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Department of Economics
SCAPE Working Paper Series
Paper No. 2005/07 - May 2005
http://nt2.fas.nus.edu.sg/ecs/pub/wp-scape/0507.pdf

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Key words: Trade, Competitiveness, Exports, East Asia, Shift-Share

JEL classification numbers: F10, F14

This paper uses dynamic shift-share analysis to examine the export performance of China in electronics compared to the east Asian NIEs exporting to the USA, European Union and Japan between 1988 and 2001. Our findings suggest that China has now emerged as a serious contender in the export market for electronics goods, but this position has not been a dominant one. Her main gains have been in consumer electronics and telecommunications equipment and to a lesser extent in disk-drives, printers and PCs; but in the higher-end exports of printed circuit boards and semiconductors, China has not yet gained a significant stronghold in developed country markets, at least to the extent that the growth in her overall exports and increase in market shares might suggest. Moreover, China's success since the early 1990s has been largely underpinned by strong export growth rather than a favourable industry mix. Nonetheless, If China can sustain rapid growth in exports and is able consolidate its industrial base, China's overall competitiveness can be expected to improve substantially in the future. Its low cost structure, an increasingly skilled workforce and an influx of technology and management skills associated with large foreign direct investment inflows, together with its recent entry into the WTO, places China in a very favourable position.

A Dynamic Shift-Share Analysis of the Electronics Export Market 1988-2001: Can the NIEs Compete with China? [1]

I Introduction

China has enjoyed remarkable trade growth over the past two decades, with exports expanding by almost 13 percent per annum on average between 1986 and 2001 and 20 percent between 1986 and 1995.[2] This coincided with substantial changes in the international landscape since the mid-1980s as globalisation of the world economy led to intense competition in the east Asian region and significant changes in export competitiveness.

These developments have been heightened by the re-entry of China into the global economy in the 1990s, a process begun with domestic reforms in 1978, but catalysed by China's accession to the World Trade Organization (WTO) in 2002. The result has been an acceleration in the process of dismantling its trade barriers, opening its market up to foreign services and reducing the weight of state-controlled enterprises in the economy.

The spectre of the 'China threat' has forced other countries in the Asian region to re-assess their own international competitiveness. Whilst some observers point to the opportunities China presents as a market for exports, a source of tourism earnings and indigenous foreign direct investment (FDI), and its potential to act as a 'locomotive' for regional demand and a stabilizer against downswings in global demand, others are less optimistic.

Rapid growth in GDP 0f 9.4 percent on an annual average basis since 1986[3] and fast 'catch-up' based on low costs, a seemingly endless reserve army of underemployed agricultural workers, technicians from the communist era, and a rapidly rising pool of ambitious English-speaking graduates, has transformed China into the potential workshop of the world, particularly in lower-end manufacturing such as textiles, bicycles, shoes and furniture. But

[1] Some of the empirical work underpinning this paper is derived from a shift-share study focusing on Singapore, which was released as an MAS Occasional Paper (see Monetary Authority of Singapore (2002) based on a joint project between the Monetary Authority of Singapore and International Enterprise Singapore, in collaboration with Peter Wilson from the National University of Singapore. The authors are also grateful to Ho Shih Chuan and Khor Hoe Ee for their valuable comments. The views expressed in this paper are, however, solely those of the authors and should not be attributed to the Monetary Authority of Singapore, IE Singapore, or the National University of Singapore.

[2] Calculated from the UN Combase online database.

[3] Asian Development Bank, Key Indicators of Developing and Asian Pacific Countries 2002.

China is also catching up in electronics which have increased from a negligible base in 1987 to account for 19 percent of its global exports by 2001[4]. China is accused of neo-mercantilism because of its rising foreign exchange reserves (($169 billion in 2000[5]) underpinned by an undervalued currency, which has enabled it maintain a competitive edge in exports; and of being a 'giant vacuum cleaner' 'sucking up' the lion's share of FDI inflows into the developing countries, attracted by rising incomes in its vast home market, especially in the southern Pearl River delta.

China is also seen as a potential new source of shocks to the Asian region as its excess capacity and low costs translate into enhanced price competition and a fall in profit margins and in the value of manufacturing assets.[6] Although the Chinese economy is still relatively closed in comparison to the exceptionally open Asian NIEs, with a trade to GDP ratio of 44 percent in 2000, and its ratio of domestic consumption to world consumption is quite small, the impact of China on its neighbours is magnified by the absolute size of its exports and imports ($249 billion, $225 billion respectively in 2000[7]) and the growing interdependence in the Asian region as China becomes more integrated into the local trade matrix as both an export market and source of imports.

How real is the China threat to the Asian NIEs in the major developed country markets of the world?

This paper uses dynamic shift-share analysis to re-assess China's export performance in electronics exports to the developed country markets of the USA, European Union (EU) and Japan in relation to Singapore, Hong Kong, Korea, Malaysia and Taiwan, which have become close competitors in these markets. Although there has been some discussion about the longer-term economic challenge posed by China to Japan, the focus in this paper is on Japan as a major export market for China and the other Asian NIEs.

In the absence of easily obtainable and internationally comparable trade data at a more disaggregated level, most comparative studies on the east and

[4] Calculated from the UN Combase online database.

[5] Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries 2002.

[6] The impact of the SARS epidemic in 2003, which originated in China, on countries such as Singapore through the loss of tourism receipts is another, less traditional, transmission channel for regional shocks in an increasingly integrated world economy.

south-east Asian economies have been restricted to the one or two-digit standard international trade classification (SITC). Whilst this gives us the general picture within very broad categories, it needs to be supplemented by further decomposition to narrow down the range of product categories which constitute a significant proportion of each country's exports and to capture areas of specialization and unwrap the pattern of concentration or diversification within the product groups themselves. For example, SITC category 75, which incorporates office and data processing machines, incorporates a wide range of electronics and related items, not all of which will be relevant to all competitors. By contrast, the present paper looks at 5 three-digit level categories of electronics, as well as electronics as a whole, which are pertinent for identifying the extent to which China is emerging as a threat to her east Asian competitors in international markets.

We begin with some background on China's export performance relative to the NIEs since the mid-1980s. This is followed by a discussion of the methodology used in this paper and our empirical findings. We complete the analysis with some concluding remarks and qualifications.

II China and the Newly Industrialized Asian Economies

Whilst China has not been a traditional competitor of the other NIEs, it is fast becoming one especially in the late 1990s, primarily as a result of its low cost base and surge in inward foreign direct investment.

China's share of developing country inward FDI more than doubled in the early 1990s compared to the second half of the 1980s (Table 1) and accounted for approximately one fifth on average between 1995 and 2000 and almost one half of the flow to Asia (excluding Japan). Japan and India have seen their shares increase since 1985 but all of China's other competitors in the Asian region have seen a fall in shares in the 1995-99 period compared to 1985-9.

As far as electronics specifically is concerned, China's share in total exports to developed country markets is still dwarfed by the other NIEs (Table 2), with the exception of service-oriented Hong Kong, but in absolute terms, the

[7] Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries 2002.

electronics and information technology industry is now China's largest industry, with output of computers accounting for close to two-thirds of overall industrial production and in terms of turnover, China's electronics and information technology industry currently ranks third in the world. [8] Not surprisingly, the USA, Japan, and EU are important markets for these countries in electronics, both individually, and as a bloc. By 2000 electronics accounted for approximately 70 percent of Singapore's exports to the USA, Japan and the EU (excluding re-exports), followed by Malaysia (60%), Taiwan (57%), Korea (41%), China (22%) and Hong Kong (15%).

There have also been significant changes in the export product-mix in China's electronics industry (Table 3). Not only has there been a significant increase in the importance of electronics as a whole in total exports from a negligible base in 1985, to about 22 percent by 2000, but particularly important has been the rise in the share of consumer electronics to almost 8 percent, and disk drives, printers and PCs to 5.9 percent. On the other hand, printed circuit boards and semiconductors still only account for 1.6 percent and 1.3 percent respectively.

The perception that China is a threat to the NIEs stems largely from its extraordinary growth in exports and rising share in key developed country markets, including electronics. Table 4 shows the growth profile of China's exports compared to the NIEs over three periods: 1985-9, 1990-95 and 1996-2000, and changes in market shares for each country as a percentage of the share of the group as a whole.

In the first period all the Asian NIEs grew fast globally and to the developed country markets. In the second period China and Malaysia were the star performers, particularly in the US market, but Singapore and Korea also achieved respectable growth. Only Taiwan and Hong Kong performed poorly in comparison. Export growth slowed dramatically for the group as a whole in the most recent phase on the back of three external shocks. Exports of electronics moderated sharply in 1996 due to a serious supply glut in the global electronics industry. Before the region could fully recover trade was further disrupted by the Asian financial crisis of 1897-1998. After a year of

[8] Source : Committee on Electronic Information Communication (CEIC): www.ceic.math.ca and MTI-

exuberant growth in the international technology sector and the world economy in 2000, east Asia was again hard hit by a major correction in the global information technology market, precipitated by a synchronised slowdown in the United States, the EU and Japan. Taken individually, growth was moderate for Korea, Malaysia and Taiwan but China again performed much better than her competitors, while Hong Kong grew at a negative rate and Singapore managed only 3 percent globally and a negative 0.5 percent in the US market.

As far as market shares are concerned, China's performance is equally impressive, increasing its share of the Asian NIEs global exports from 22 percent in the first period to 30 percent in the third, and more than doubling its share in the US and total developed country markets to 28 percent and 32 percent respectively. Malaysia and Taiwan also increased their shares in global and developed country markets but in a much less spectacular fashion, and Taiwan's shares actually fell between the second and third periods. Singapore's shares remained remarkably stable over the three periods, while Korea saw a significant decline in the US and Japanese markets from a high initial base and Hong Kong's shares in global and developed markets declined from 14 percent and 16 percent in the first period to around 4 percent in the most recent period.

Has China's rapid export growth and rising share in developed country markets since 1985 been the result of increasing competitiveness? Or does it reflect a natural process of shifting comparative advantage or market diversification, or just several cyclical downturns which reduced the competitiveness of China's more export-oriented competitors? The rest of the paper will look more closely at this phenomenon with the help of shift-share analysis which goes beyond the growth rates and shares in Table 4 by assessing China's performance against what might have been expected in comparison with a reference group of her competitors and looks specifically at the electronics industry.

TDB (2001).

III Shift-Share Analysis

Shift-share analysis has been used extensively to analyse differences between regional and national growth rates in variables such as export growth, employment and productivity.[9] Although a relatively simple technique with a number of well-documented shortcomings, it has proved to be a useful descriptive tool for isolating trends in regional performance and for supplying data for policymakers to interpret changes in the industrial structure of their economies.

The particular version of shift-share analysis used here is based on Wilson (2000) and utilizes the national growth rate methodology of Richardson (1978) and Esteban-Marquillas (1972) but combines it with the dynamic version of shift-share of Barff and Knight (1988). We focus on export growth over a period of time where the 'regions' are the competing east Asian NIEs (China, Hong Kong, Korea, Malaysia, Singapore, Taiwan) and the 'nation' is the combined group of these countries. For earlier SITC two-digit level shift-share studies of the manufacturing export competitiveness of the 'Dynamic Asian Economies' of Singapore, Malaysia, Thailand, Hong Kong, Korea and Taiwan, see DBSBank (1992), Wilson and Goh (1998), and Wilson (2000). For the Association of Southeast Asian Nations (ASEAN), see Wilson and Wong (1999).

As far as China is concerned, in an early analysis at the one and two-digit SITC levels, Herschede (1991) compared the export performance of China with six members of ASEAN and the NIEs (South Korea, Taiwan and Hong Kong) over the period 1982 to 1987. China did better than the combined group of Asian countries, largely at the expense of ASEAN, but the NIEs did even better still. Voon (1998) looked at Chinese export competitiveness relative to Indonesia, Malaysia, Singapore and Thailand (ASEAN4) between 1982 and 1994, distinguishing between agricultural products, primary products, less labour-intensive manufactured exports and more labour-intensive manufactured exports, and found evidence of some rivalry between

[9] For earlier reviews of the basic methodology of shift-share, see Richardson (1978), Esteban-Marquillas (1972), and Fothergill and Gudgin (1979). More recent contributions include Haynes and Machunda (1987) and Hayward and Erickson (1995).

China and ASEAN4. Although China and Malaysia stood out from the rest of the group, Malaysia did better than China in less labour-intensive manufactured exports while China did better than Malaysia in more labour-intensive manufactured exports.

In the present context the objective is to compare China's export performance in electronics against a reference group which includes her main Asian NIE competitors. Any difference between China's performance and that part of the total change in exports that might be ascribed to the rate of export growth of the reference group as a whole - the *share effect* - is referred to as the *export differential* or *shift effect* and is measured in absolute US dollar terms. A positive net shift implies an improvement in competitiveness relative to the reference group as a whole and a negative value constitutes a deterioration in competitiveness.

Shift-share is not a causal analysis and does not, in itself, identify the reasons behind any change in a country's performance as measured by the export differential, such as changes in its domestic cost structure or effective exchange rate. However, the export differential can be further decomposed into three additive factors: *the industry mix effect (IME); the competitive effect (CE);* and the *interaction effect (IE).* Iinspection of these components might shed some light on the structural characteristics which lie behind any overall positive or negative net shifts.

The *Industry mix effect* (IME) shows how much of the export differential is due to a divergence between the competing economy's economic structure and the reference group. It will be positive if a country's share of exports in fast growing industries is larger than the reference group or its share in slow growing industries is smaller. On the other hand, the mix effect will be unfavorable if the economy is dominated by relatively slow growing industries or it has a dearth of fast growing ones.

The *Competitive effect* (*CE*) shows how much of the export differential is due to a difference between the export growth rate of the particular country and the group as a whole. In other words, it captures the contribution due to the special dynamism of that sector in the individual country compared with the

growth of that sector at the reference group level. If a country's growth exceeds the rate for the group, the effect is positive and it is deemed to have a *competitive advantage* in that product category.

Finally, the *Interaction effect* (IE)[10] shows how much of the export differential is attributable to a combination of the industry mix effect and the competitive effect or a combination of economic structure and competitiveness. It indicates whether the country is specialized in those sectors in which it also enjoys a competitive advantage and will take on a positive value if either the competing economy specializes on exports in which it has a competitive advantage or produces little of the exports in which it has no such advantage.

Further details on the formula used to calculate the shift-share results can be found in Appendix B.

Most studies using shift-share methods are comparative static in that they only consider changes in the variable of interest, such as exports, between the beginning and the terminal years of the time period under investigation. For example: Herschede (1991), DBSBank (1992), Voon (1998) and Wilson and Goh (1998). The standard procedure is to use the industry mix at the start of the period to calculate the industry mix effect over the whole period, or to adopt an arbitrary compromise by averaging over the period in some way. This can be a problem if there are significant changes in industrial structures over time as one would expect for the economies considered in this paper. Failure to take into account changes in the size of a country's total exports over the period can also lead to problems if these exports grow faster or slower than those of the reference group. If they grow faster then the comparative static approach will assign too little of the export growth to the 'share effect' and vice versa if a country's exports grow more slowly than the group.[11] Only by applying an annual growth rate to a country's exports at the beginning of the year can the share effect be accurately measured.

In this study dynamic shift-share analysis is used. This variation of shift share allows growth rates and industry mixes to vary over the time period and so takes these factors into account by automatically updating the industry mix component each year and allowing for changes in the size of total exports in

[10] Sometimes called the 'allocative effect'.

each of the countries in the sample. Moreover, by providing a *continuous* picture of the evolution of the export differential and its components over time using annual growth rates, the analysis can help to Identify any structural breaks that may have occurred during the period under investigation and any trends in export competition between reference economies, rather than simply identifying the direction of the net shift between the start and end period.

IV Empirical Analysis

Dynamic shift-share analysis is applied to five 3-digit export categories of electronics as well as to total electronics exports for the six reference economies selling to the USA, EU and Japan between 1988 and 2001.[12]

Total exports were used for all the reference economies except Singapore and Hong Kong. For most countries where the import content of exports is relatively small, the use of gross export data would be perfectly adequate to capture the contribution that exports make to the domestic economy. In the case of Singapore, since a substantial part of its trade (particularly with other Asian countries) has historically taken the form of entrepot exports, we use domestic exports instead, which automatically excludes re-exports. This gives a more accurate representation of changes in export competitiveness insofar as it captures the exports that Singapore generates from its own industrial base.[13]

A similar problem arises with respect to Hong Kong, which reverted to Chinese sovereignty in 1997. The rather special characteristics of the Hong Kong economy mean that it continues to be treated independently in empirical work on trade. But, since a large proportion of Hong Kong's manufacturing production, particularly processing and assembly, has been shifted to mainland China since the early 1980s, this tends to overstate China's bilateral exports to the rest of the world which are measured inclusive of the Hong Kong component, and understate those of Hong Kong itself.[14]

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[11] See Barff and Knight (1988) for elaboration on this point.
[12] The export data was extracted from the UN Combase online database (http://unstats.un.org/unsd/comtrade).
[13] For a discussion of this problem and its importance to Singapore, see Sen (2000).
[14] On this issue see Ho (1998) and Fung and Lau (1998).

V Results

The export differential

Figure 1 provides a convenient visual representation of the evolution over time of the net shifts or export differentials for China's electronics exports, both in aggregate and by SITC 3-digit categories. To facilitate interpretation the differentials are left in absolute terms (millions of US dollars), but should be seen in the context of the scale used in each case. The primary task here is to ascertain whether there are any patterns in the profiles of the differentials across markets and product groups, rather than focusing on specific years, which may give a somewhat myopic picture of export performance or be sensitive to exceptional swings in the data. The full shift-share results for China are listed in Appendix B.[15]

The profiles in Figure 1 suggest that China has now emerged as a serious contender in electronics exports with an increasing number of positive export differentials in electronics as a whole across all three markets from 1992 onwards, but her position has not been a dominant one, primarily due to uneven performance across the product categories. China has been one of the top gainers in global trade over the past decade in consumer electronics and telecommunication equipment, which enjoyed sustained positive net shifts by the early 1990s. There was also a switch to positive differentials in disk drives, printers and PCs but only after 1996. But In the higher-end exports of printed circuit boards and semiconductors, China has not yet gained a significant stronghold in developed country markets. This is not surprising since China's manufactured exports in general are still relatively concentrated in lower-end categories of products such as clothing and textiles compared to the other more mature industrialized reference economies. High tech exports constituted only 18 percent of China's manufacturing exports in 2000, substantially less than the other more established manufacturers of Malaysia and Korea (Table 5).

Figure 2 shows China's performance in relation to her main competitors. For electronics as a whole the principal gainers after 1995 summed across the three export markets appear to be newcomers of China and Malaysia at the

expense of the older Tigers of Singapore and Hong Kong. Korea and Taiwan are more ambiguous and Taiwan's positive differentials overall are largely determined by sizeable absolute gains in the Japanese market in the late 1990's. After the 1998 Asian financial crisis, many Japanese electronics firms began to outsource their manufacturing operations and Taiwanese contract manufacturers were the main beneficiaries. However, Taiwan's net-shift plunged sharply into negative territory in 2001 as exports were hard hit by the global electronics downturn.

Singapore's overall electronics exports performed well between 1988 and 1995 in all markets compared to the reference economies coinciding with a period when there was substantial foreign investment in the electronics sector and positive spillovers from other economies in the region, which were expanding strongly over this period. These were the "golden" years for Singapore's electronics exports which benefited from her first-mover advantage by switching into higher-value added and capital-intensive electronics exports earlier than her competitors and gaining a significant foothold as an important production and export centre. However, the general trend of positive net shifts for Singapore electronics seems to have reversed around 1996 in all three export markets. In fact, Singapore was the only economy among the reference economies to experience continuous negative export differentials between 1996 and 2001. The only bright spot for Singapore was semiconductor exports, which saw small negative shifts between 1997 and 1999, and a large positive net shift in 2000, boosted by the opening of several wafer fabrication plants such as ST Microelectronics and Chartered Semiconductor Manufacturing (MAS, 2002).

Although China and Malaysia stand out in terms of overall performance in electronics since the mid-1990s, no single reference economy appears to have dominated all categories of electronics exports. In those product areas where China has become a serious competitor (Figure 2), Malaysia and Taiwan (and maybe Korea) are competitors with China in disk drives, printers and PCs; Taiwan in consumer electronics (positive differentials from 1996 are offset by a large negative value in 2000); and Malaysia and Korea in

[15] For reasons of space the full results for all reference countries are not reproduced here but can be

Telecommunications equipment. In the higher value-added sectors of semiconductors and printed circuit boards, where so far China has not been so competitive, Singapore, Taiwan and Malaysia dominate the former[16] while Malaysia, Korea and Taiwan are the key players in the latter.[17]

Decomposition of the export differential

A key advantage of shift-share analysis lies in its ability to identify both the overall pattern of a country's export growth relative to a reference group, and to decompose this performance in terms of its export structure (IME), competitiveness (CE) and the interplay between export structure and competitiveness (*IE*). This decomposition is summarised for China in Table 6 according to the sign of the effect and in Appendix A in absolute dollar terms for the three export destinations individually and in aggregate.

China's switch from negative to positive export differentials in the overall electronics market since the early 1990s has largely been underpinned by a strong CE effect, while the IME has generally been negative. The combination of a strong positive CE but a less-than-optimal industry mix resulted in large and negative IE's for China which dragged down China's overall export performance. However, If China can sustain rapid growth in exports and is able consolidate its industrial base, China's overall competitiveness can be expected to improve substantially in the future. Its low cost structure, an increasingly skilled workforce and an influx of technology and management skills associated with large foreign direct investment inflows, together with its recent entry into the WTO, places China in a very favourable position.

China's performance contrasts dramatically with that of Singapore (MAS 2002) whose earlier advantage in electronics was based on a favourable IME often combined with a relatively high export growth rate (positive CE) so the result was a positive IE embodying the combined effect of the export structure interacting with export growth. Increasingly in the 1990s, however, the situation began to reverse. While a positive IME was generally maintained,

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obtained from the authors on request.

[16] Malaysia's differentials after 1995 are overwhelmingly positive in semiconductors but the averages are turned negative by a very sizeable fall in 2000.

[17] To keep the number of graphs manageable those for semiconductors and printed circuit boards, where China's impact has so far been negligible, have not been shown.

the CE deteriorated significantly producing a negative IE and overall net shift. In other words, Singapore's exports were heavily concentrated in some electronics products which were growing at a respectable rate but slower than the reference economies.

VI Conclusion

The object of this paper has been to apply dynamic shift-share analysis to examine the export performance of China's electronics sector in relation to a reference group of east Asian NIEs which have become increasingly close competitors in the export markets of the USA, European Union and Japan between 1988 and 2001. Previous studies using shift-share methods have tended to focus on the one or two-digit export classification using comparative statics. By contrast, the present paper has looked at five three-digit electronics categories as well as electronics as a whole and applied dynamic shift-share.

Our findings suggest that China has now emerged as a serious contender in the export market for electronics goods but her position has not been a dominant one. Her main gains have been in consumer electronics and telecommunications equipment and to a lesser extent in disk-drives, printers and PCs; but in the higher-end exports of printed circuit boards and semiconductors, China has not yet gained a significant stronghold in developed country markets, at least to the extent that the growth in her overall exports and increase in market shares might suggest.

Moreover, China's switch from negative to positive export differentials in the overall electronics market since the early 1990s has been largely underpinned by strong export growth rather than a favourable industry mix. [18] Nonetheless, If China can sustain rapid growth in exports and is able consolidate its industrial base, China's overall competitiveness can be expected to improve substantially in the future. Its low cost structure, an increasingly skilled workforce and an influx of technology and management skills associated with

[18] It is interesting that in Herschede's (1991) earlier and broader shift-share analysis of China, ASEAN and the NIEs, China's less impressive performance compared to the NIEs was also based on a weaker industry mix effect.

large foreign direct investment inflows, together with its recent entry into the WTO, places China in a very favourable position.

Has China become a serious threat to her east Asian competitors in electronics exports?

For electronics as a whole, our results suggest that the principal gainers after 1995 across all three export markets appear to be the relative newcomers of China and Malaysia at the expense of the older Tigers: Singapore and Hong Kong. However no single reference economy seems to have dominated all categories of electronics exports by the second half of the 1990s.

Interpreted in this way, as growth in the older Asian tigers slows to its medium-term potential, their export performance is also likely to moderate relative to other economies in the region. This is a natural transition and is largely dictated by supply-side considerations. A negative export differential within a broad manufacturing category need not signify a loss of competitiveness overall but rather conceal a natural process of changing comparative advantage or a process of ‘catching-up’ as rising real wages and productivity results in a restructuring away from labour-intensive industries towards higher value-added activities within a given manufacturing category. This is also the case if the diversification takes the form of a movement out of manufacturing and into services, or into markets which may not be included in the analysis.

An important question is how long it will take before China catches up in higher value-added production and how successfully her competitors use the breathing space to make the necessary structural adjustments. Whilst shift-share analysis can be a useful tool for assessing broad changes in a country’s international ‘competitiveness’ over quite long time periods the results need to be interpreted with care. Shift-share is not a mechanistic tool signaling an inevitable process of success or failure to compete in international markets since any adverse movements in export competitiveness relative to the group as a whole can be changed by implementation of appropriate policies, such as trade liberalization, incentives for inward foreign direct investment, or export promotion.

Thus, whilst shift-share analysis can be a useful tool for assessing broad changes in a country's international 'competitiveness' over quite long time periods the results need to be interpreted with care. Shift-share is not a mechanistic tool signaling an inevitable process of success or failure to compete in international markets since any adverse movements in export competitiveness relative to the group as a whole can be changed by implementation of appropriate policies, such as trade liberalization, incentives for inward foreign direct investment, or export promotion. A negative export differential within a broad manufacturing category need not signify a loss of competitiveness overall but rather conceal a natural process of changing comparative advantage or a process of 'catching-up' as rising real wages and productivity results in a restructuring away from labour-intensive industries towards higher value-added activities within a given manufacturing category. This is also the case if the diversification takes the form of a movement out of manufacturing and into services, or into markets which may not be included in the analysis.

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An important question is how long it will take before China catches up in higher value-added production and how successfully her competitors use the breathing space to make the necessary structural adjustments. This, in turn, will depend on how quickly wages in China rise with productivity increases. Given a large potential labour supply from the rural sector and absence of price pressures from an appreciating currency it could be some time.

In the east Asian region, the less developed members of ASEAN would appear to be at most risk in the immediate future since they compete head on with China in lower end manufacturing and for FDI and are in danger of being 'leapfrogged' in the value-added chain. China has already overtaken ASEAN as a low cost export production base and attractor of FDI. The problem here is not simply higher relative costs in ASEAN but the fact that they are still too competitive with China both in their domestic markets and in third markets, including lower end electronics goods. Much will depend on their ability to

raise their value-added and find more niches which are complementary to China's manufacturing production rather than competing with it, and by improving the quality of their infrastructure and the transfer of technology from multinational corporations (MNCs).[19] The past record of Malaysia and Thailand in areas such as the automotive industry suggests that they are better placed than Indonesia and the Philippines, and the least developed members of ASEAN – Vietnam, Cambodia, Laos and Myanmar, but even Malaysia is finding it difficult to broaden its manufacturing base from over-reliance on low cost manufacturing and natural resources, and increase the technology transfer from MNCs.

Notwithstanding political tensions, the Asian tigers with close proximity to China are probably better placed to adjust to China's manufacturing dominance since they are no longer low cost back-end producers competing in 'commodities' but are already competing in front-end marketing, design, product innovation/differentiation, quality semiconductors, logistics/hub activities, and are integrating more successfully with China and finding complementarities. A large proportion of Taiwan's electronic products are now manufactured in China including those of electronics firm ACER, and Korean firms, such as Samsung, are also producing in the mainland.

Singapore does not have the advantage of geographic proximity to China, the natural resources of Malaysia, or the deeper financial markets of Hong Kong, but has an impressive record for adjusting to changes in the external environment and is currently nurturing high value-added manufacturing clusters in electronics, chemicals and bio-medical sciences, diversifying its exports to give them a more global and is continuing to promote Singapore as a premier financial centre.[20]

It is also important to bear in mind when assessing the 'China threat' that trade is not a zero sum game akin to a competitive sport since trade between a group of countries usually generates symbiotic benefits to all concerned depending on the direct and indirect stimuli through mutual imports. Thus whilst the NIEs are export competitors of China, China is simultaneously an

[19] Indonesia, for example, has been trying to establish itself as an attractive offshore base for Singapore's lower-end manufacturing under the umbrella of the 2003 free trade agreement between Singapore and the USA.

important market both for their final goods (Table 7) and for their intermediate exports which are ultimately destined for other markets, as well as a source for tourists and China-registered FDI.

Many of the east Asian economies, such as Singapore and Malaysia, have been major beneficiaries of 'growing neighbors' in the region in the last two decades due to relatively high trade openness and strong trade multiplier linkages with regional economies (Abeysinghe and Wilson, 2002). Moreover, the strong growth in these countries' exports to China has partly resulted from a strengthening in the production network within the region as they have been increasingly exporting intermediate components, such as semiconductors and disk drives, to other Asian countries which then assemble them into end products such as PCs and telecommunications equipment. MNCs typically decentralise their electronics production within the region in order to capitalise on the comparative advantage of each country. Higher-end intermediate electronics components (typically semiconductors), are produced in one country and are then shipped to the other Asian countries for assembly into final products for export to the developed country markets. Thus, whilst Singapore, for example, has seen a decline in the growth of its overall exports in recent years, this has been offset to some extent by a rise in the importance of intermediate exports of electronics components or re-exports to countries in the east Asian region, including China (Monetary Authority of Singapore, 2002).

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Appendix A: **The shift-share formula**

e=exports, i=export category, j=a competing country, then the change in exports of category i of competing economy j to a specific destination de_{ij} is given by the 'share effect' $s_{ij,}$ the 'industry mix effect' $m_{ij,}$ the 'competitive effect' c_{ij} and the 'interactive effect' $a_{ij:}$

$de_{ij} = s_{ij} + m_{ij} + c_{ij} + a_{ij}$

In other words, each sector of each country has a 'standard' growth component given by s_{ij} to which must be added the positive and negative contribution due to factors associated specifically with each country $(m_{ij} + c_{ij} + a_{ij})$

s_{ij} represents the change in exports which would have occurred if the structure of exports in the competing economy had followed the reference group (homothetic exports e'_{ij}) and its export category had grown (r_{ij}) at the corresponding group rate $r_{i0:}$

$s_{ij} = e'_{ij} r_{i0}$ where $e'_{ij} = e_{i0} \cdot e_{0j} / e_{00}$

e_{i0} = exports of i from the reference group 0

e_{0j} = total exports from the competing economy

e_{00} = total exports from the reference group

If $e_{ij} - e'_{ij}$ is positive the individual country is specialized relative to the group and vice versa if it is negative. Hence any difference between the actual changes in exports in sector i of country j and the 'share effect' s_{ij} represents the 'net shift' or 'shift effect' or 'export differential' ed_{ij} ascribed to the specific characteristics of the individual economy and is measured in absolute US dollar values.

$ed_{ij} = de_{ij} - s_{ij} = de_{ij} - e'_{ij} r_{i0} = e_{ij} r_{ij} - e'_{ij} r_{i0}$

A positive value for the export differential implies an improvement in competitiveness relative to the reference group and a negative value constitutes a deterioration in competitiveness. The export differential is in turn accounted for by the three additive components $m_{ij,}$ $c_{ij,}a_{ij.}$

The industry mix effect m_{ij} shows how much of the export differential is due to a divergence between the competing economy's economic structure compared to the reference group. It will be positive if a country's share of exports in fast growing industries is larger than the reference group or its

share in slow growing industries is smaller. On the other hand, the mix effect will be unfavorable if the economy is dominated by relatively slow growing industries or it has a dearth of fast growing ones:

$m_{ij} = r_{i0} (e_{ij} - e'_{ij})$

The competitive effect c_{ij} shows how much of the export differential is due to a difference between the export growth rate of the competing economy and the group. In other words the contribution due to the special dynamism of that sector in the individual country compared with the growth of that sector at the reference group level. If a country's growth exceeds the rate for the group the effect is positive and it has a competitive advantage in that product category.

$c_{ij} = e'_{ij} (r_{ij} - r_{i0})$

Finally, the interactive effect a_{ij} shows how much of the export differential is attributable to a combination of the industry mix effect and the competitive effect or economic structure and competitiveness. It indicates whether the country is specialized in those sectors in which it also enjoys a competitive advantage and will take on a positive value if either the competing economy specializes on exports in which it has a competitive advantage or produces little of the exports in which it has no such advantage:

$a_{ij} = (e_{ij} - e'_{ij}) (r_{ij} - r_{i0})$

Table 2: Exports of electronics by the Asian NIEs to the USA, EU and Japan in 2000

	752	759	7613	764	776	Electronics
% of exports						
China	5.9	1.6	7.9	4.8	1.3	21.5
Korea	9.3	8.8	2.8	6.7	13.7	41.3
Malaysia	11.1	14.6	10.5	7.2	16.8	60.2
Singapore	30.7	14.6	1.4	2.9	20.8	70.4
Hong Kong	0.1	2.4	0.0	0.4	11.6	14.5
Taiwan	22.0	13.8	1.2	5.7	14.7	57.4
Total Reference countries	12.5	8.2	5.0	5.4	10.6	41.7

Note: Exports for Singapore and Hong Kong refer to domestic exports; 752 is disk drives, printers and PCs, 759 is printed circuit boards, 7613 is consumer electronics, 764 is telecommunications equipment, 776 is semiconductors, total electronics includes SITC 752,759,7613,764,776.
Source: *IE Singapore.*

Table 1: Foreign direct investment inflows into China in a global context, 1985 to 2000

US$ billions	1985-89	1990-94	1995-99	2000	2001
World	640	1021	2977	1491	735
Developing	114	333	868	237	204
Asia	63	208	473	133	102
Share in developing countries total			(per cent)		
China	10.8	24.1	23.5	17.1	22.9
Hong Kong	13.0	6.9	7.8	26.0	11.1
Malaysia	3.4	6.6	3.0	1.6	0.3
Korea	3.0	1.2	2.5	3.9	1.6
Singapore	10.6	7.8	5.3	2.3	4.2
Taiwan	3.4	1.7	1.0	2.1	2.0
Japan	0.4	2.0	2.2	3.5	3.0
India	0.7	0.6	1.5	0.9	1.7
Share of Asian total			(per cent)		
China	19.7	38.5	43.2	30.5	45.9
Hong Kong	23.7	10.9	14.2	46.3	22.4
Malaysia	6.2	10.6	5.5	2.8	0.5
Korea	5.4	1.9	4.6	6.9	3.1
Singapore	19.2	12.4	9.8	4.0	8.4
Taiwan	6.2	2.8	1.9	3.7	4.0
Japan	0.8	3.3	4.1	6.2	6.1
India	1.3	1.0	2.8	1.7	3.3

Note Foreign direct investment (FDI) inflows are the sum of capital received from an FDI enterprise by a foreign investor and comprises: equity capital, reinvested earnings, and intra-company loans; Asia excludes Japan.
Source: *World Investment Report (2002)*, UNCTAD, www.unctad.org.

Table 3: The composition of China's exports of electronics to the USA, Japan and the EU 1990 to 2000

% of exports	1990	1995	2000
Disk drives, printers, PCs (SITC 752)	0.01	2.03	5.9
Printed circuit boards (SITC 759)	0.12	1.12	1.6
Consumer electronics (SITC 761-3)	0.75	3.75	7.9
Telecommunications equipment (SITC 764)	0.17	2.69	4.8
Semiconductors (SITC 776)	0.06	0.46	1.3
Total electronics	1.11	10.05	21.5

Source*: IE Singapore.*

Table 4: China's average export growth and market shares compared to the NIEs 1985-2000

	1985-1989		1990-1995		1996-2000	
Country	Export Share (%)	Export Growth (%)	Export Share (%)	Export Growth (%)	Export Share (%)	Export Growth (%)
China:						
USA	6.5	19.3	14.9	35.9	27.8	16.3
EU	17.3	27.5	18.7	24.0	29.7	15.2
Japan	26.2	12.0	30.4	23.1	42.5	8.5
Total	14.4	15.6	19.9	26.7	32.1	13.0
Global	22.2	19.8	24.2	19.2	30	11.4
HongKong:						
USA	19.1	6.1	9.7	-2.4	5.2	-2.4
EU	21.2	18.3	9.9	-2.9	4.9	-4.0
Japan	4.2	31.6	2.9	-1.0	1.3	-14.5
Total	15.8	11.6	8.0	-2.6	4.1	-4.1
Global	13.6	15.0	7.9	0.7	4.0	-4.5
Korea:						
USA	34.9	18.6	23.4	3.1	19.5	10.3
EU	24.9	25.6	19.1	13.3	20.1	7.8
Japan	31.9	32.3	26.4	4.7	20.1	5.5
Total	31.5	23.4	22.6	5.8	19.8	8.0
Global	26.4	20.5	21.9	12.6	22.4	6.9
Malaysia:						
USA	6.3	23.4	10.3	22.1	12.2	5.9
EU	11.5	15.4	11.7	17.7	13.1	5.2
Japan	15.0	2.7	12.5	15.4	12.9	8.4
Total	9.9	12.6	11.2	18.6	12.7	5.9
Global	10.9	13.6	11.8	19.8	12.9	6.2
Singapore:						
USA	12.1	23.3	13.9	12.5	12.9	-0.5
EU	10.3	29.5	13.4	17.4	13.3	1.8
Japan	8.3	13.9	8.0	15.6	7.2	3.5
Total	10.6	22.5	11.9	14.5	11.6	0.6
Global	11.5	18.0	12.2	16.3	11.2	3.0
Taiwan:						
USA	21.1	0.8	27.9	1.7	22.4	5.8
EU	14.8	18.0	20.6	6.3	18.8	8.9
Japan	14.4	14.5	19.6	7.1	15.9	7.3

Total	17.8	6.7	23.4	3.9	19.7	6.6
Global	15.4	11.2	22.1	9.2	19.4	6.3
Reference:						
USA	100	33.6	100	8.6	100	7.9
EU	100	32.6	100	17.8	100	8.2
Japan	100	28.6	100	12.1	100	6.6
Total	100	31.6	100	11.1	100	7.5
Global	100	29.1	100	13.5	100	6.9

Note: The export share numbers are the shares of each country as a percentage of the overall share of the reference group; the total figures refer to the sum of the USA, EU and Japan; for Taiwan the first period averages begin in 1987;
Source: *IE Singapore*.

Table 5: China's high-technology exports compared to other Asia-Pacific countries in 1997 and 2000

% of manufactured exports	1997	2000
Singapore	55.1	61.5
Malaysia	47.8	58.2
Korea	26.0	34.2
Hong Kong	20.8	22.8
China	12.7	18.4
Japan	25.9	28.1
East Asia & Pacific	26.5	31.6

Note: East Asia and the Pacific includes 24 developing countries in the East Asian and Pacific region; high technology exports involve high R&D intensity, such as aerospace, computers, pharmaceuticals, scientific equipment.
Source: World Bank World *Development Indicators database*, http://www.worldbank.org/data/

Table 6: The decomposition of the net shifts into positive and negative for China's global exports

SITC		88	89	90	91	92	93	94	95	96	97	98	99	0	1
752	IME	-	-	-	-	-	-	-	-	-	-	+	-	-	+
	CE	+	-	-	+	+	+	+	+	+	+	+	+	+	+
	IE	-	+	+	-	-	-	-	-	-	-	-	-	-	-
	NS	-	-	-	-	-	-	-	-	-	+	+	-	+	+
759	IME	-	+	-	-	-	-	-	-	-	-	-	-	-	+
	CE	-	+	-	+	+	+	-	-	+	+	+	-	-	+
	IE	+	-	+	-	-	-	+	+	-	-	-	+	+	-
	NS	-	+	-	-	-	+	-	-	+	+	-	-	-	+
7613	IME	-	-	+	-	-	-	-	-	+	+	-	+	+	-
	CE	+	+	+	+	+	+	+	+	+	+	+	-	+	-
	IE	-	-	-	-	-	-	-	-	-	-	+	-	+	-
	NS	-	+	+	+	+	+	+	+	+	+	+	-	+	-
764	IME	-	-	-	-	+	-	-	-	-	-	-	-	-	-
	CE	-	+	+	+	+	+	+	+	+	+	+	-	+	+
	IE	+	-	-	-	-	-	-	-	-	-	-	+	-	-
	NS	-	+	-	-	+	+	+	+	+	+	+	-	+	+
776	IME	-	-	-	-	+	-	-	-	+	-	+	-	-	+
	CE	+	-	+	+	+	+	+	+	+	+	+	+	+	+
	IE	-	+	-	-	-	-	-	-	-	-	-	-	-	-
	NS	-	-	-	-	+	-	-	-	+	-	+	-	-	+
E	IME	-	-	-	-	+	-	-	-	-	-	-	-	-	+
	CE	+	+	+	+	+	+	+	-	+	+	+	-	+	+
	IE	-	-	-	-	-	-	-	+	-	-	-	+	-	-
	NS	-	-	-	-	+	+	-	-	+	+	+	-	+	+

Key: 752: Disc drives, printers, PCs
759: Printed circuit boards
7613: Consumer electronics (SITC 761,762,763)
764: Telecommunications equipment
776: Semiconductors
E: Electronics (SITC 752+759+7613+764+776)

Table 7: The importance of China as a market for the Asian NIEs and supplier of imports 1985-2000

	Exports to China				Imports from China			
	1985	1990	1995	2000	1985	1990	1995	2000
	(percent of exports)				(percent of imports)			
Hong Kong	26.0	24.8	33.3	36.2	25.5	36.8	36.2	42.9
Korea	-	-	7.3	10.6	-	-	5.5	7.4
Malaysia	1.0	2.1	2.6	2.7	2.0	1.9	2.2	2.6
Singapore	1.5	1.5	2.3	3.9	8.6	3.4	3.2	5.2

Note: Data is unavailable for Taiwan.
Source: *Key Indicators of Developing Asian and Pacific Countries 2002*, Manila: Asian Development Bank, www.ADB.org

Figure 1: China's net shifts for electronics

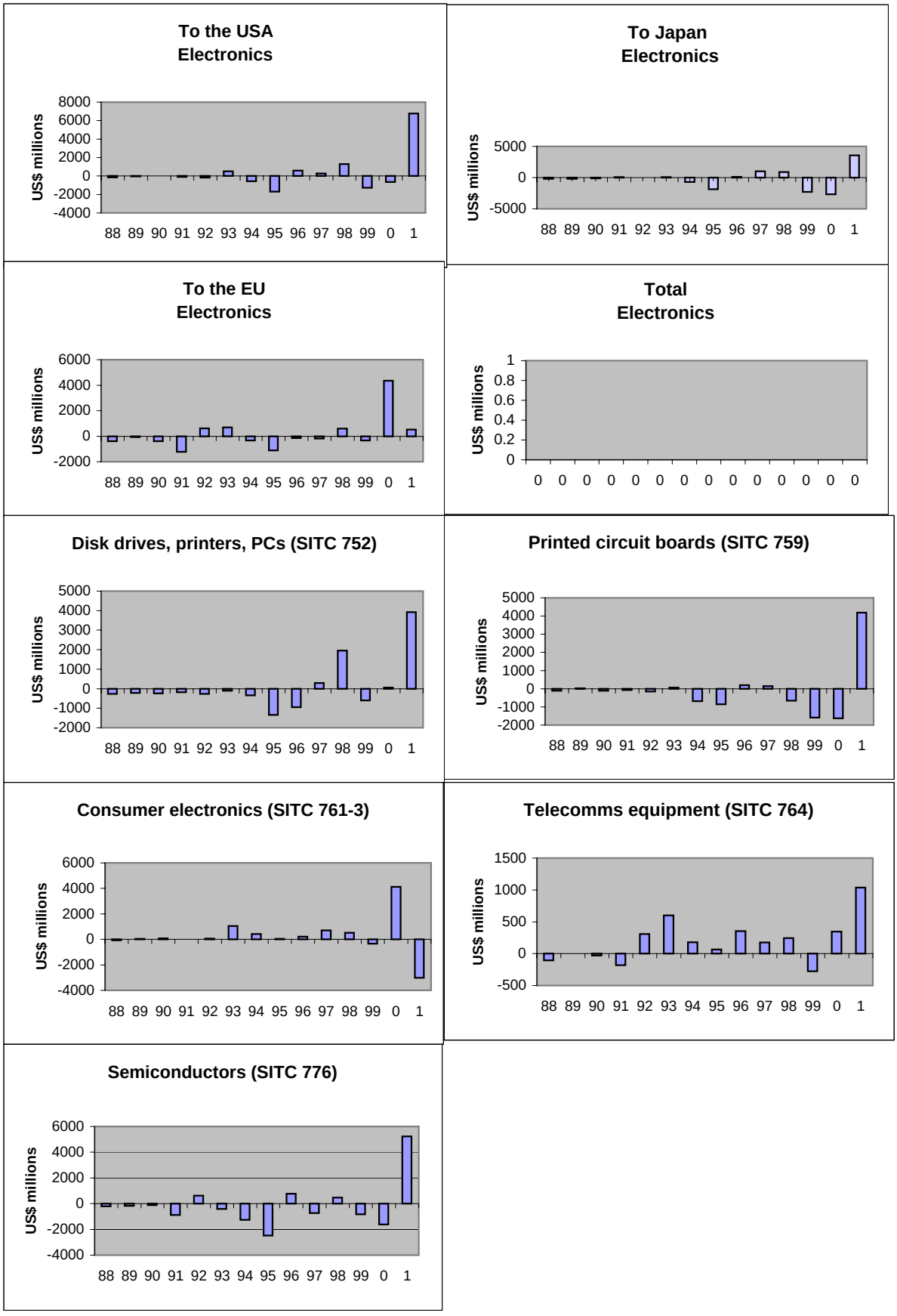
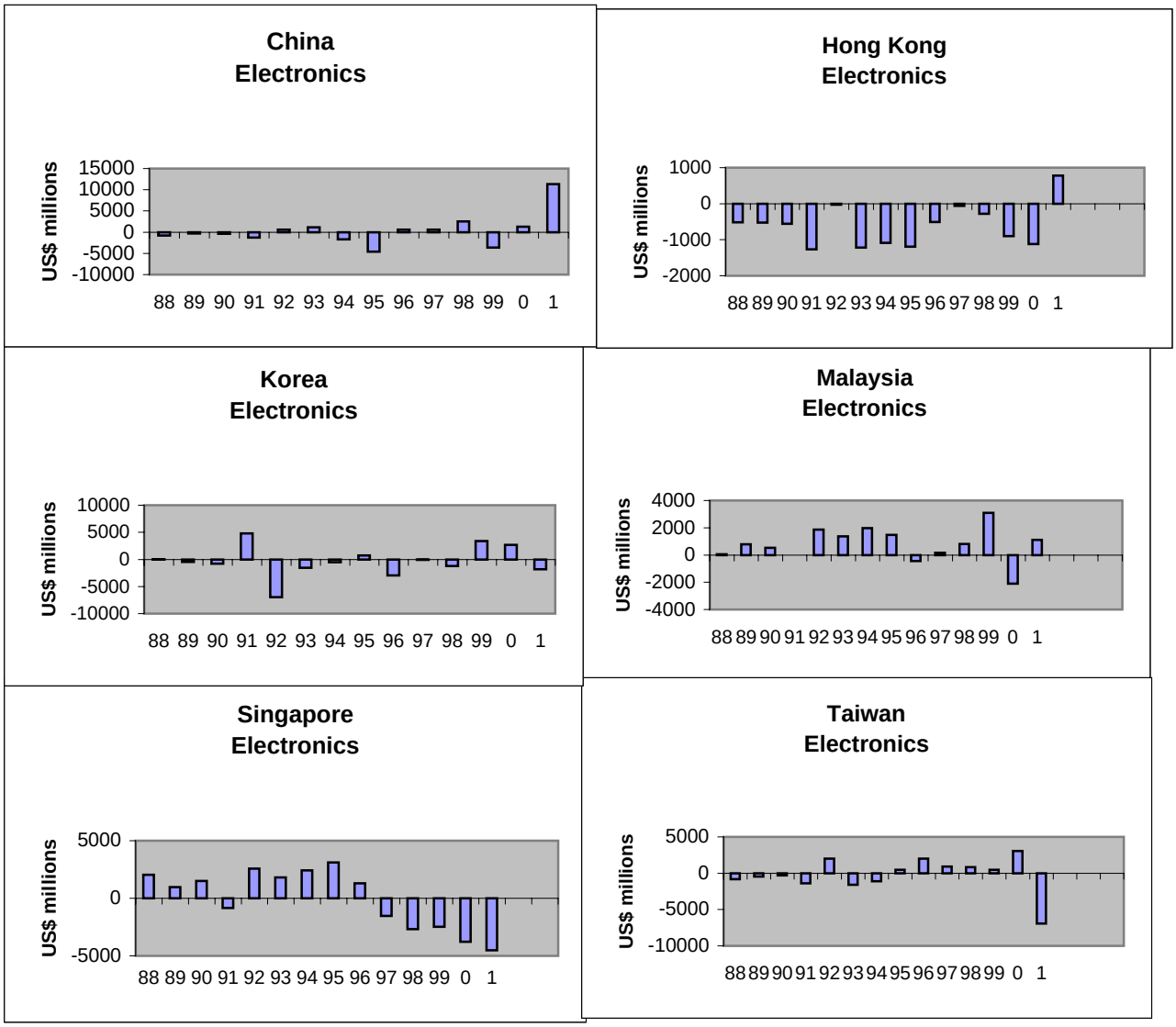
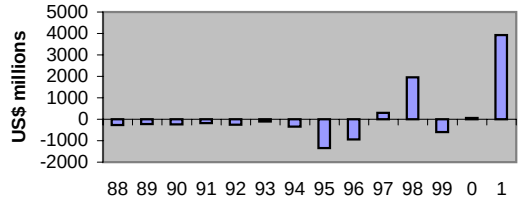


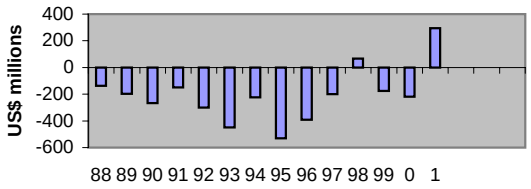
Figure 2: China and her main competitors in electronics



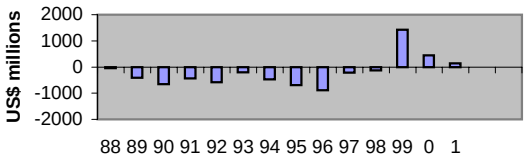
China
Disk drives, printers, PCs (SITC 752)



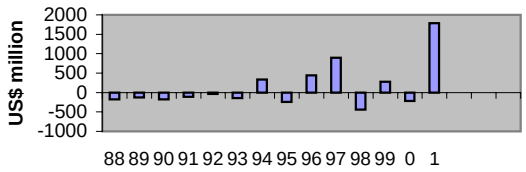
Hong Kong
Disk drives, printers, PCs (SITC 752)



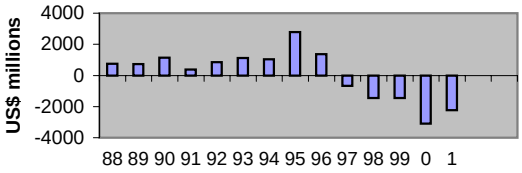
Korea
Disk drives, printers, PCs (SITC 752)



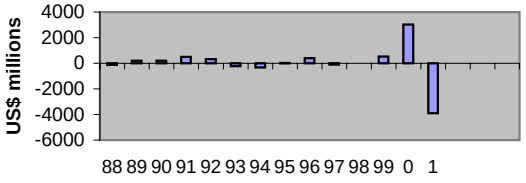
Malaysia
Disk drives, printers, PCs (SITC 752)



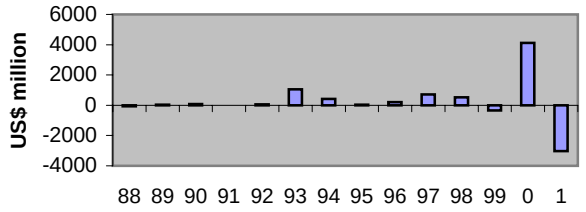
Singapore
Disk drives, printers, PCs (SITC 752)



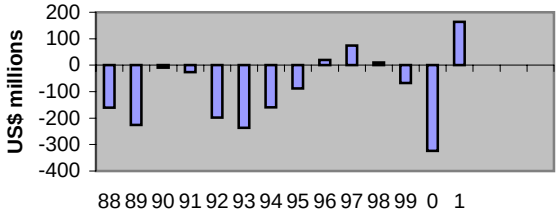
Taiwan
Disk drives, printers, PCs (SITC 752)



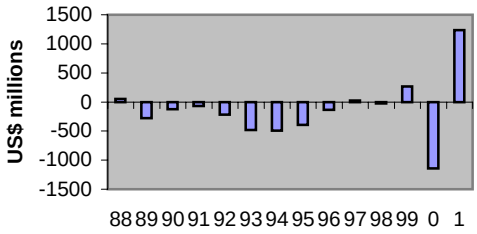
China
Consumer electronics (SITC 761-3)



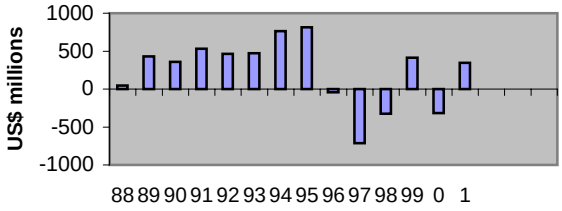
Hong Kong
Consumer electronics (SITC 761-3)



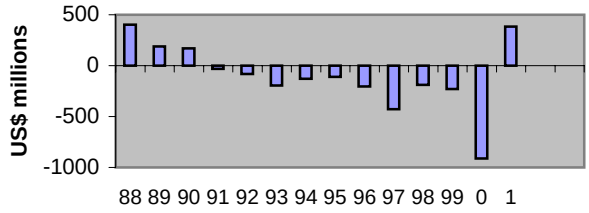
Korea
Consumer electronics (SITC 761-3)



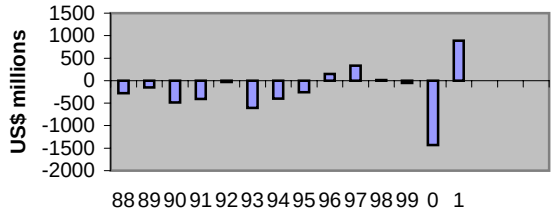
Malaysia
Consumer electronics (SITC 761-3)



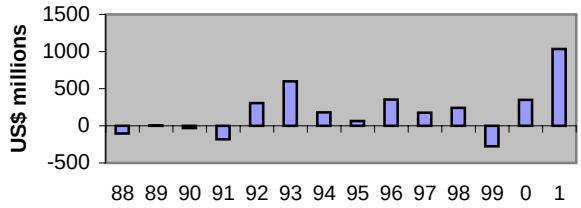
Singapore
Consumer electronics (SITC 761-3)



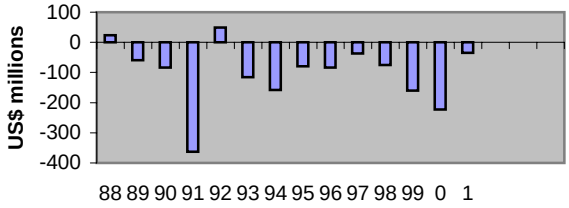
Taiwan
Consumer electronics (SITC 761-3)



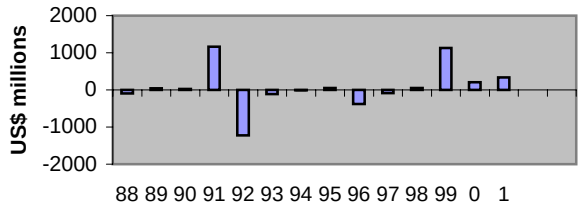
China
Telecomms equipment (SITC 764)



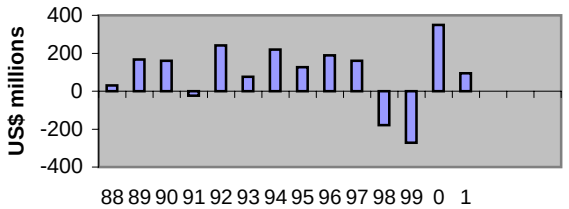
Hong Kong
Telecomms equipment (SITC 764)



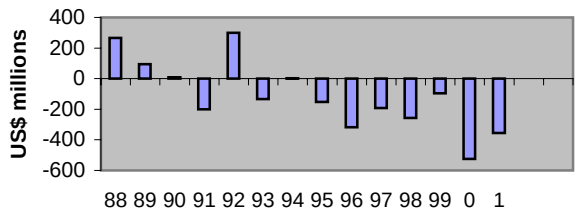
Korea
Telecomms equipment (SITC 764)



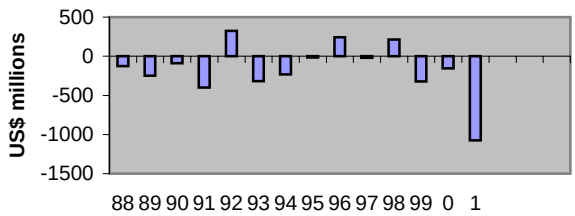
Malaysia
Telecomms equipment (SITC 764)



Singapore
Telecomms equipment (SITC 764)



Taiwan
Telecomms equipment (SITC 764)



APPENDIX B

Shift-Share Results for China 1988-2001

To the United States ($ millions)

Disk drives, printers and PCs (SITC 752)

	88	89	90	91	92	93	94	95	96	97	98	99	0	1
Industry mix effect	-54.2	-76.6	-46.8	-49.9	-107.2	-175.3	-202.1	-622.7	-541.0	-481.5	182.6	-294.3	-253.0	657.9
Competitive effect	1713.835	34.46015	30.10432	4296.131	1158.558	1544.839	1198.24	2167.149	468.7014	2963.356	2694.122	669.3208	1867.574	838.9021
Interactive effect	-1712.77	-34.2702	-29.9578	-4277.72	-1121.53	-1447.36	-1096.21	-1909.79	-375.489	-2355.74	-1908.01	-401.574	-1035.53	-389.654
Export differential	-53.135	-76.4048	-46.6575	-31.4764	-70.1929	-77.7935	-100.038	-365.333	-447.741	126.1061	968.7109	-26.5683	579.0761	1107.101

Printed circuit boards (SITC 759)

Industry mix effect	-26.6	12.2	-15.3	-31.6	-85.1	-117.4	-344.1	-304.6	25.0	-18.9	-155.5	-319.0	-759.1	1186.059
Competitive effect	-51.3763	152.5492	-23.4957	11.05702	271.3837	1039.095	5.178942	-312.467	1584.882	429.7294	158.5562	-738.793	-357.65	4130.3
Interactive effect	44.06133	-140.466	19.93154	-9.88986	-245.545	-902.018	-4.08247	252.2827	-1329.55	-314.587	-113.723	538.9495	281.5308	-3373
Export differential	-33.8912	24.29235	-18.9083	-30.4704	-59.2541	19.66248	-343.027	-364.739	280.2969	96.26614	-110.637	-518.842	-835.189	1943.382

Consumer electronics (SITC 761-3)

Industry mix effect	-9.8	-9.5	35.7	-12.1	-31.4	-54.4	-47.1	-0.1	-5.6	-17.3	10.9	87.1	116.4	1.6
Competitive effect	204.5854	499.5097	42.41065	9.167784	112.8193	2161.782	465.5462	65.92039	205.7234	339.8001	138.1869	-152.822	155.5322	177.1087
Interactive effect	-196.482	-456.953	-31.872	-6.87282	-87.641	-1652.58	-119.68	-1.31399	6.255646	51.27334	53.07397	-62.5787	41.09705	50.88164
Export differential	-1.65751	33.04725	46.24683	-9.76343	-6.26328	454.7685	298.768	64.50645	206.4028	373.8139	202.1481	-128.349	312.9949	229.5471

Telecommunications equipment (SITC 764)

Industry mix effect	-17.9	9.3	7.9	20.1	-12.4	-32.5	-62.0	-4.3	-1.5	-2.0	-63.8	-137.5	-223.2	-33.2
Competitive effect	-72.609	313.1418	393.8439	116.0494	401.716	1863.83	377.7616	77.19198	172.1533	-112.313	148.1978	-48.9329	-80.4728	548.1132
Interactive effect	71.20726	-309.882	-384.028	-108.673	-367.436	-1541.98	-146.284	-13.753	-19.4312	3.419527	-35.1951	11.84426	20.48226	-174.538
Export differential	-19.2988	12.5148	17.67087	27.51138	21.87551	289.3726	169.4385	59.17855	151.2617	-110.887	49.23355	-174.581	-283.168	340.4115

Semiconductors (SITC 776)

Industry mix effect	-43.7565	-33.3321	2.409642	-61.3357	-65.9265	-179.001	-607.526	-1123.52	394.4668	-253.918	102.9807	-568.316	-474.603	2935.476
Competitive effect	218.6008	186.1452	83.35088	221.8835	698.4151	107.2796	1110.893	1069.832	410.7091	1003.973	2000.74	3275.808	811.8706	2438.883
Interactive effect	-217.598	-184.472	-82.3312	-219.08	-687.142	-104.339	-1091.28	-1044.28	-398.097	-972.054	-1930	-3121.59	-749.503	-2238.12
Export differential	-42.7532	-31.6586	3.42934	-58.5317	-54.6538	-176.06	-587.913	-1097.97	407.0792	-221.999	173.7234	-414.098	-412.236	3136.239

Electronics (SITC 752+759+7613+ 764+776)

Industry mix effect	-152.706	-95.2224	-6.60605	-133.121	-302.98	-554.576	-1243.08	-1606.63	-49.0507	-581.948	-99.5298	-1416.84	-1964.25	3400.272
Competitive effect	63.60766	1746.274	118.2485	477.1739	1916.075	10544.2	2928.241	-336.66	2313.168	2716.184	4162.494	400.768	3348.117	7818.622
Interactive effect	-61.637	-1689.26	-109.861	-446.783	-1781.58	-9479.67	-2247.93	238.9347	-1666.82	-1870.94	-2779.78	-246.362	-2022.39	-4462.21
Export differential	-150.736	-38.209	1.781248	-102.731	-168.489	509.9497	-562.772	-1704.36	597.2997	263.2996	1283.179	-1262.44	-638.522	6756.68

To Japan (US$ millions)

	88	89	90	91	92	93	94	95	96	97	98	99	0	1
Disk drives, printers and PCs (SITC 752)														
Industry mix effect	-11.9964	-19.1152	-24.7895	-24.0173	-12.4573	-172.276	-173.964	-806.141	-97.8511	239.3404	174.3792	-659.151	-769.954	376.1731
Competitive effect	17.22417	-35.9183	-47.0734	23727.02	-68.9657	3552.932	-80.0021	233.0487	200.0041	488.9931	437.2325	-912.231	721.3252	2768.906
Interactive effect	-17.1506	35.64145	47.0243	-23720.6	64.52262	-3474.78	61.56291	-191.195	-159.421	-382.812	-322.834	627.5965	-564.24	-2026.09
Export differential	-11.9229	-19.3921	-24.8386	-17.6173	-16.9004	-94.1198	-192.403	-764.287	-57.2678	345.5218	288.7777	-943.786	-612.869	1118.985
Printed circuit boards (SITC 759)														
Industry mix effect	-19.1554	-13.2856	-17.5656	-10.8447	-29.1673	-26.1702	-93.8214	-170.57	-87.9808	80.05821	-96.8967	-383.203	-709.174	644.9448
Competitive effect	-19.5976	104.4076	37.60243	85.22161	95.73396	576.2393	-48.9114	39.52909	109.2508	321.4236	237.8057	-690.858	-573.089	723.6772
Interactive effect	19.29679	-103.384	-36.605	-82.1177	-89.5923	-520.863	32.7306	-29.3512	-79.6718	-225.616	-141.929	367.8596	400.083	-551.736
Export differential	-19.4562	-12.2617	-16.5682	-7.74074	-23.0256	29.20645	-110.002	-160.392	-58.4018	175.8659	-1.01999	-706.201	-882.18	816.8859
Consumer electronics (SITC 761-3)														
Industry mix effect	-54.8252	-33.7995	56.59245	-37.0783	-4.88123	-73.9218	-45.6335	-128.649	16.81165	87.80576	0.41012	-51.3793	-90.1938	-61.9902
Competitive effect	-52.9554	102.4462	385.2978	198.3825	40.30424	450.7424	-56.9603	-15.0732	-14.4003	169.2894	206.5003	-188.708	-55.3005	570.689
Interactive effect	51.07813	-100.19	-371.168	-165.896	-26.1079	-278.981	13.2086	5.678228	5.655605	-71.8736	-74.0934	50.85252	18.75514	-205.297
Export differential	-56.7025	-31.5433	70.72262	-4.59152	9.315079	97.83949	-89.3852	-138.044	8.066925	185.2215	132.817	-189.235	-126.739	303.4021
Telecommunications equipment (SITC 764)														
Industry mix effect	-41.703	-40.8692	-6.30534	-18.6961	-14.3658	-35.6512	-6.32688	-1.5008	2.334156	3.412435	-5.48492	1.809936	91.26443	78.87352
Competitive effect	-38.4985	386.8782	-8.23008	127.5475	571.2506	478.0666	80.02653	28.90716	100.4645	91.08694	80.75109	119.2468	-53.418	194.1854
Interactive effect	36.82709	-375.242	7.350948	-115.459	-486.731	-256.505	-3.28671	-0.246	1.76964	7.87815	6.953576	8.897227	-15.6029	49.75843
Export differential	-43.3744	-29.2329	-7.18448	-6.60742	70.15347	185.9104	70.41294	27.16036	104.5683	102.3775	82.21974	129.954	22.2435	322.8
Semiconductors (SITC 776)														
Industry mix effect	-71.7793	-93.387	-151.7	93.8673	-24.8213	-168.378	-350.25	-854.041	37.80433	62.32883	377.6639	-570.166	-1246.03	928.1701
Competitive effect	-95.4233	-240.858	867.8487	1837.169	83.25355	1070.3	-106.101	291.3437	1306.378	1129.506	137.5827	-104.317	1187.696	479.0741
Interactive effect	94.06477	238.6648	-865.462	-1823.97	-80.2531	-1030.62	97.98539	-272.986	-1214.59	-1009.39	-117.607	89.50767	-1010.77	-386.169
Export differential	-73.1378	-95.5797	-149.313	107.0689	-21.8209	-128.698	-358.366	-835.683	129.5881	182.4449	397.64	-584.975	-1069.1	1021.075
Electronics (SITC 752+759+7613+ 764+776)														
Industry mix effect	-199.792	-200.288	-138.526	-5.47833	-83.7755	-463.997	-659.267	-1708.05	-197.647	421.3465	341.7489	-1384.85	-2450.57	1256.984
Competitive effect	-198.155	749.5549	341.1969	1767.405	885.071	3078.719	-51.3588	-461.762	1000.089	1589.874	1358.492	-1983.63	-553.728	6102.089
Interactive effect	193.3524	-737.277	-329.853	-1691.41	-783.574	-2524.58	30.883	298.5671	-675.888	-1019.79	-799.806	1074.236	335.6566	-3775.91
Export differential	-204.594	-188.01	-127.182	70.51195	17.72167	90.13809	-679.743	-1871.25	126.5538	991.4317	900.4344	-2294.24	-2668.65	3583.165

To the European Union (US$ millions)

Disk drives, printers and PCs (SITC 752)

	88	89	90	91	92	93	94	95	96	97	98	99	0	1
Industry mix effect	-178.002	-29.506	-157.858	-121.118	-109.738	-25.6065	-139.628	-472.476	-547.873	-371.411	-22.2693	-56.8175	-225.375	540.6627
Competitive effect	1854.708	4.544852	-383.367	13166.95	611.0228	3701.731	901.303	1363.892	1467.015	1578.05	1876.238	468.2731	321.4595	1879.17
Interactive effect	-1853.88	-4.53462	382.4845	-13154.5	-594.008	-3586.27	-814.837	-1184.56	-1161.86	-1105.28	-1138.43	-221.772	-135.105	-837.859
Export differential	-177.177	-29.4958	-158.74	-108.714	-92.723	89.85613	-53.1612	-293.141	-242.714	101.36	715.5381	189.6836	-39.0201	1581.974

Printed circuit boards (SITC 759)

Industry mix effect	-36.9811	-25.9826	-69.598	-47.3578	-40.6486	-77.2358	-140.98	-242.07	-41.4205	-100.35	-461.968	-431.548	-109.707	819.5918
Competitive effect	1313.829	1312.698	-106.304	7829.571	57.08992	904.9526	-60.8119	-159.495	-101.784	98.28182	-76.5656	-69.8412	486.4503	2841.27
Interactive effect	-1313.75	-1311.63	105.3349	-7795.51	-43.9759	-759.625	40.72112	115.4483	76.68463	-76.3729	59.82997	56.34463	-394.786	-2284.45
Export differential	-36.9021	-24.9121	-70.5673	-13.2967	-27.5346	68.09183	-161.07	-286.117	-66.5195	-78.441	-478.704	-445.045	-18.0426	1376.408

Consumer electronics (SITC 761-3)

Industry mix effect	-53.0021	32.27212	-89.6597	32.41077	26.0508	-85.4376	1.478554	-2.595	-0.26122	12.97565	-2.73214	15.40321	208.8296	-2250.75
Competitive effect	329.8431	54.16601	220.088	-122.304	208.6141	3253.147	234.4646	20.40511	-34.3875	152.7763	173.8937	-41.0378	3516.675	-635.521
Interactive effect	-312.513	-49.2096	-197.046	103.5648	-171.368	-2678.93	-41.6809	-0.99501	0.429615	-10.4902	3.732917	-6.37377	356.8448	-740.297
Export differential	-35.6716	37.22852	-66.6176	13.67146	63.29704	488.7744	194.2622	16.8151	-34.2191	155.2617	174.8944	-32.0084	4082.349	-3626.57

Telecommunications equipment (SITC 764)

Industry mix effect	-48.8107	-24.516	-51.2894	-242.934	138.6869	-76.0453	-56.9467	-78.1503	-3.25205	-21.6133	0.191372	-70.9698	-132.392	-7.86041
Competitive effect	53.03753	1822.962	-147.386	413.134	445.1483	2201.051	-10.3526	46.71467	154.9717	415.3131	247.7302	-53.0627	1042.935	313.1318
Interactive effect	-52.9099	-1816.85	141.2644	-407.681	-427.368	-2002.74	5.515988	-27.453	-86.218	-199.828	-71.8982	9.366897	-217.461	22.99824
Export differential	-48.683	-18.3997	-57.4114	-237.481	156.4673	122.2667	-61.7833	-58.8886	65.50163	193.8719	176.0234	-114.666	693.0818	328.2697

Semiconductors (SITC 776)

Industry mix effect	-85.6535	-35.4582	-27.9671	-871.176	508.6004	-93.2733	-276.117	-489.884	100.0517	-570.846	-11.3889	-53.3691	-469.03	816.8491
Competitive effect	676.4175	5.897402	247.8726	-829.927	2101.331	338.0755	675.3525	-125.731	912.5751	517.2553	194.3915	2275.027	874.3164	326.3319
Interactive effect	-675.428	-5.86867	-246.628	822.6622	-2091.96	-330.573	-658.612	121.207	-881.625	-490.293	-182.907	-2142.16	-780.704	-286.465
Export differential	-84.664	-35.4295	-26.7228	-878.441	517.9708	-85.7711	-259.377	-494.408	131.0022	-543.884	0.095974	79.50064	-375.417	856.7157

Electronics (SITC 752+759+7613+ 764+776)

Industry mix effect	-397.363	-77.8223	-395.635	-1199.48	490.993	-369.21	-524.416	-1101.54	-467.225	-742.006	-324.121	-707.796	-2153.19	1269.041
Competitive effect	693.0936	222.2017	437.9826	-554.705	2169.077	13214.62	615.7417	-47.384	1058.462	1696.592	2484.743	925.2481	14551.34	-994.986
Interactive effect	-678.828	-215.388	-422.406	529.9222	-2042.59	-12162.2	-432.455	33.18628	-738.186	-1126.42	-1572.77	-539.987	-8055.2	242.7422
Export differential	-383.098	-71.0085	-380.059	-1224.26	617.4775	683.218	-341.129	-1115.74	-146.949	-171.831	587.8484	-322.535	4342.951	516.7971

Total (US$ millions)

Disk drives, printers and PCs (SITC 752)

	88	89	90	91	92	93	94	95	96	97	98	99	0	1
Industry mix effect	-272.814	-218.43	-242.694	-218.3	-308.75	-399.641	-540.124	-1900.54	-1368.02	-864.012	305.8322	-820.683	-1046.95	1709.937
Competitive effect	4462.211	-7.15234	-309.117	20532.82	1958.473	7941.721	2160.972	4635.641	2253.466	5251.078	5526.903	550.8574	2556.279	4656.248
Interactive effect	-4460.21	7.133338	308.3379	-20495.7	-1909.29	-7649.39	-1960.44	-4082.63	-1828.95	-4092.44	-3881.53	-326.567	-1450.47	-2445.77
Export differential	-270.813	-218.449	-243.473	-181.146	-259.564	-107.309	-339.59	-1347.53	-943.502	294.6222	1951.202	-596.393	58.85275	3920.413

Printed circuit boards (SITC 759)

Industry mix effect	-106.732	3.561985	-100.511	-110.007	-196.039	-279.682	-652.194	-783.464	-88.206	-69.9783	-767.842	-1196.51	-1581.66	2708.334
Competitive effect	-172.339	529.3191	-100.694	908.23	420.5026	2902.086	-141.624	-353.836	1510.855	903.7872	447.2096	-1521.85	-233.272	7534.827
Interactive effect	164.2779	-515.947	95.0288	-870.337	-375.707	-2565.59	107.4595	281.0539	-1229.78	-690.804	-332.419	1133.018	183.4322	-6052.5
Export differential	-114.793	16.93427	-106.177	-72.1139	-151.243	56.81814	-686.358	-856.246	192.8688	143.0045	-653.051	-1585.34	-1631.5	4190.657

Consumer electronics (SITC 761-3)

Industry mix effect	-92.2732	-13.6675	37.3825	-15.1402	-13.1524	-227.49	-95.0489	-49.1642	34.92686	66.63976	-2.30759	62.19987	94.71183	-1062.33
Competitive effect	607.5421	682.3884	418.1172	115.9318	403.534	6154.389	696.121	101.7168	210.887	737.0793	510.6206	-354.188	3902.66	-1237.42
Interactive effect	-582.582	-635.238	-368.895	-97.3555	-324.111	-4878.13	-184.456	-16.3018	-30.6681	-97.9073	10.78013	-44.9785	127.0867	-718.329
Export differential	-67.3134	33.48323	86.60438	3.436143	66.27044	1048.769	416.6163	36.25081	215.1458	705.8118	519.0931	-336.967	4124.458	-3018.08

Telecommunications equipment (SITC 764)

Industry mix effect	-101.809	-19.7095	-32.3642	-198.734	159.1737	-145.827	-155.403	-84.0686	-27.9118	-22.4732	-40.6896	-151.229	-272.817	-27.4185
Competitive effect	-144.98	2212.622	89.00037	396.3824	1971.405	3455.331	532.4812	209.29	500.8405	231.172	333.7743	-142.478	723.5797	1187.317
Interactive effect	142.9551	-2190.56	-84.9519	-377.541	-1824.09	-2708.7	-197.293	-59.6223	-118.385	-32.6396	-50.4812	19.42354	-103.405	-124.645
Export differential	-103.834	2.356847	-28.3157	-179.893	306.4904	600.8053	179.7855	65.59912	354.5438	176.0593	242.6034	-274.284	347.3568	1035.253

Semiconductors (SITC 776)

Industry mix effect	-206.397	-158.783	-106.058	-885.317	590.4928	-468.673	-1286.88	-2533.93	628.2068	-886.146	405.3824	-1138.19	-2039.09	4808.004
Competitive effect	156.2642	-25.4597	779.1489	987.0458	2277.505	1950.674	944.1583	1402.772	3497.162	2770.89	945.404	4437.779	4167.484	3354.545
Interactive effect	-155.406	25.2998	-774.592	-978.363	-2245.79	-1899.53	-912.956	-1353.13	-3353.84	-2613.09	-880.552	-4125.84	-3748.6	-2936.12
Export differential	-205.539	-158.943	-101.502	-876.634	622.2062	-417.526	-1255.68	-2484.29	771.5333	-728.349	470.2347	-826.248	-1620.2	5226.43

Electronics (SITC 752+759+7613+ 764+776)

Industry mix effect	-776.465	-400.371	-430.234	-1389.65	204.8292	-1528.98	-2625.85	-4559.85	-732.686	-1238.66	-212.431	-3532.72	-6574.97	6586.239
Competitive effect	726.1511	3315.238	940.9304	1900.685	6117.997	29171.62	3573.664	-92.6543	4736.089	5886.927	8059.08	-220.434	19681.53	9190.097
Interactive effect	-711.979	-3239.48	-903.559	-1817.38	-5738.67	-26461.1	-2633.04	66.2928	-3412.81	-4057.11	-5316.57	133.922	-11827.6	-4421.66
Export differential	-762.292	-324.617	-392.862	-1306.35	584.1607	1181.558	-1685.23	-4586.22	590.5898	591.149	2530.082	-3619.24	1278.968	11354.68

Figure 1: Singapore's net shifts for electronics by destination

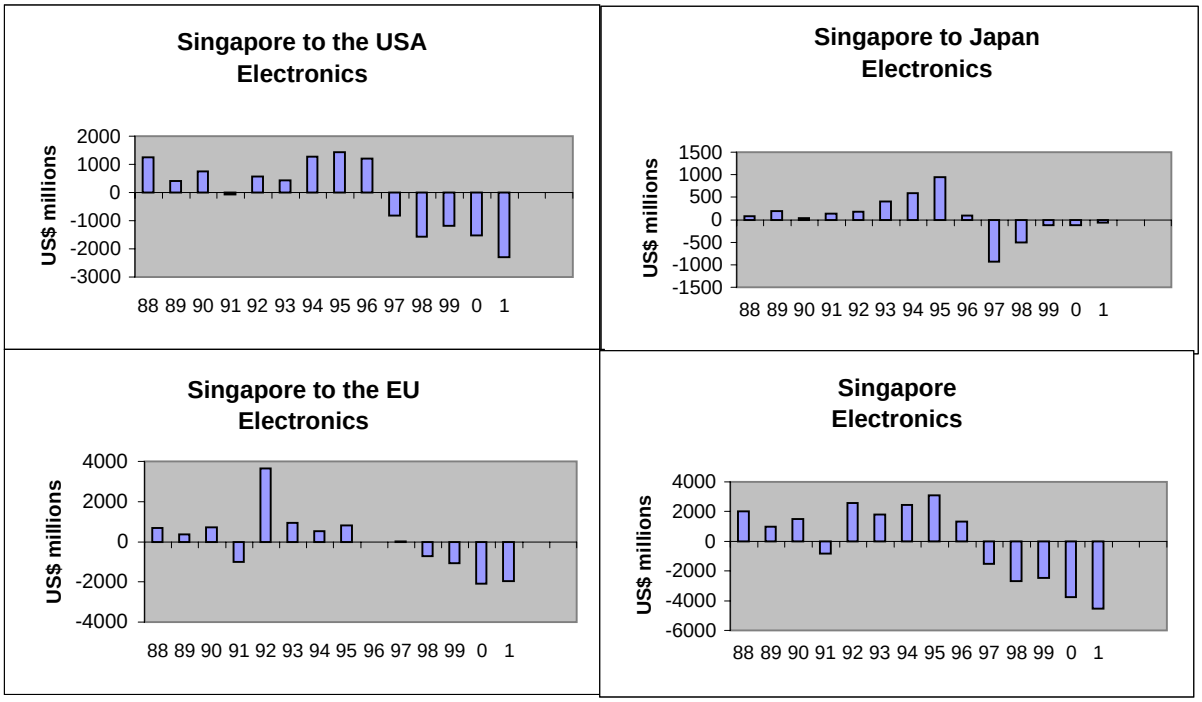


Figure 2:Singapore's net shifts for categories of electronics exports

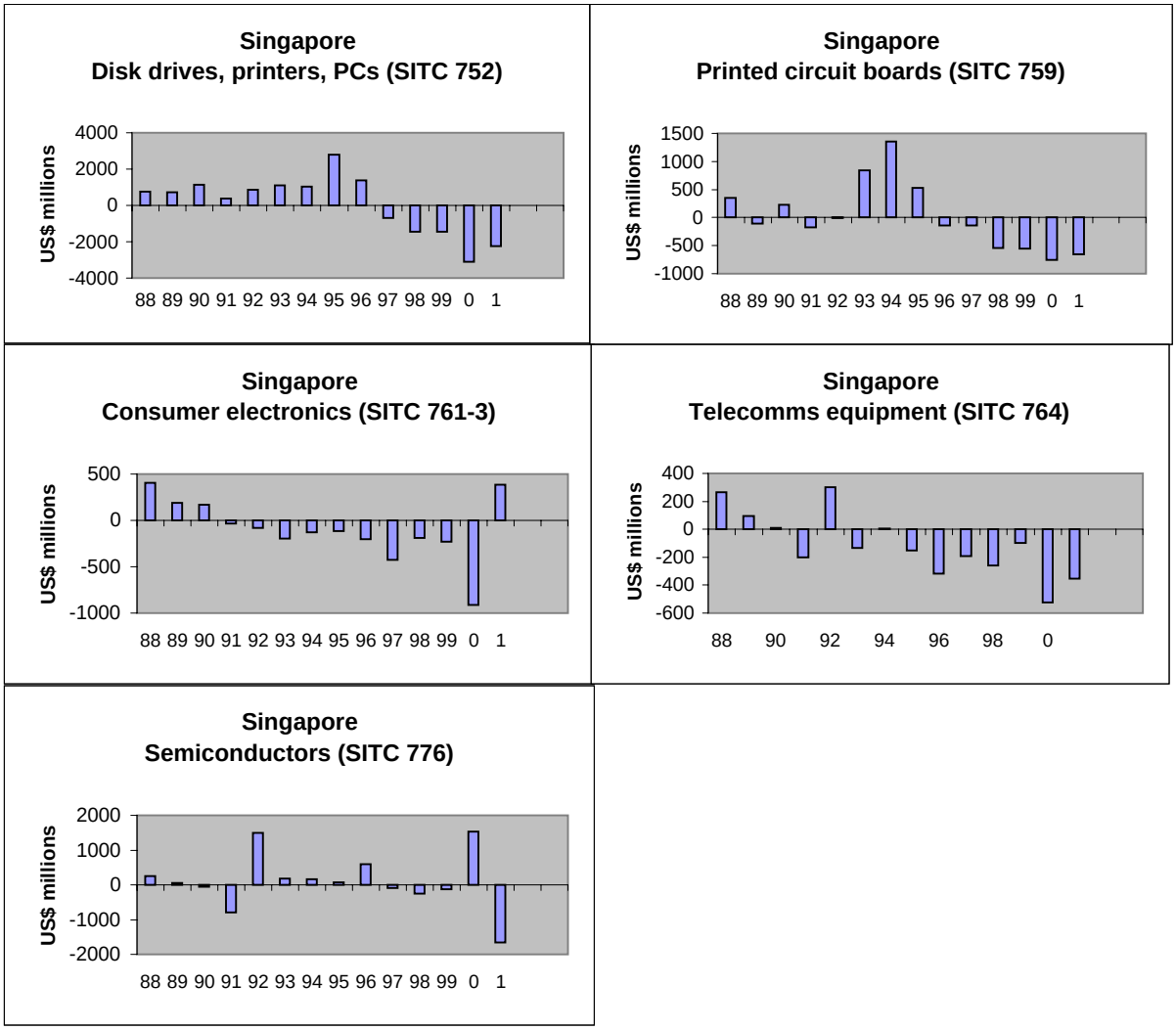
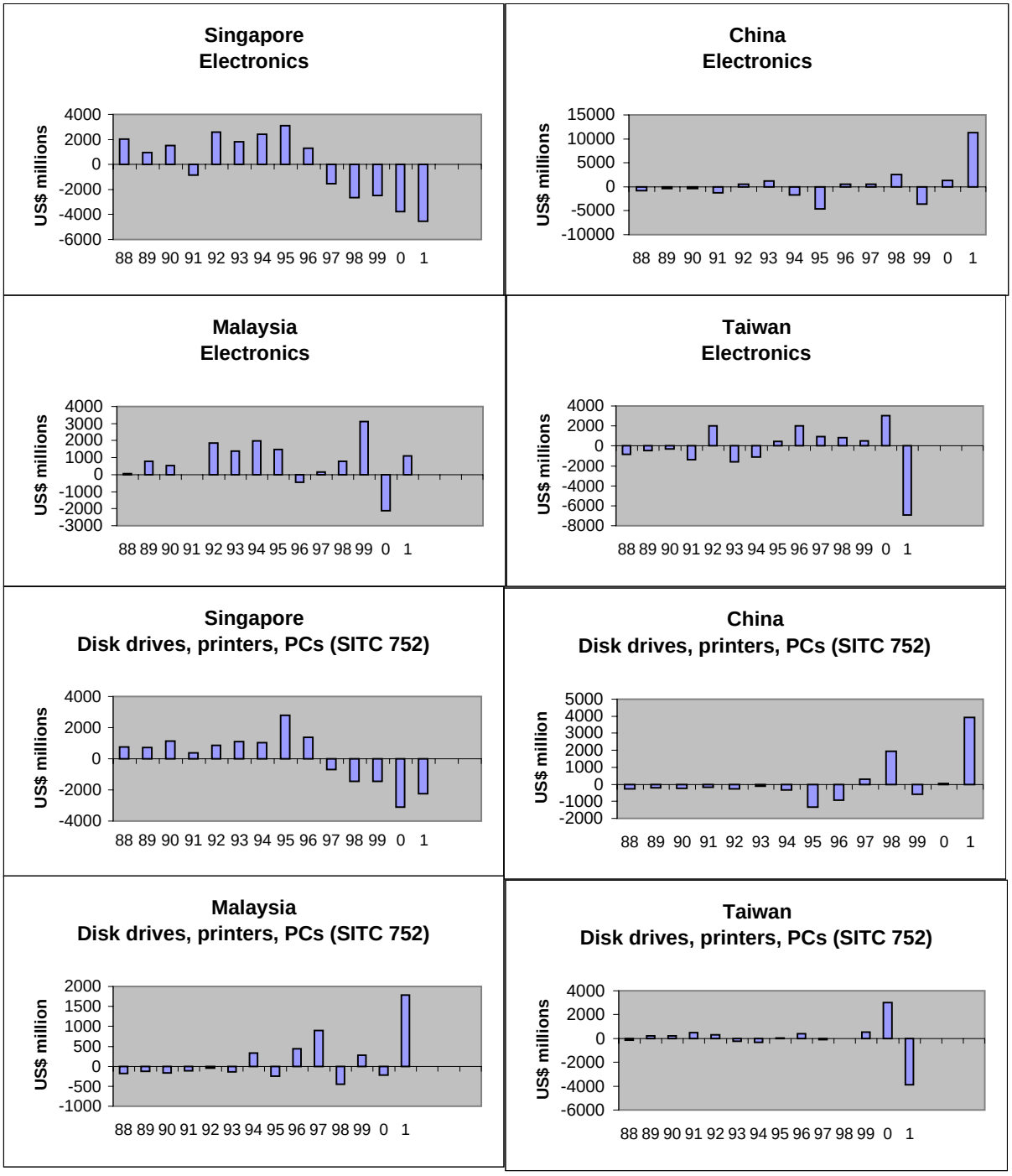
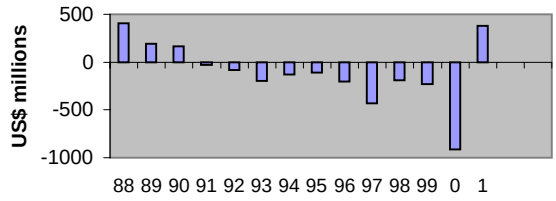


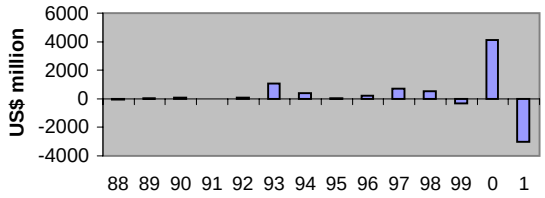
Figure 3: Singapore and her main competitors in electronics



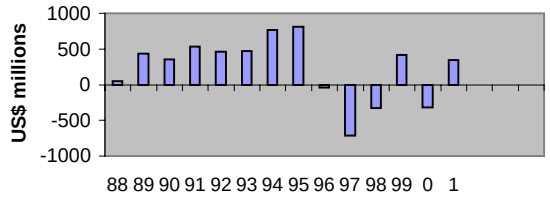
Singapore
Consumer electronics (SITC 761-3)



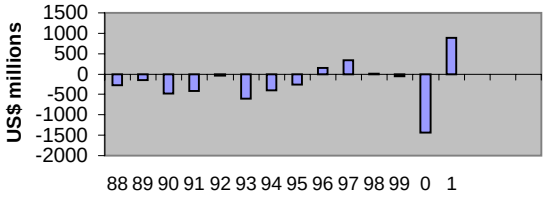
China
Consumer electronics (SITC 761-3)



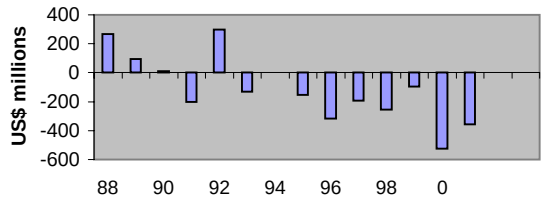
Malaysia
Consumer electronics (SITC 761-3)



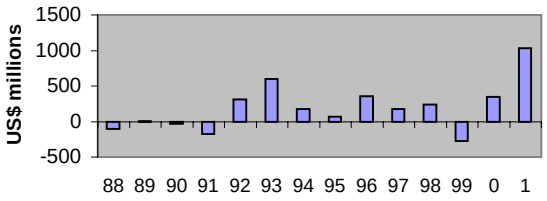
Taiwan
Consumer electronics (SITC 761-3)



Singapore
Telecomms equipment (SITC 764)



China
Telecomms equipment (SITC 764)



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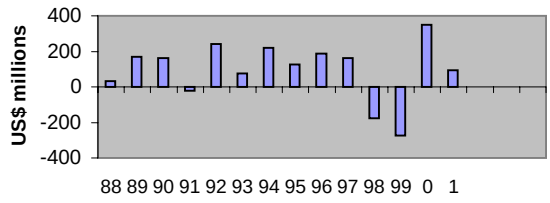
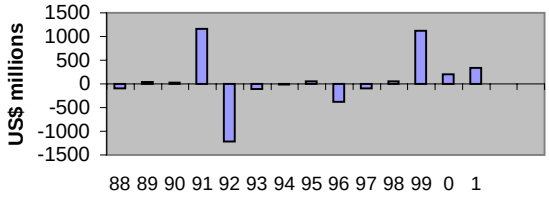
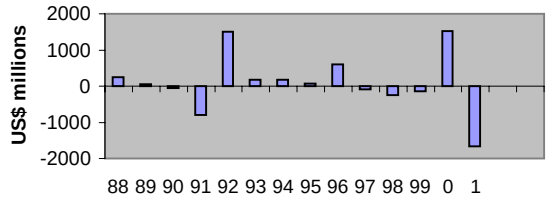
Telecomms equipment (SITC 764)



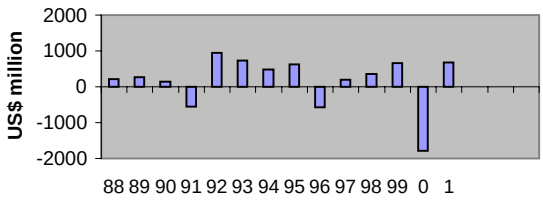
Korea
Telecomms equipment (SITC 764)



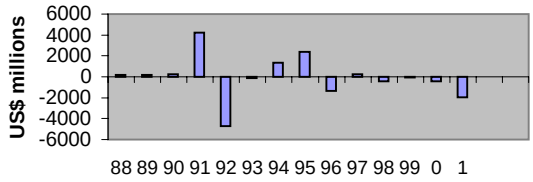
Singapore
Semiconductors (SITC 776)



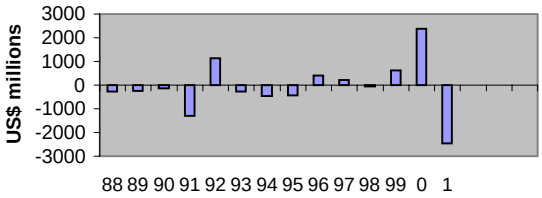
Malaysia
Semiconductors (SITC 776)



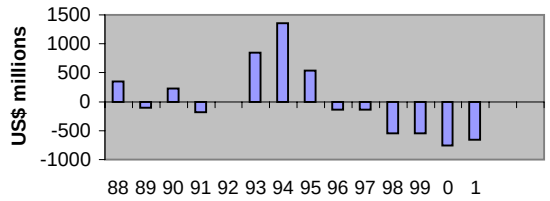
Korea
Semiconductors (SITC 776)



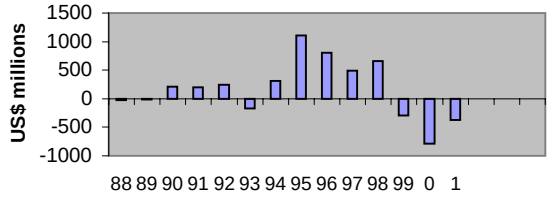
Taiwan
Semiconductors (SITC 776)



Singapore
Printed circuit boards (SITC 759)



Taiwan
Printed circuit boards (SITC 759)



Malaysia
Printed circuit boards (SITC 759)

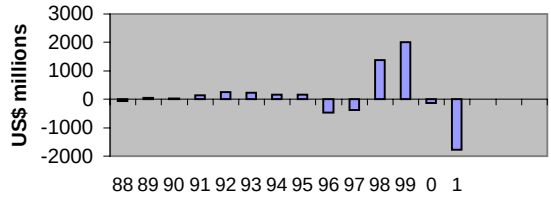


Figure 4: Singapore's net shifts and competitors in chemicals