia a VAR model using nominal exports and imports within East Asia and between East Asia and Japan and the US is estimated.[17] Of particular interest is the effect of a change in exports by East Asian countries to Japan and the US. According to the "internationalization hypothesis" this should result in an increase of trade among East Asian countries as the components for the production of the final good are traded within East Asia. In addition, it should result in an increase in exports by Japan and the US to the extent that these countries supply capital goods and intermediate inputs to East Asia. This input-output view of trade flows is suggested by the tendency of East Asian countries to simultaneously expand their import and export presence in certain product categories – most notably, in IT-intensive ones. Furthermore East Asian imports are especially concentrated in certain manufactured good – such as capital/intermediate goods – which are needed for the production process[18].

In this respect the timing of the production process is of crucial importance. In the short-run East Asian exports can increase by running down existing inventories of final goods. This would then result in a restocking of inventories, which will require increased imports of inputs. More generally, increased imports will, however, have to precede any exports, as any product needs to be produced before it can be sold. This is especially true for foreseen increases in export demand.

Thus in terms of the impulse response analysis the shock needs to be interpreted in a temporal rather than in a strictly causal sense. Exports from Japan to East Asia, for example, do not "cause" the ensuing exports from East Asia to the US. They merely precede them in the time dimension and may therefore have important predictive content.

[17] Alternatively, one could estimate explicit export import demand functions for the various countries, taking into account the dependence of a country's imports on exports by that country. Although this approach may allow a more satisfactory treatment of other factors affecting trade flows, it does not lend itself as easily to an analysis of more complicated input-output relationships between imports and exports of several countries. Furthermore, it is difficult to find stable demand relationships for a number of the countries of interest, with data problems complicating the issue further.

[18] For example, the share of capital goods / parts in total export from Japan to East Asia is considerably higher than in Japanese exports in general. While the share of capital goods / parts (including IT related goods) in exports to East Asia is about 50% (1995-2001 average), such goods constitute only around 30% of all Japanese exports (see Chart 22). In comparison, the share of consumer goods is only 14% for exports to East Asia and a much larger 30% for overall exports. While Japanese exports to East Asia are thus especially concentrated in capital goods / parts, imports from East Asia contain relatively more final manufactured goods such as consumer goods.

(Chart 22) Commodity composition of Japanese trade with East Asia

(Share, %)

	Capital Goods/Parts	Consumer Goods
Export	53.9	14.1
Import	28.4	29.8

*1995-2001average
* IT-related goods are included in Capital goods/parts

The analysis concentrates on the trade flows between East Asia, Japan and the US. The regional aggregate East Asia comprises nine countries with relatively high GDP levels and for which data are comparatively easy to obtain. These are the NIEs (South Korea, Taiwan, Singapore and Hong Kong), four members of ASEAN (Thailand, Indonesia, Malaysia and the Philippines), and China. Intra-regional trade flows among East Asian countries, labeled EAEA, are defined as the total nominal exports of each East Asian country to the other eight countries (excluding the exporting country in question). The other trade flows are labeled JPEA (Japan to East Asia), EAJP (East Asia to Japan), EAUS (East Asia to US), and USEA (US to East Asia)[19]. These five variables are used as the endogenous variables of the VAR model.

Because all import and export data are denominated in US dollars, fluctuations in the external value of the US-dollar could cause changes in the value of imports and exports unrelated to any real developments[20]. In order to eliminate these effects as far as possible, the nominal effective exchange rate of the US dollar is included into the VAR system as an exogenous variable. In addition, a dummy variable for the combined effect of the Asian currency crisis and the pick-up of US demand for IT-imports[21] is included as an exogenous variable.

[19] Although there exists the possibility that changes in trade flows between Japan and US may affect other trade flows, the focus of this paper is only on East Asian countries. Trade in goods between Japan and US was excluded from the analysis in order to narrow down the number of variables in the model.
[20] See Chart 23 regarding the proportion of trade settled in each currency by South Korea and Indonesia.
[21] The dummy variable takes a value of 1 for the period from 1998 to the first half of 2000 and zero for all other dates. This was a period during which East Asia’s export competitiveness increased due to the decline in the value of local currencies as a result of the crisis. At the same time, IT demand in the US grew conspicuously.

(Chart 23) Currency used for trade settlement in Korea and Indonesia

(Share, %)

	Korea		Indonesia	
	Exports	Imports	Exports	Imports
US $	88	82	92	78
Yen	5	11	3	8
Others	7	7	5	14

* Shares at 1998

Source : Bank of Korea, Central bank of Republic of Indonesia

Thus, the general structure of the VAR is as follows:

$$\mathrm{X}_{i,t} = \sum_j \left(\sum_l \alpha_{j,l} \mathrm{X}_{j,t-l} \right) + \beta_i e_t + \gamma_i d_t + c_i + u_{i,t}$$

where

i, j = JPEA, EAJP, EAUS, USEA, EAEA

l = number of lags

$X_{j,t-l}$ = nominal trade flow in period t-l

e_t = nominal effective exchange rate of the US dollar

d_t = dummy variable

c_i = constant

$u_{i,t}$ = error term[22]

Collection and processing of data for estimates

Ideally, the model should be based on real imports and export flows (trade volumes), as the input-output relationships between trade flows are based on real magnitudes. However, appropriate import and export deflators, especially for bilateral trade data, are not always

[22] The effect of independent fluctuations of other demand factors on imports and exports are not explicitly included as an additional variable. Rather, such factors are captured in the error term as “shocks” during the period concerned and allowed to affect trade flows in that way. The explanatory power of the model, of course, crucially depends on the relative magnitude of such shocks relative to the input-output relationships in trade flows. The analysis is based on the assumption that in the case of the East Asian countries that the important role of many East Asian countries as a production and processing center implies that these error terms should be comparatively small.

available for the East Asian countries. In addition, trade statistics from the various countries also differ slightly with respect to their definition and compilation methods, rendering the different trade data incompatible. Therefore we refrain from using country statistics, but utilize instead mainly data from the IMF's Direction of Trade Statistics (DOTS)[23], ensuring a common standard across different countries. The data are nominal values of bilateral imports and exports denominated in US-dollar[24].

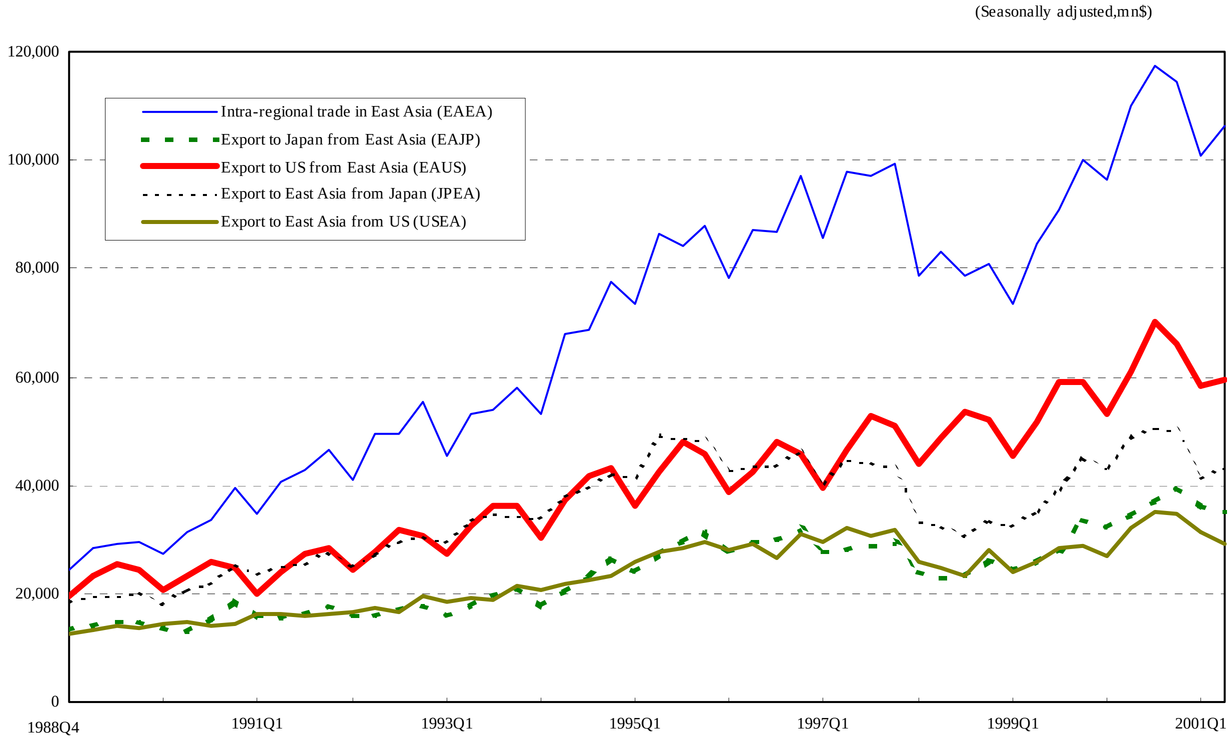
The IMF's DOTS data are not seasonally adjusted. The seasonal fluctuations in East Asian trade data exhibit clear seasonal fluctuation patterns, for example related to the Lunar New Year. We therefore transform the original data into seasonally adjusted series using X12-ARIMA. Because no detailed data on seasonal and daily fluctuations are available, it is not possible to obtain smooth series for monthly data, thus leaving some considerable seasonal variation in the series. Therefore the monthly data are first converted to quarterly series and then seasonally adjusted (see Chart 24). For the nominal effective exchange rate of the US-dollar the index produced by JP Morgan (1990=100) is used.

[23] Because IMF DOTS does not include trade data of Taiwan, We retrieved exports of Taiwan and export of the other countries to Taiwan from CEIC database.

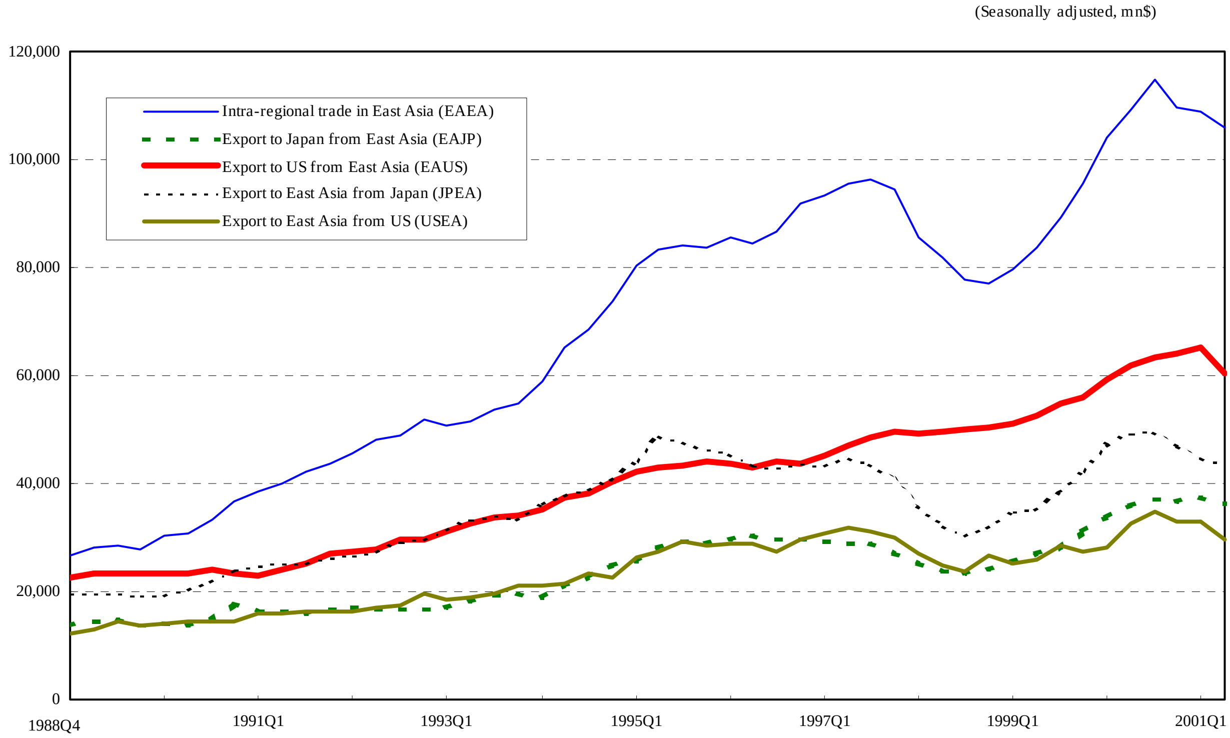
[24] In order to study the input-output relationships among trade flows more explicitly it may be interesting to use more disaggregated trade flow data, distinguishing, for example between finished goods and intermediate goods. Unfortunately, no data of a sufficiently high frequency suitable for a dynamic time series analysis exist, as such data are generally on an annually basis. This is also true for the “COMTRADE” database used for the analysis in Chapter 3.

(Chart 24) Intra- and inter- regional trade in East Asia

(1) Not Seasonally adjusted



(2) Seasonally adjusted



*1. Export data are used in principal
*2. Intra-regional trade in East Asia (EAEA) is defined as a total of export from a country to the other 8 countries.

Stationarity of the data and lag length selection

As a first step the variables of the VAR are tested for possible non-stationarity. The tests consisted of the augmented Dickey-Fuller and the Philipps-Perron tests, both conducted for the case of a constant term and a trend in the estimation equation and for the case of only a constant term. These tests suggest nominal export flows and the US dollar nominal effective exchange rate are I (1) series (see Chart 25).

(Chart 25) Unit root test

	ADF test				PP test			
	ADF test statistics		trend	(t-value)	PP test Statistics		trend	(t-value)
EAJP	-2.383		0.003	(2.215)	-1.976		0.002	(1.376)
	-0.841		none	-	-0.798		none	-
d EAJP	-2.987	**	none	-	-4.809	**	none	-
JPEA	-1.896		0.001	(1.016)	-1.527		0.000	(0.135)
	-1.873		none	-	-1.550		none	-
d JPEA	-3.401	**	none	-	-3.502	**	none	-
EAUS	-2.119		0.004	(1.974)	-1.820		0.002	(1.311)
	-1.080		none	-	-0.639		none	-
d EAUS	-2.742	*	none	-	-5.050	**	none	-
USEA	-1.479		0.002	(1.079)	-1.623		0.002	(1.017)
	-1.286		none	-	-1.656		none	-
d USEA	-3.265	**	none	-	-6.951	**	none	-
EAEA	-1.945		0.002	(1.394)	-1.297		0.000	(0.069)
	-1.910		none	-	-1.771		none	-
d EAEA	-3.906	**	none	-	-3.831	**	none	-
USDNFXR	-2.698		0.445	(2.821)	-2.557		0.304	(2.428)
	0.525		none	-	0.118		none	-
d USDNFXR	-3.060	**	none	-	-6.710	**	none	-

*1 Sample period:1988/4Q-2001/2Q.
*2 USDNFXR:Nominal effective exchange rate of UD dollar.
*3 d: 1st difference.
*4 One and two asterisks indicate that the coefficient is significant at the 10% and 5 % significance level.
*5 Lag order in ADF test is 3.
*6 Truncation lag order in PP test is 3, following Newey-West.
*7 Critical values are based on MacKinnon Table (1991).

Cointegration tests performed for the five trade flows indicate the possibility of one or more cointegration relationships between the variables[25]. In the case of a strict input-output relationship between trade flows such a relationship might indeed be reflected in long-term relationships between variables. However, in reality other factors, such as imports for final domestic demand, also play an important role and the long-run relationships between imports and exports may as a consequence be difficult to interpret. A substantial part of any relationship may reflect higher import demand due to export-related increases in income levels, rather than input-output relationships. For this reason, we chose not to estimate a VECM, which would explicitly take cointegration relationships between the levels of trade flows into consideration. Instead, we chose to conduct a VAR analysis in first (log) differences. The constant term is kept even after differencing in order to account for any trend in the level variables. Such a trend may, for example, be the result of trends in trade with countries not explicitly included in the estimation.

Regarding the choice of appropriate lag length the Akaike Information Criterion (AIC) suggests a lag length of 6. However, if a lag of six quarters (one and a half years) is used, it is difficult to ensure a sufficient degree of freedom for the estimation. Moreover, the Breusch-Godfrey test for autocorrelation of the residuals indicates that serial correlation practically disappears for a lag of around three quarters in most of the estimation equations. In view of these considerations, the lag length of the VAR was set at three quarters[26].

Test of Granger Causality

As a preliminary exercise, we examine whether causal relationships can be found among the five trade flows in order to justify their inclusion as endogenous variables into the VAR. For that purpose Granger-causality tests were performed for different pairs of trade flows. The test results suggest that the various trade flows are connected through a complex system of causal relationships, with the direction of causality lending some support for the input-output hypothesis, especially for exports from East Asia to the US (see Chart 26).

JPEA is causal to EAJP (or ,alternatively, JPEA generally precedes EAJP and thus helps to predict EAJP)(see Chart 26(1)). A concrete example for such a relationship is, for instance, the case where Taiwan has to import semiconductor equipment and other intermediate goods (JPEA) before Taiwanese exporters (foreign affiliates of Japanese companies or domestic companies) can then produce semiconductors and export them to Japan (EAJP). The reverse

[25] For the sake of brevity the results for the cointegration tests are omitted.

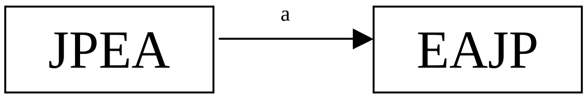
[26] In order to assess the robustness of the results to changes in this lag specification we re-estimated the model for other lag lengths. The shapes of the impulse response functions for these alternative specifications are very similar to the ones obtained in the 3-quarter lag model.

causation, however, is not found, consistent with Japan being a major supplier of inputs to the East Asian production process, while East Asian exports to Japan consist mainly of final products or intermediate inputs for the production of goods mainly geared toward Japanese domestic demand. For the case of trade flows between East Asia and the US causation is found in both direction, suggesting that the division of labor may be more symmetrical in this case, with exports to the trading partner also requiring inputs from the trading partner (see Chart 26(2)).

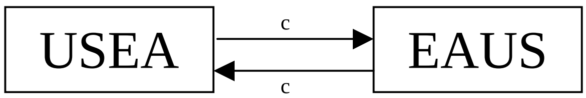
(Chart 26) Granger Causality Test

Granger Causality

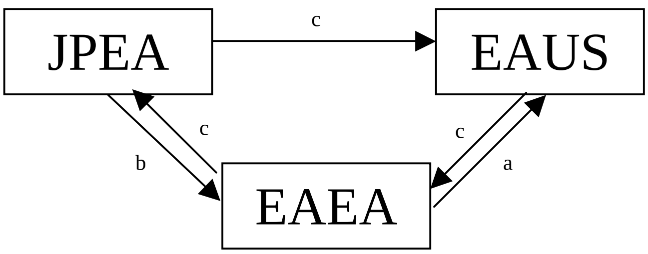
(1) Trade between Japan and East Asia



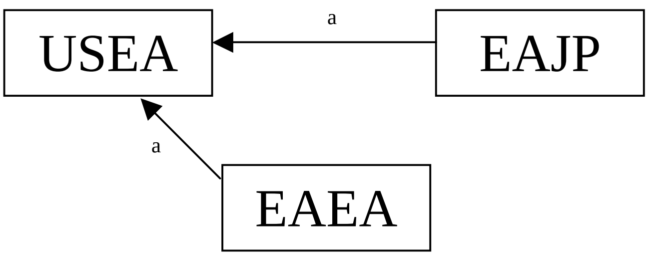
(2) Trade between US and East Asia



(3) Export from Japan via East Asia to US, and intra-regional trade in East Asia and export from East Asia to US



(4) Export from US via East Asia to Japan, and intra-regional trade in East Asia and export from East Asia to Japan



*1 Sample: 1988/3Q-2001/2Q

*2 Arrows indicate the direction of granger causality (a : 5% significance level, b : 10% significance level, c : 20% significance level). For instance, the example of (1) indicates that JPEA is granger-causal to EAJP.

Regarding possible indirect trade linkages from Japan to the US via East Asia, the analysis shows that Japanese exports to East Asia (JPEA) "cause" both, trade among East Asian countries (EAEA) and exports from East Asia to the US (EAUS) (see Chart 26(3)). This suggests that exporters in East Asian countries need imports of inputs from Japan prior to exporting to the US. The finding that intra-regional trade is also caused by Japanese exports to East Asia suggests that part of the exports go to other East Asian countries rather than the US or Japan. These may either be exports of final goods or intermediate products further along the production chain, which are sent for additional processing to another East Asian country. The fact that inter-regional trade (EAEA) causes East Asian exports to the US (EAUS) implies that more than one East Asian country may be involved in the production chain, with part of the inter-regional trade caused by Japanese exports being intermediate products for further processing. Although this suggests intra-regional trade in East Asia is to a considerable part related to indirect trade flows from Japan to the US via East Asia, this issue can not be directly addressed in this bivariate setting but requires a multivariate approach, like the VAR analysis below. The evidence for some weak reverse causation from EAUS to EAEA and from EAEA to JPEA may capture some of the effects of inventory changes associated with unexpected changes in foreign demand, which would imply the reverse temporal or Granger-causal ordering. The low significance level of this reverse causation suggests that trade flows are largely driven by foreseen changes in final external demand, with unexpected demand shocks playing only a minor quantitative role.

The Granger causality analysis does not provide any evidence for a similar pattern of indirect trade flows in the opposite direction – from the US via East Asia to Japan (see Chart 26(4)). As already suggested by the casual interpretation of Chart 3, such indirect trade relationships appear to be especially relevant for Japanese exports. The US appears to use East Asia mainly for the production of goods, which it intends to import itself, rather than export to other countries[27]. In addition, the production of these goods does not appear to be based on a multi-country chain of production within East Asia, as US exports to East Asia do not cause any significant amount of inter-regional trade within East Asia (EAEA).

In order to analyze more complex multi-variate dynamic interdependencies between the various trade flows, the next section estimates a VAR for the trade flows of interest. Although a more formal test for endogeneity in a multivariate system would require a test for block causality, we take this observed multitude of bivariate causal relationship as sufficient evidence for the inclusion of all five variables into the VAR.

[27] Strictly speaking the results, of course, are more limited in scope as they only relate to exports to Japan. however, as it appears unlikely that export strategy of US companies differs dramatically between the various export destination, the generalization in the text seems justifiable.

(2) Estimates and impulse responses

Some key statistics of the of VAR estimation results are shown in Chart 27. The degrees-of-freedom-corrected coefficient of determination ranges between 0.22 and 0.53. The Breusch-Godfrey statistic suggests that the degree of serial correlation of the error terms in the different equations is relatively low[28].

(Chart 27) VAR Estimation

Sample: 1988/4Q-2001/2Q

	DLEAJP	DLJPEA	DLEAUS	DLUSEA	DLEAEA
Adjusted R^2	0.416	0.529	0.218	0.291	0.347
BG Test (P value)	0.023	0.158	0.111	0.108	0.005

Based on the VAR estimates, we calculate impulse response functions for each of the variables, in order to analyze the dynamic propagation of trade shocks among the various countries. Chart 28-1 and 2 contain the different impulse response functions[29], where rows are associated with the variables being shocked and columns associated with the variables responding to the shocks. The top row, for example, shows the response of each of the variables EAJP, JPEA, EAUS, USEA and EAEA to shocks in EAJP. The shocks and responses are normalized by the standard deviations of the residuals given by the VAR estimate and the dotted lines indicate the 90% confidence band[30].

Of particular interest for the "internationalization hypothesis" is the response of trade flows to a shock in Japanese exports to East Asia (top three graphs in chart 28-1 and second row in Chart 28-2). An increase in JPEA is followed within one quarter by a significant increase in East Asian exports to Japan and East Asian exports to the US increase – somewhat less strongly – with the largest impact occurring after three quarters. This build-up of the effect may be related to the high persistence of the initial shock to JPEA, as indicated in the second

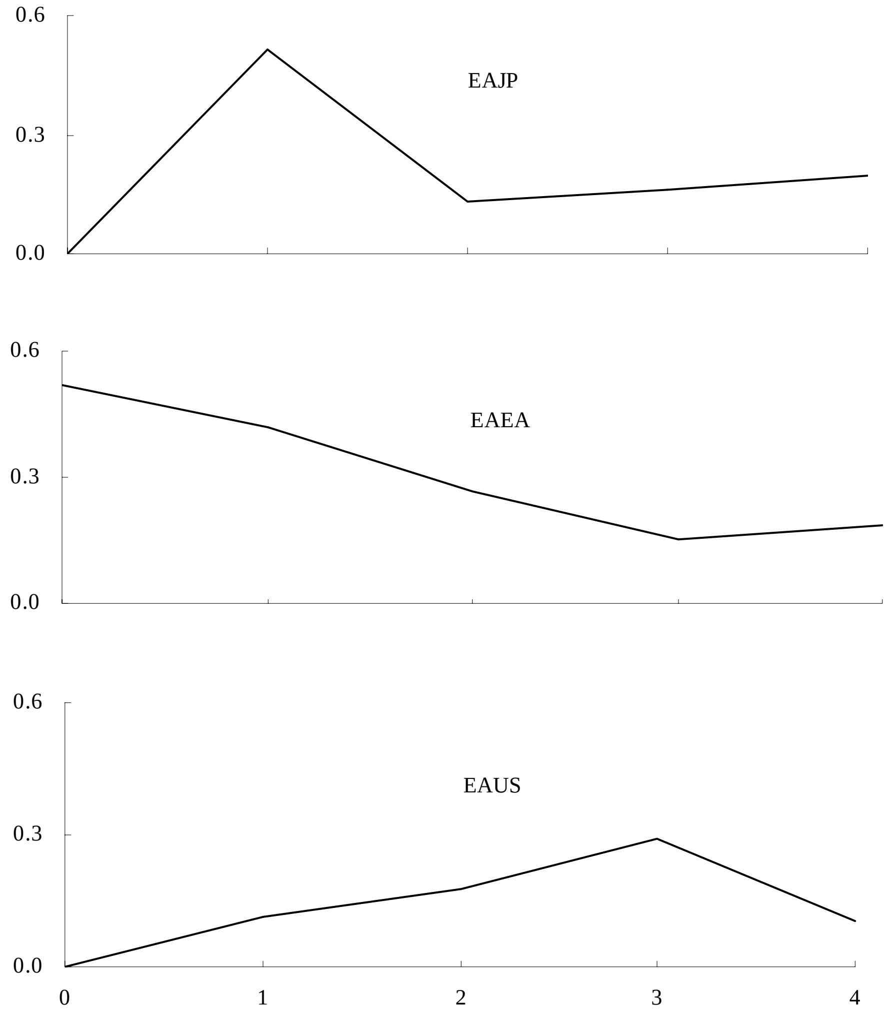
[28] The sign conditions for the exogenous variables, the nominal effective exchange rate of the US dollar and Asian crisis dummy, are met.

[29] In order to calculate the impulse response functions some identification restrictions need to be imposed on the variance-covariance matrix of the errors in order to determine the contemporaneous propagation of shocks. Because it is difficult to impose a piori constraints on this propagation on theoretical grounds, we used an "atheoretical" Cholesky decomposition (decomposition by lower triangular matrix) to identify structural shocks. Depending on the concrete data, the resulting impulse response functions may depend crucially on the order of the variables. Therefore, we re-estimated the model for different orderings of the variables in order to assess the robustness of the results. In general, the shape of the impulse response functions proved to be stable.

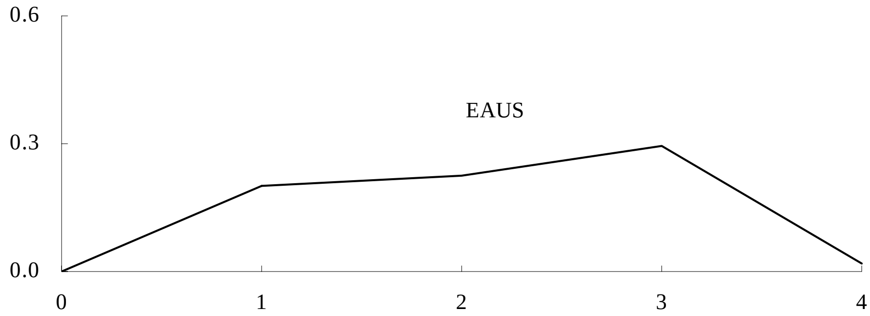
[30] We conducted Monte Carlo simulations 3,000 times, in each simulation calculating the impulse response function based on randomly drawn parameters of the VAR model. From the resulting distribution of the impulse response functions we derived the confidence intervals around the initial estimates.

(Chart 28-1) Impulse Response (1)

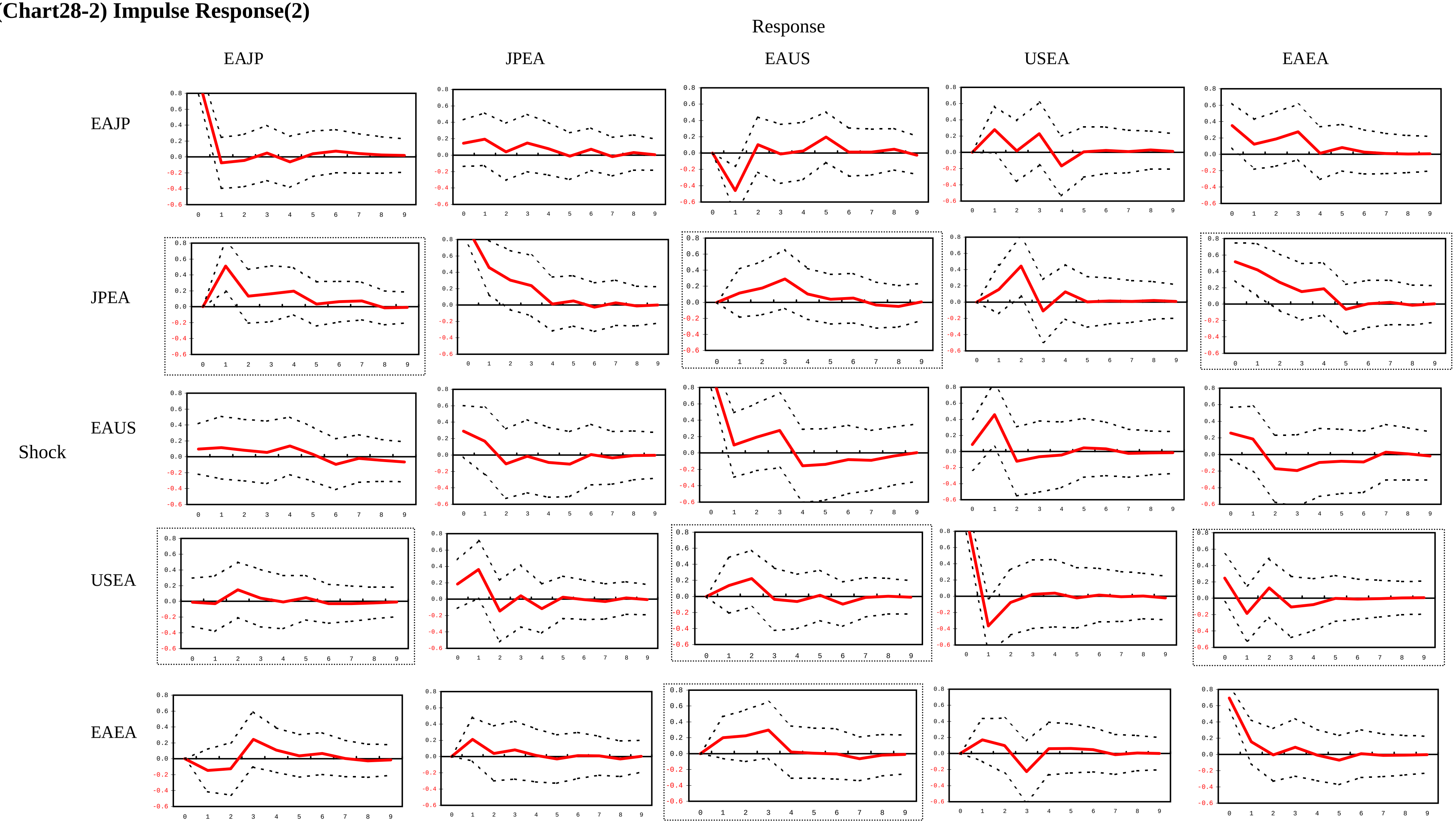
Responses of each trade flow when a shock is given to JPEA (Export from Japan to East Asia)



Responses of EAUS when a shock is given to EAEA (Intra-regional trade in East Asia)



(Chart28-2) Impulse Response(2)



1. Given shocks are standard error of residuals drwan by VAR estimation. Responses are standardized by standard error of residuals of corresponding variables.
2. Dotted line is 90% confidence band
3. Order of variables : EAUS,USEA,EAJP,JPEA,EAEA
4. Graphs in dotted box are impulse responses mentioned in the paper.

panel in the second row in chart 28-2. Inter-regional trade flows increase immediately in response to increased Japanese exports to East Asia. This suggests, as discussed above, that the output produced with Japanese inputs is exported to other East Asian countries either for final use or for further processing. In line with the high persistence of the shock to JPEA the response of EAEA also dies down only slowly. The positive response of USEA to a shock to JPEA may indicate a certain degree of complementarity between Japanese and US inputs to the East Asian production process. While Japan thus seems to utilize East Asian countries as a production base, the reverse relationship does not receive any corroborating evidence by the analysis. An increase in East Asian exports to Japan does not result subsequently in any noticeable pick-up in reverse trade from Japan to East Asia (second panel in the first row).

Looking at the responses to a shock to intra-regional trade flows in East Asia (bottom row), it can be seen that there is a comparatively large response in EAUS around one to three quarters after a shock (see the bottom graph in chart 28-1). This may reflect the relative high degree of segmentation of the production process with intermediate good being exchanged among East Asian countries prior to exporting the final product to the US. This pattern may partly capture the indirect trade flows from Japan via East Asia to the US. In addition, it may capture autonomous production integration within East Asia independent of foreign direct investment by and intermediate imports from Japan and the US.

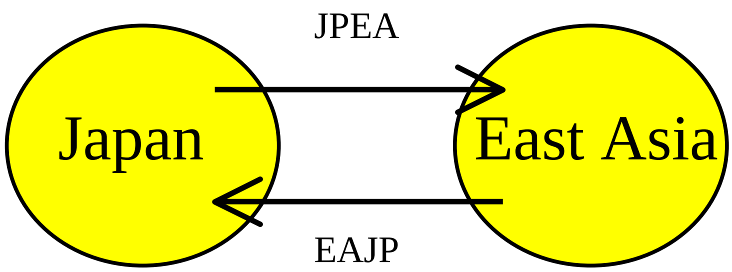
Regarding a shock to US exports to East Asia (fourth row), the impulse response analysis confirms the earlier findings from the Granger causality tests that the relationship between the US and East Asia is quite different from the one between Japan and East Asia. In particular, the East Asian exports from East Asia to Japan do not respond noticeably to a change in USEA. Thus indirect trade flows from the US to Japan via East Asia do not appear to play an important role. Furthermore, inter-regional trade in East Asia does not exhibit a clear response pattern, suggesting that the goods produced with US inputs are not exported to other East Asian countries either. Rather – and similar to Japanese-East Asian trading relationships – exports to East Asia are followed by reverse exports from East Asia to the US after 1 to 2 quarters. Furthermore, Japanese exports to East Asia respond as well, suggesting again possible complementarities of US and Japanese imported inputs in East Asian production of export goods[31].

[31] The main findings of the impulse response analysis are summarized in diagram form in Chart 29.

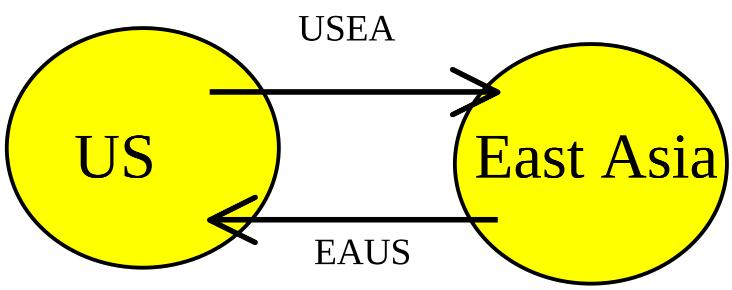
(Chart 29) Interdependency of Trade flows judging from Impulse responses

1. Shock transmissions in trade flows among [Japan and East Asia] and [US and East Asia]

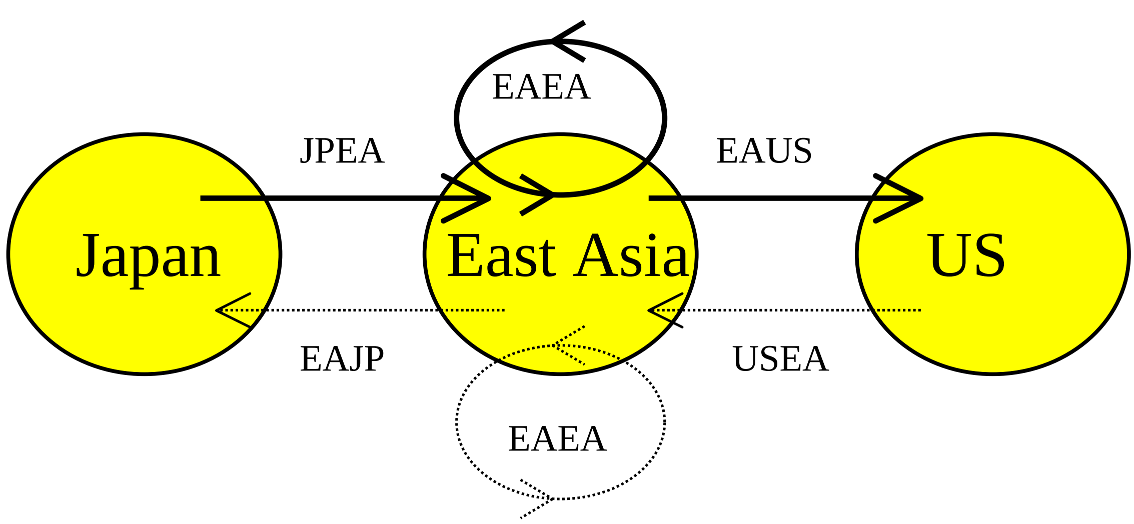
(1) Strong linkage of trade flows between Japan and East Asia
-- An increase of JPEA brings an increase of EAJP



(2) Strong linkage of trade flows between US and East Asia
-- An increase of USEA brings an increase of EAUS



2. Shock transmissions in [trade flows from Japan via East Asia to US]
-- An increase of JPEA brings an increase of EAEA and then an increase of EAUS with a bit lag.
On the other hand, an increase of USEA does not cause significant change in EAEA or EAJP.



(Chart 30) Impulse Response (Accumulation of 5 quarters)

Shock \ Response	from EA to JP <EAJP>	from JP to EA <JPEA>	from EA to US <EAUS>	from US to EA <USEA>	intra EA <EAEA>
from EA to JP <EAJP>	0.864 (1.260)	0.608 (1.333)	-0.341 (1.108)	0.357 (1.161)	0.946 (1.289)
from JP to EA <JPEA>	1.003 (1.074)	1.941 (1.304)	0.686 (1.084)	0.618 (1.142)	1.541 (1.281)
from EA to US <EAUS>	0.488 (1.523)	0.246 (1.657)	1.409 (1.584)	0.313 (1.638)	-0.016 (1.603)
from US to EA <USEA>	0.139 (1.410)	0.330 (1.401)	0.259 (1.176)	0.619 (1.476)	-0.000 (1.377)
intra EA <EAEA>	0.081 (1.007)	0.347 (1.060)	0.746 (1.046)	0.101 (1.085)	0.923 (1.154)

*1 Accumulated in 5 quarters, as in 5 quarters (from 0Q to 4Q after) the effect of impulse is thought to be fade.
*2 figures in () are accumulation of standard deviation of each term multiplied by 1.645, which is 95% critical value in standard normal distribution. Values added to figures in () to accumulated impulse response are upper limits of 90% confidence band. On the other hand, values subtracted by figures in () from accumulated impulse response are lower limits of 90% confidence band.

In order to illustrate the overall impact of the various shocks, the cumulative responses over several periods are shown in Chart 30. As the responses after more than five quarters appear negligible, we calculated the sum of the responses for the first five quarters after the shock. EAEA exhibits the largest response to shocks in JPEA, followed by the response of EAJP and EAUS. In other words, Japanese exports to East Asia have a very strong effect on intra-regional trade in East Asia, and result to a lesser extent in exports in the opposite direction to Japan and to the US. The largest response to shocks in EAEA is in EAUS, with the response of JPEA being only half as large. The main effect of growth in intra-regional trade in East Asia is thus the one on growth in East Asian exports to the US. Looking finally at the response to shocks in USEA, the largest cumulative response is in JPEA, followed by a somewhat smaller response in EAUS. However, there is hardly any response in EAEA and EAJP. Thus even the cumulative effects of changes in exports from the US to East Asia on intra-regional trade in East Asia and on East Asian exports to Japan appear to be relatively minor.

The results of the variance decomposition of the expected error term of the estimated VAR system for a four-quarter time horizon are shown in Chart 31. The variance decomposition provides a means to determine to what extent changes in each trade flow can be explained by changes in other trade flows. In the table, the total variance in the estimated residual for each variable is decomposed horizontally, and is shown as the percentage contribution to the overall variance of the variable shown in the upper row (horizontal total = 100).

(Chart 31) Variance Decomposition (4Q after)

(%)

Response \ Shock	from EA to JP (EAJP)	from JP to EA (JPEA)	from EA to US (EAUS)	from US to EA (USEA)	intra EA (EAEA)	Total
from EA to JP (EAJP)	65.5	22.5	3.4	1.6	7.1	100.0
from JP to EA (JPEA)	5.2	71.9	7.8	11.8	3.2	100.0
from EA to US (EAUS)	12.7	7.9	65.0	4.2	10.2	100.0
from US to EA (USEA)	8.5	13.3	12.7	60.5	5.0	100.0
intra EA (EAEA)	15.1	34.9	10.9	7.8	31.4	100.0

* Relative Variance contribution after 4Q, as the effect of impulse is thought to be fade in 5 quarters (from 0Q to 4Q).

Regarding the results, the major impact of other trade flows on changes in EAEA is particularly noteworthy. Other trade flows account for almost 70% of the variance in the EAEA error term, with the contribution of JPEA being especially high (34.9%). This indicates that intra-regional trade in East Asia is closely tied to trade with Japan and the US, with the influence of Japanese exports to East Asia being particularly pronounced. Conversely, these exports from Japan to East Asia (JPEA) are least affected by other trade flows, which contribute less than 30% to the overall error variance. Thus Japanese exports appear to be the most autonomous, in the sense that they require the least imports from other countries. East Asian exports to Japan (EAJP), however, are strongly influenced by Japanese exports to East Asia (JPEA), contributing almost one fourth to the overall error variance. All other trade flows have only a relatively small impact on the error variance, with the contribution of USEA being particularly small. Although East Asian exports to the US (EAUS), are less affected by Japanese exports to the East Asia (JPEA), the contribution of JPEA to the error variance of EAUS is roughly twice as high as that of US exports to East Asia (USEA)[32].

[32] The large contribution of EAJP to the expected error of EAUS is a little difficult to interpret. It is a reflection of the fact that EAUS exhibits a negative response to shocks in EAJP, as indicated by the impulse response analysis. This implies that when East Asian exports to Japan increase exports to the US decline temporarily, possibly reflecting short-term supply limitations.

Conclusions

The preceding VAR analysis tries to shed some light on the dynamic interdependencies among trade flows between East Asia, Japan and the US, as well as within East Asia. In particular, the analysis was intended to assess to what extent the important role of East Asia as a production and processing center, documented in Chapter 2 and 3, is reflected in the dynamics of trade flows. If inputs from Japan and the US are processed by East Asian countries, with the final product being exported again to Japan and the US and if the associated trade flows are a dominant factor in overall trade in the region, this inter-linkage between trade flows should, in principle, be reflected in a VAR linking the various trade flows. In this respect it is important to keep in mind that by focusing on the input-output relationship among trade flows a number of important factors determining trade flows are ignored and some caution therefore has to be exercised in interpreting the results. These caveats notwithstanding the evidence provided by the VAR analysis indicates that trade flows from and to East Asia, as well as within East Asia, exhibit significant interdependencies, with the nature of these interdependencies being consistent with an increased internationalization of the production process within East Asia.

The link between Japan and East Asia appears to be particularly strong. Exports from Japan to East Asia have a strong effect on subsequent exports of East Asia to Japan and the US, as well as on inter-regional trade flows in East Asia. It seems plausible to assume that these close ties are a result of the large amount of foreign direct investment undertaken by Japanese companies in East Asian countries since the 1980s, although we do not analyze this link directly. Using the comparative advantage of East Asian economies in certain – mostly labor-intensive – product categories and stages of production, Japanese companies have integrated the East Asian region into the production process. In the process, previously national trade has been transformed into international trade, although often remaining intra-company in nature. As a result, Japanese companies export capital goods and intermediate inputs to East Asian countries, which then process these products further with the ultimate objective of exporting them to their final destination in the US, Japan and other East Asian countries.

Although US firms have likewise shifted production capacity abroad, the degree of trade integration and the overall purpose of this shift may have been different than in the case of Japan. Like Japanese companies, US firms seem to supply inputs into the East Asian production process, but unlike in the Japanese case the output is largely re-exported to the US rather than to other export markets. As the impulse response analysis shows, an increase in US exports to East Asia has only a very limited positive impact on growth in East Asian exports to Japan and growth in trade within East Asia. In this respect, there is an asymmetry between Japanese trade and US trade with East Asia. Japanese companies appear to be utilizing East Asian countries as a production and export platform, whereas for US companies they constitute largely a production platform. Reflecting this role of East Asia as a production base, with comparatively small independent domestic demand factors, inter-regional trade flows in East Asia are largely driven by developments abroad, as indicated by the variance decomposition analysis. The effect of trade with Japan is considerably more pronounced than trade with the US, underlining the strength of the Japan-East Asia trade and production linkage.

In closing, we would like to point out a number of remaining problems and possible areas for future research. First, data limitations dictated the use of nominal trade flows as endogenous variables. If suitable deflators can be found, it would be interesting to conduct the analysis using real data. Second, the analysis is based on the premise that input-output relationships are an important determinant of trade flows in East Asia. In an extension, one could try to include other factors, such as domestic demand and relative price effects, explicitly into the analysis, moving into the direction of modeling export and import demand equations. Due to the limited number of degrees of freedom, the number of parameters would in this case probably have to be reduced and limitations placed on some of them (such as the income elasticity of exports). Third, it would be interesting to conduct a similar analysis for more disaggregated trade flow data, to include some East Asian countries – in particular China – individually and to add some other regions, such as Europe, to the analysis. Fourth, as the trading and production pattern in East Asia underwent dramatic changes during the past decade, it would be desirable to analyze the impact of these changes on the dynamics of the trading flows more directly. As a first step, in that direction one could estimate the VAR model for different sub-periods. The small number of observations relative to the number of parameters to be estimated, unfortunately, severely limits the possibility of such an analysis in the present data sample.

5. Closing thoughts

East Asia has experienced impressive growth over recent decades. This growth has been associated with and to a large extent driven by stronger inter- and intra-regional trade integration, which, in turn, was closely connected to the massive inflow of foreign direct investment into the region. In particular, Japanese and US companies have invested heavily in the region transforming it into a production and processing center for many manufactured goods, with a special focus in IT-related goods. The emergence of East Asia as a global supplier of IT-products has, for example, been reflected in the substantial shifts in the revealed comparative advantage structure of the region. Partly as a consequence of this trade-creating internationalization of the production process, the share of trade by East Asian countries in global trade has increased substantially. The aim of the present study was to contribute to a better understanding of the nature of trading patterns in East Asia, of the changes that have occurred during the 1990s and of the implications of these changes for the dynamic relationship between trade flows in East Asia. As trade patterns are to a large part a more general reflection of a country's economic structure, the analysis also provides some relevant insights into overall economic developments in East Asia. The study should be seen as largely exploratory and as a first step toward a more in-depth analysis of the East Asian economies and their relationship with the global economy.

An important lesson from the analysis is that the nature of trade flows, which derive from the production process being located in different countries, may be very different from that of the traditional trade in final goods. In particular, whereas for the latter case direct trade linkages play a major role, in the former case indirect trade channels running along the chain of production may be equally – if not more – relevant. This has important consequences for the propagation of shocks and the assessment of vulnerabilities to external developments. For example, the VAR analysis suggests that a slowdown in the US may not only affect countries through a reduction of their direct exports to the US. In addition, trade among East Asian countries and exports from Japan to East Asia are likely to slow down. The sequencing and size of the shock propagation suggests that this does not merely reflect second-round income effects but rather reduced demand for imported components and parts. These linkages, of course, need to be taken into account when assessing business cycle linkages and possible contagion effects in the case of a crisis. In addition, the implications of changes in external demand for the current account and for exchange rate adjustments may differ substantially depending on the nature of the trade flows, underlining the importance of a careful analysis of trade and production interdependencies.

The relative importance of production-related trade flows is likely to increase further along with the globalization process, largely driven by declining trading and transportation costs, which will render an increasing international segmentation of the production chain profitable. In this respect the role of foreign direct investment as a means to reduce transaction costs is likely to be crucial and a more careful study of the relationship between capital flows and trade flows may be a useful future research project.

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Appendix I: On the interpretation of the comparative advantage/disadvantage charts

The area 2 of Chart 8 represents a traditional comparative advantage situation, where the share of the good in question in a country’s overall exports is above the world average, while the import share is below the world average. Thus the country has a comparative advantage on both the export and the import sides (RCA > 0, RCDA < 0, RTA > 0). By contrast, the area 4 represents the reverse case of a traditional comparative disadvantage situation, with the country having a comparative disadvantage on both the export and the import sides (RCA < 0, RCDA > 0, RTA < 0). For goods in this area, the export share is below the world average and the import share is above the world average.

In the areas 1-(1) and 1-(2), a country has a comparative advantage on the export side for a particular good (RCA > 0) and simultaneously a comparative disadvantage on the import side (RCDA > 0). This is indicative of an open trade structure, as the share of both imports and exports of goods in that category are above the world average. By construction of the indices, RCA < 0 and RCDA < 0 for the group of goods comprising all other goods except the good in question (i.e., the country’s share of imports and exports of the group of other goods is below the world average). This means that there is a strong probability that the composition of import and export goods is similar, from which it may be surmised that trade within the same industry is high[33] (high proportion of intra-industry trade).

Points in the area 1-(1) indicate a situation of an overall comparative disadvantage, when one combines export and import-side information (RCA - RCDA = RTA < 0) because the amount by which the country's export share exceeds the world average is smaller than the degree to which its import share exceeds the world average. On the other hand, the area 1-(2) indicates an overall comparative advantage when exports and imports are integrated (RTA > 0) because the degree to which the country's export share exceeds the world average is larger than the degree to which its import share exceeds the world average.

In the areas 3-(1) and 3-(2), a country has a comparative disadvantage on the export side for a particular good (RCA < 0) but a comparative advantage on the import side (RCDA < 0). The country has a below-world-average share of the good in both on the export and on the import side, indicating a closed trade structure[34]. Area III-(1) indicates a situation of an overall comparative advantage when information from the export and import-side are integrated (RTA > 0) because the degree to which the country's export share falls short of the world average is smaller than the degree to which its import share falls short of the world average. On the other hand, area 3-(2) represents a situation of an overall comparative disadvantage

[33] Conversely, if for a good A RCA > 0 and RCDA < 0, then there is unlikely to be much intra-industry trade. For example, if all exports are of good A and all imports are of good B (RCA > 0 and RCDA < 0 for good A), then there would be no intra-industry trade.

[34] Like I-(1) and I-(2), intra-industry trade would be assumed to be high.

(RTA < 0) because the amount by which the country's export share falls short of the world average is larger than the amount by which its import share falls short of the world average.

Appendix II: A comparison between the Grubel and Lloyd's and Aquino's measures of intra-industry trade

Chart 32 contains a numerical example[35] to highlight the differences between Grubel and Lloyd's B and Aquino's Q as measures of the degree of intra-industry trade. For that purpose four trade scenarios are considered. 1-(1) and 1-(2) represent scenarios where imports and exports are balanced. In 1-(1), all trade is intra-industry, and there is no inter-industry trade. In 1-(2), on the other hand, there is no intra-industry trade, and all trade is inter-industry. An adequate measure of the degree of intra-industry trade should thus assign the highest possible index value to the first case and the lowest possible value to the second case. In the current context this would imply a value of 100 and 0 respectively. As can be seen in Chart 32 both indices assign these values to the two scenarios. Thus, in the case of balanced trade, both indices accurately reflect the degree of intra-industry trade and there is no discrepancy between Grubel and Lloyd's B and Aquino's Q.

Next, let us consider the two scenarios where imports and exports are not in equilibrium (2-(1) and 2-(2)). In both cases, total exports are 70 and total imports are 35. In 2-(1), exports of each good are twice those of imports, and there is no bias in the import/export structure of goods. In such a case, there is no inter-industry trade, and all trade is intra-industry. In the case of 2-(2), on the other hand, there is no import of textile, and trade occurs both inter-industry and intra-industry. Comparing the two indices for this case, it can be seen that Grubel and Lloyd's B is 66.7 for both 2-(1) and 2-(2), making it impossible to distinguish the difference in the degree of intra-industry trade. Aquino's Q, however, is 100 for 2-(1), properly reflecting the fact that all trade is intra-industry, and 57.1 for 2-(2), allowing a clear distinction between the two cases.

[35] From Aquino [1978].

(Chart 32) About Intra-Industry trade

1. In case total trade is balanced

1-(1)

All trade are intra-industry trade

	Export	Import
Chemicals	70	70
Textiles	0	0
Total	70	70
Grubel and Lloyd's "B"	100.0	
Aquino's "Q"	100.0	

1-(2)

All trade are inter-industry trade

	Export	Import
Chemicals	70	0
Textiles	0	70
Total	70	70
Grubel and Lloyd's "B"	0.0	
Aquino's "Q"	0.0	

2. In case total trade is not balanced

2-(1)

All trade are intra-industry trade

	Export	Import
Chemicals	40	20
Textiles	30	15
Total	70	35
Grubel and Lloyd's "B"	66.7	
Aquino's "Q"	100.0	

2-(2)

Intra-industry trade and inter-industry trade co-exist

	Export	Import
Chemicals	40	35
Textiles	30	0
Total	70	35
Grubel and Lloyd's "B"	66.7	
Aquino's "Q"	57.1	

(Referrence Table 1) RCA (SITC 1 digit category)

RCA		Food and live animals	Beverages and tobacco	Crude materials, inedible, except fuels	Mineral fuels, lubricants,and related materials	Animal and vegetable oils, fats and waxes	Chemicals and related products, n.e.s.	Manufactured goods classified chiefly by material	Machinery and transport equipment	Miscellaneous manufactured articles
EXPORT	SITC CODE	0	1	2	3	4	5	6	7	8
92-95 average										
	SOUTH KOREA	-68.3	-91.7	-64.9	-59.8	-98.0	-35.4	47.2	14.1	20.2
	HONG KONG	-84.2	4.0	-78.8	-88.0	-87.0	-62.9	-25.6	-32.1	295.3
	SINGAPORE	-67.8	38.7	-57.2	104.6	6.9	-36.9	-60.0	48.0	-36.9
	THAILAND	181.0	-69.4	23.1	-82.8	-92.9	-68.0	-26.5	-25.5	94.4
	INDONESIA	3.5	-61.7	105.4	445.4	443.3	-73.7	50.4	-84.2	38.7
	MALAYSIA	-60.3	-86.3	106.6	82.0	1,216.7	-75.0	-44.4	21.2	-23.8
	PHILIPPINES	103.8	-54.3	36.8	-43.8	1,201.6	-63.7	-35.7	-25.9	78.6
	CHINA	9.3	-28.9	-18.6	-18.4	-46.4	-46.2	19.4	-57.1	205.1
	U.S.	0.6	29.0	48.6	-56.9	-21.5	11.4	-44.7	19.1	-8.6
	JAPAN	-94.4	-92.3	-83.8	-89.4	-96.7	-38.8	-31.2	74.4	-38.1
96-99 average										
	SOUTH KOREA	-70.9	-87.0	-64.9	-40.7	-96.0	-22.5	40.7	24.2	-23.3
	HONG KONG	-81.5	-15.6	-75.2	-95.0	-82.3	-62.8	-32.6	-38.7	340.0
	SINGAPORE	-75.0	20.3	-72.3	21.5	-46.0	-34.2	-66.5	57.6	-36.2
	THAILAND	166.4	-71.3	28.8	-70.4	-80.0	-56.1	-21.9	-5.4	36.9
	INDONESIA	16.3	-54.3	151.0	292.2	657.9	-56.5	42.0	-75.3	30.0
	MALAYSIA	-67.5	-72.1	14.9	13.9	1,123.8	-66.6	-44.1	36.4	-31.2
	PHILIPPINES	-14.6	-77.7	-40.7	-81.1	396.0	-84.4	-65.2	50.8	25.4
	CHINA	-13.2	-48.7	-37.7	-50.2	-59.9	-44.6	17.6	-39.3	197.1
	U.S.	-4.3	8.9	32.2	-71.6	-31.0	10.8	-39.6	22.0	-5.3
	JAPAN	-93.9	-91.2	-78.9	-93.9	-96.8	-27.6	-28.4	65.3	-31.4

(Referrence Table 2) RCDA (SITC 1 digit category)

RCDA		Food and live animals	Beverages and tobacco	Crude materials, inedible, except fuels	Mineral fuels, lubricants,and related materials	Animal and vegetable oils, fats and waxes	Chemicals and related products, n.e.s.	Manufactured goods classified chiefly by material	Machinery and transport equipment	Miscellaneous manufactured articles
IMPORT	SITC CODE	0	1	2	3	4	5	6	7	8
92-95 average										
	SOUTH KOREA	-36.6	-67.7	104.4	92.9	-23.7	1.4	-4.7	-5.4	-46.7
	HONG KONG	-44.6	52.4	-58.1	-77.1	-56.3	-28.0	31.3	-7.8	91.9
	SINGAPORE	-52.7	29.0	-71.1	19.7	40.0	-27.3	-27.3	42.6	-29.2
	THAILAND	-46.6	-55.4	15.2	-12.0	-71.3	11.9	24.5	22.0	-61.9
	INDONESIA	-23.6	-61.4	82.7	-10.1	-7.4	53.0	4.9	10.5	-73.3
	MALAYSIA	-35.2	-68.7	-44.4	-61.9	-21.5	-19.8	-3.9	57.3	-60.2
	PHILIPPINES	13.2	-8.4	8.8	56.3	-48.3	23.1	9.6	1.1	-71.6
	CHINA	-54.9	-78.9	39.6	-48.6	164.1	22.4	53.6	9.4	-55.7
	U.S.	-43.4	-14.4	-39.3	13.5	-52.4	-43.6	-23.5	21.6	28.7
	JAPAN	97.2	57.4	138.5	130.1	-48.3	-22.7	-28.8	-49.8	2.5
96-99 average										
	SOUTH KOREA	-27.8	-60.8	89.2	155.2	-34.5	-2.8	-11.5	-11.1	-42.1
	HONG KONG	-40.6	-6.0	-55.3	-73.7	-17.9	-34.2	24.9	-5.8	94.0
	SINGAPORE	-60.0	25.2	-78.1	19.7	-36.6	-39.8	-39.1	46.1	-23.4
	THAILAND	-39.4	-63.4	8.5	20.4	-73.3	8.7	21.6	13.5	-55.8
	INDONESIA	23.1	-52.4	90.2	21.6	-51.3	44.8	2.8	-1.4	-76.0
	MALAYSIA	-30.5	-72.2	-35.2	-59.7	-26.5	-25.9	-16.0	54.8	-61.2
	PHILIPPINES	12.4	-48.9	-5.1	13.8	-42.7	-12.1	-16.5	29.8	-67.6
	CHINA	-56.3	-79.3	95.9	-26.4	139.7	39.7	45.5	-2.5	-56.1
	U.S.	-42.7	-11.3	-35.6	10.3	-59.8	-38.7	-18.7	15.5	31.8
	JAPAN	91.2	45.6	114.3	125.0	-47.9	-28.7	-32.4	-36.0	14.4

(Referrence Table 3) RTA (SITC 1 digit category)

RTA	Food and live animals	Beverages and tobacco	Crude materials, inedible, except fuels	Mineral fuels, lubricants,and related materials	Animal and vegetable oils, fats and waxes	Chemicals and related products, n.e.s.	Manufactured goods classified chiefly by material	Machinery and transport equipment	Miscellaneous manufactured articles
SITC CODE	0	1	2	3	4	5	6	7	8
92-95 average									
SOUTH KOREA	-31.7	-24.0	-169.3	-152.7	-74.3	-36.8	51.8	19.5	66.9
HONG KONG	-39.6	-48.4	-20.7	-10.8	-30.7	-34.9	-56.9	-24.3	203.4
SINGAPORE	-15.1	9.7	13.9	84.9	-33.1	-9.6	-32.7	5.4	-7.8
THAILAND	227.6	-14.0	7.9	-70.8	-21.6	-79.8	-51.0	-47.6	156.4
INDONESIA	27.1	-0.3	22.7	455.5	450.8	-126.7	45.4	-94.7	111.9
MALAYSIA	-25.2	-17.5	151.0	143.9	1,238.2	-55.2	-40.5	-36.1	36.4
PHILIPPINES	90.6	-45.9	28.0	-100.1	1,249.9	-86.8	-45.2	-27.0	150.2
CHINA	64.2	50.0	-58.2	30.2	-210.5	-68.6	-34.2	-66.6	260.8
U.S.	44.0	43.4	87.9	-70.5	30.9	55.0	-21.2	-2.5	-37.3
JAPAN	-191.7	-149.7	-222.3	-219.5	-48.5	-16.1	-2.4	124.2	-40.5
96-99 average									
SOUTH KOREA	-43.1	-26.2	-154.1	-196.0	-61.5	-19.7	52.2	35.3	18.8
HONG KONG	-40.9	-9.7	-19.9	-21.3	-64.4	-28.6	-57.6	-32.9	246.1
SINGAPORE	-15.0	-4.9	5.8	1.8	-9.3	5.6	-27.4	11.5	-12.8
THAILAND	205.8	-7.9	20.4	-90.9	-6.7	-64.9	-43.5	-18.9	92.8
INDONESIA	-6.8	-2.0	60.8	270.6	709.2	-101.3	39.2	-73.9	106.0
MALAYSIA	-37.0	0.1	50.1	73.5	1,150.3	-40.7	-28.1	-18.5	30.1
PHILIPPINES	-27.0	-28.8	-35.6	-94.9	438.7	-72.4	-48.7	21.0	93.0
CHINA	43.1	30.6	-133.6	-23.9	-199.6	-84.3	-27.9	-36.8	253.2
U.S.	38.4	20.3	67.8	-81.9	28.8	49.5	-20.9	6.6	-37.0
JAPAN	-185.2	-136.9	-193.2	-218.9	-48.9	1.2	4.0	101.3	-45.7

(Reference Table 4) RCA in Machinery and Transport Equipment (SITC 2 digit category)

RCA		Power-generating machinery and equipment	Machinery specialized for particular industries	Metalworking machinery	General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.	Office machines and automatic data-processing machines	Telecommunications and sound-recording and reproducing apparatus and equipment	Electrical machinery, apparatus and appliances, n.e.s. , and electrical parts thereof	Road vehicles	Other transport equipment
EXPORT	SITC CODE	71	72	73	74	75	76	77	78	79
92-95 average										
	SOUTH KOREA	-62.7	-53.2	-63.6	-50.8	-15.0	120.3	123.9	-33.3	73.6
	HONG KONG	-79.1	-60.4	-45.5	-74.9	73.0	44.7	40.1	-99.9	-98.4
	SINGAPORE	-37.7	-47.5	-54.3	-27.1	384.3	220.0	115.5	-89.3	-60.2
	THAILAND	-71.3	-89.8	-79.4	-30.7	81.7	52.4	26.8	-85.8	-70.8
	INDONESIA	-95.8	-95.0	-98.8	-93.4	-86.0	-23.1	-83.1	-92.7	-90.3
	MALAYSIA	-65.6	-84.9	-87.2	-52.4	64.2	314.3	155.2	-93.4	-13.7
	PHILIPPINES	-98.2	-95.7	-93.5	-92.9	-33.4	89.9	131.1	-83.7	-99.5
	CHINA	-66.7	-78.5	-64.2	-64.4	-55.3	38.0	-39.8	-85.6	-76.6
	U.S.	59.6	18.1	-1.6	5.6	41.1	-14.2	15.3	-11.1	129.8
	JAPAN	51.9	43.6	101.0	43.0	90.8	112.7	81.5	100.8	-4.9
96-99 average										
	SOUTH KOREA	-74.6	-34.5	-44.7	-41.5	-3.7	63.8	121.1	-5.9	107.6
	HONG KONG	-84.0	-71.5	-37.2	-81.0	-3.8	-9.6	63.5	-100.0	-98.2
	SINGAPORE	-54.7	-37.1	-59.8	-38.5	405.7	97.5	166.0	-90.9	-63.8
	THAILAND	-45.6	-85.3	-76.7	-24.6	154.4	42.0	40.6	-77.6	-74.7
	INDONESIA	-81.6	-90.5	-97.1	-89.0	-63.5	-9.4	-72.7	-92.6	-84.5
	MALAYSIA	-67.6	-77.8	-82.4	-64.0	182.8	234.3	169.2	-93.6	-45.2
	PHILIPPINES	-91.6	-89.7	-79.7	-87.8	218.5	21.1	335.6	-81.9	-89.5
	CHINA	-61.9	-78.5	-69.7	-54.2	3.2	52.2	-17.7	-82.4	-61.6
	U.S.	60.2	33.5	7.8	12.4	25.2	-4.8	20.8	-14.1	148.3
	JAPAN	46.7	56.2	161.6	36.2	60.5	50.1	79.7	91.6	-2.8

(Reference Table 5) RCDA in Machinery and Transport Equipment (SITC 2 digit category)

RCDA / IMPORT	SITC CODE	Power-generating machinery and equipment	Machinery specialized for particular industries	Metalworking machinery	General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.	Office machines and automatic data-processing machines	Telecommunications and sound-recording and reproducing apparatus and equipment	Electrical machinery, apparatus and appliances, n.e.s. , and electrical parts thereof	Road vehicles	Other transport equipment
		71	72	73	74	75	76	77	78	79
92-95 average										
	SOUTH KOREA	23.9	77.3	126.4	39.9	-51.2	-38.2	39.0	-85.8	72.0
	HONG KONG	-47.9	-41.4	-52.3	-25.4	-22.8	147.8	45.7	-58.6	-62.5
	SINGAPORE	21.9	-2.6	-15.1	15.8	85.4	127.3	155.9	-75.5	62.6
	THAILAND	17.7	88.1	122.7	64.0	-16.3	-3.4	56.0	-21.9	21.6
	INDONESIA	123.6	223.0	97.3	89.6	-87.4	-18.5	-26.9	-37.7	15.5
	MALAYSIA	18.4	85.2	153.6	28.7	-33.2	47.8	241.7	-65.3	163.8
	PHILIPPINES	57.4	55.6	-12.1	-5.0	-55.3	22.1	20.8	-37.9	77.1
	CHINA	7.4	246.9	224.5	21.8	-64.8	45.4	-14.3	-58.2	53.1
	U.S.	21.2	-22.7	-7.9	-20.4	54.3	33.1	13.5	53.6	-33.8
	JAPAN	-57.9	-66.4	-62.2	-61.4	-30.5	-43.1	-35.8	-65.4	-31.7
96-99 average										
	SOUTH KOREA	-10.3	24.4	72.7	11.9	-52.5	-36.8	73.1	-87.9	5.2
	HONG KONG	-43.4	-48.6	-54.9	-39.2	10.6	130.4	52.4	-75.0	-61.5
	SINGAPORE	-17.3	25.8	-24.1	-1.9	114.1	45.0	174.7	-81.8	108.9
	THAILAND	-6.4	29.2	129.2	37.6	-15.0	-28.2	97.5	-60.6	50.1
	INDONESIA	71.4	230.8	68.8	95.8	-87.5	-10.4	-47.1	-42.2	-26.8
	MALAYSIA	-17.2	48.0	72.4	-55.6	-1.7	-1.5	276.3	-69.2	99.5
	PHILIPPINES	-34.1	46.2	-8.3	-18.6	15.8	26.5	179.4	-60.4	3.8
	CHINA	0.1	130.7	151.6	15.4	-39.7	23.5	21.8	-84.8	22.3
	U.S.	13.6	-19.4	5.3	-22.7	44.7	16.7	1.8	45.5	-21.4
	JAPAN	-49.2	-58.2	-51.9	-56.7	1.7	-21.0	-17.6	-65.8	-25.9

(Reference Table 6) RTA in Machinery and Transport Equipment (SITC 2 digit category)

RTA		Power-generating machinery and equipment	Machinery specialized for particular industries	Metalworking machinery	General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.	Office machines and automatic data-processing machines	Telecommunications and sound-recording and reproducing apparatus and equipment	Electrical machinery, apparatus and appliances, n.e.s. , and electrical parts thereof	Road vehicles	Other transport equipment
	SITC CODE	71	72	73	74	75	76	77	78	79
92-95 average										
	SOUTH KOREA	-86.6	-130.4	-190.1	-90.8	36.2	158.5	85.0	52.5	1.6
	HONG KONG	-31.2	-18.9	6.7	-49.5	95.8	-103.1	-5.6	-41.3	-36.0
	SINGAPORE	-59.5	-45.0	-39.2	-42.9	298.9	92.7	-40.5	-13.7	-122.8
	THAILAND	-89.0	-178.0	-202.1	-94.7	98.0	55.8	-29.2	-64.0	-92.4
	INDONESIA	-219.4	-318.1	-196.1	-182.9	1.4	-4.6	-56.2	-55.0	-105.8
	MALAYSIA	-84.0	-170.1	-240.9	-81.1	97.4	266.4	-86.5	-28.1	-177.5
	PHILIPPINES	-155.6	-151.4	-81.3	-87.9	21.9	67.9	110.3	-45.8	-176.6
	CHINA	-74.1	-325.4	-288.6	-86.2	9.5	-7.4	-25.4	-27.4	-129.8
	U.S.	38.3	40.8	6.4	26.0	-13.2	-47.3	1.8	-64.8	163.5
	JAPAN	109.8	110.1	163.2	104.4	121.3	155.8	117.3	166.2	26.8
96-99 average										
	SOUTH KOREA	-64.4	-58.9	-117.3	-53.4	48.7	100.6	48.0	82.0	102.4
	HONG KONG	-40.7	-22.9	17.7	-41.9	-14.3	-140.0	11.1	-24.9	-36.7
	SINGAPORE	-37.5	-62.9	-35.7	-36.6	291.6	52.4	-8.8	-9.1	-172.7
	THAILAND	-39.1	-114.5	-205.9	-62.2	169.4	70.2	-56.9	-17.0	-124.9
	INDONESIA	-153.0	-321.3	-165.9	-184.8	23.9	0.9	-25.6	-50.5	-57.7
	MALAYSIA	-50.4	-125.8	-154.8	-8.4	184.5	235.8	-107.1	-24.4	-144.6
	PHILIPPINES	-57.4	-136.0	-71.4	-69.2	202.7	-5.4	156.2	-21.6	-93.3
	CHINA	-61.9	-209.2	-221.3	-69.5	42.9	28.7	-39.5	2.3	-83.9
	U.S.	46.6	52.9	2.5	35.1	-19.5	-21.6	19.0	-59.6	169.6
	JAPAN	95.9	114.4	213.5	92.9	58.8	71.0	97.3	157.4	23.1

(Reference Table 7) RCA in IT-related goods (SITC 4 digit category)

RCA		Digital computers	Digtl proc,storage units	Input or output units	Storage units,data proc.	Parts,of copying machine	Parts,data proc. etc.mch	Parts,telecommun. equipt	TV picture tubes,CRT, etc	Oth.electronc valv,tubes	Diodes,transistors etc.	Electronic microcircuits
EXPORT	SITC CODE	7522	7523	7526	7527	7591	7599	7649	7761	7762	7763	7764
92-95 average												
	SOUTH KOREA	-5.2	-91.0	203.3	-69.5	-84.7	-51.6	49.7	579.9	60.2	77.1	364.7
	HONG KONG	-40.1	-27.8	-86.6	-85.7	102.9	255.1	322.7	-97.8	-99.0	191.1	70.1
	SINGAPORE	902.6	-40.7	434.4	996.2	-49.3	273.8	222.4	381.4	18.7	256.1	312.7
	THAILAND	-98.1	-98.6	-19.8	322.7	-70.5	156.8	34.7	56.6	-79.7	52.7	35.1
	INDONESIA	-96.4	-97.7	-85.5	-81.2	-99.2	-84.2	-54.1	-97.8	-99.3	-98.3	-92.3
	MALAYSIA	-88.5	-94.4	23.9	-76.6	-90.1	245.0	171.3	379.4	99.6	612.3	454.5
	PHILIPPINES	-98.2	-100.0	192.6	-100.0	-100.0	-58.8	28.8	-99.0	-100.0	869.3	285.8
	CHINA	-86.2	-92.1	-35.6	-72.8	-71.7	-49.6	-0.9	-24.9	-81.8	-45.2	-94.6
	U.S.	31.0	117.9	-6.0	24.6	-27.8	57.1	16.1	-9.8	-42.0	-1.4	47.0
	JAPAN	96.9	-56.1	160.5	122.0	380.3	69.2	52.4	42.8	478.9	125.0	101.2
96-99 average												
	SOUTH KOREA	-57.7	-49.4	207.8	9.9	-85.5	-51.2	46.0	368.5	519.9	34.1	332.2
	HONG KONG	-98.8	-86.0	-88.4	-96.0	341.2	76.0	185.4	-100.0	-99.2	243.7	153.5
	SINGAPORE	211.8	189.0	274.8	1,211.8	-22.6	333.7	143.1	284.5	140.8	356.3	377.2
	THAILAND	-96.4	-99.3	182.0	76.0	-0.4	337.3	19.3	109.8	-49.1	194.3	29.6
	INDONESIA	-89.2	-89.6	-66.5	-99.8	-95.7	-31.5	-29.7	-75.6	-87.4	-89.9	-88.0
	MALAYSIA	-4.1	-69.4	80.2	217.9	-78.1	328.4	131.8	510.6	169.8	504.1	400.1
	PHILIPPINES	-97.3	-97.5	1,003.0	-99.9	-89.0	277.4	7.3	-98.3	-99.1	825.2	908.7
	CHINA	-66.0	-75.6	107.6	23.7	24.8	-24.3	43.8	-17.7	-45.6	-21.1	-79.8
	U.S.	0.1	103.6	-57.6	-51.5	-18.5	51.1	17.0	62.5	-49.1	13.4	48.9
	JAPAN	87.4	-50.6	94.4	52.0	482.1	58.6	49.8	-35.8	429.4	153.3	78.1

(Reference Table 8) RCDA in IT-related goods (SITC 4 digit category)

RCDA		Digital computers	Digtl proc,storage units	Input or output units	Storage units,data proc.	Parts,of copying machine	Parts,data proc. etc.mch	Parts,telecommun. equipt	TV picture tubes,CRT, etc	Oth.electronc valv,tubes	Diodes,transistors etc.	Electronic microcircuits
IMPORT	SITC CODE	7522	7523	7526	7527	7591	7599	7649	7761	7762	7763	7764
92-95 average												
	SOUTH KOREA	-60.9	-25.6	-58.9	-43.7	-48.9	-57.5	14.3	36.7	418.3	96.7	121.6
	HONG KONG	-82.3	-32.3	-55.2	-49.3	19.3	15.1	106.5	56.8	-86.6	95.1	101.3
	SINGAPORE	77.6	-74.2	64.3	119.0	-44.8	184.7	203.2	158.3	261.7	356.8	323.1
	THAILAND	-44.3	-88.7	-56.5	-86.5	-52.8	82.2	65.3	259.5	88.3	57.9	3.8
	INDONESIA	-52.7	-90.2	-93.0	-94.5	-88.4	-92.0	37.9	232.8	-52.8	-51.0	-92.0
	MALAYSIA	-69.2	-81.1	-77.6	-96.6	-77.9	50.2	307.7	522.9	309.8	431.7	159.7
	PHILIPPINES	-43.7	-95.0	-29.2	-98.5	-76.5	-30.6	153.8	18.1	-96.6	-1.7	-63.2
	CHINA	0.6	-89.7	-83.4	-91.8	-32.0	-47.0	156.4	198.5	55.2	-7.8	-40.0
	U.S.	14.7	-25.5	92.2	132.6	48.4	42.2	-22.7	-77.4	22.5	4.1	59.1
	JAPAN	-36.5	45.6	-71.9	-30.8	-59.9	-23.4	-27.8	-42.6	-46.2	-28.7	-1.8
96-99 average												
	SOUTH KOREA	-55.6	-39.7	-60.5	-44.8	-63.7	-50.9	16.0	50.7	340.9	128.2	223.3
	HONG KONG	-58.1	19.8	1.4	-39.2	83.7	43.9	133.1	112.4	33.7	125.5	75.7
	SINGAPORE	-44.1	-35.7	3.4	221.2	-25.7	230.6	120.4	14.1	277.6	365.0	377.2
	THAILAND	-68.8	-90.9	-73.5	-91.2	-29.2	88.0	9.4	723.4	62.3	129.4	19.8
	INDONESIA	-72.9	-80.6	-86.2	-97.7	-82.6	-95.1	21.9	50.7	-68.2	-78.9	-96.2
	MALAYSIA	-72.6	-76.9	-83.1	-55.1	-79.3	100.7	152.6	439.2	501.7	395.3	277.4
	PHILIPPINES	-56.7	-89.9	-66.7	-98.3	-56.8	185.1	191.7	-2.1	-91.7	48.3	50.3
	CHINA	-39.4	-50.9	-74.7	-73.5	85.3	-2.0	167.2	106.3	385.0	135.8	7.6
	U.S.	28.2	-36.8	82.7	92.7	22.1	36.7	-30.0	-86.3	-32.1	-4.5	29.7
	JAPAN	-21.3	90.5	-33.4	4.1	-10.4	-3.7	-4.9	-57.6	-56.1	-25.6	24.6

(Reference Table 9) RTA in IT-related goods (SITC 4 digit category)

RTA	Digital computers	Digtl proc,storage units	Input or output units	Storage units,data proc.	Parts,of copying machine	Parts,data proc. etc.mch	Parts,telecommun. equipt	TV picture tubes,CRT, etc	Oth.electronc valv,tubes	Diodes,transistors etc.	Electronic microcircuits
SITC CODE	7522	7523	7526	7527	7591	7599	7649	7761	7762	7763	7764
92-95 average											
SOUTH KOREA	55.7	-65.4	262.2	-25.8	-35.8	5.9	35.4	543.2	-358.1	-19.6	243.1
HONG KONG	42.2	4.5	-31.4	-36.4	83.5	240.0	216.2	-154.6	-12.4	96.0	-31.3
SINGAPORE	825.0	33.5	370.1	877.2	-4.5	89.1	19.2	223.1	-243.0	-100.7	-10.4
THAILAND	-53.8	-9.9	36.7	409.1	-17.7	74.6	-30.6	-202.9	-168.0	-5.1	31.2
INDONESIA	-43.6	-7.6	7.5	13.3	-10.9	7.7	-92.0	-330.6	-46.5	-47.2	-0.4
MALAYSIA	-19.3	-13.4	101.5	19.9	-12.2	194.8	-136.4	-143.5	-210.2	180.7	294.9
PHILIPPINES	-54.5	-5.0	221.8	-1.5	-23.5	-28.2	-125.1	-117.1	-3.4	871.0	348.9
CHINA	-86.9	-2.4	47.8	19.0	-39.6	-2.7	-157.2	-223.4	-137.1	-37.4	-54.6
U.S.	16.3	143.3	-98.2	-108.0	-76.3	14.9	38.8	67.6	-64.5	-5.4	-12.2
JAPAN	133.4	-101.7	232.4	152.9	440.1	92.5	80.2	85.4	525.1	153.7	103.0
96-99 average											
SOUTH KOREA	-2.1	-9.7	268.3	54.7	-21.8	-0.2	30.1	317.7	178.9	-94.1	108.9
HONG KONG	-40.7	-105.8	-89.8	-56.8	257.5	32.0	52.3	-212.4	-132.9	118.1	77.8
SINGAPORE	256.0	224.7	271.4	990.6	3.0	103.0	22.7	270.3	-136.8	-8.7	0.0
THAILAND	-27.6	-8.4	255.5	167.2	28.8	249.2	9.9	-613.6	-111.4	64.9	9.9
INDONESIA	-16.4	-9.0	19.7	-2.1	-13.1	63.5	-51.6	-126.3	-19.1	-11.0	8.3
MALAYSIA	68.5	7.5	163.3	273.0	1.2	227.7	-20.8	71.4	-331.8	108.8	122.7
PHILIPPINES	-40.6	-7.6	1,069.7	-1.6	-32.2	92.3	-184.3	-96.2	-7.4	776.9	858.3
CHINA	-26.6	-24.7	182.2	97.1	-60.5	-22.3	-123.4	-124.0	-430.6	-156.9	-87.4
U.S.	-28.2	140.4	-140.4	-144.2	-40.7	14.4	47.0	148.8	-17.0	18.0	19.3
JAPAN	108.7	-141.1	127.8	47.9	492.5	62.3	54.7	21.7	485.5	178.9	53.5