The Transformation of Competitive Advantage in East Asia: An Analysis of Technological and Trade Specialisation

Yuichiro Uchida and Paul Cook

Centre on Regulation and Competition
Institute for Development Policy and Management
University of Manchester

Paper presented at the Conference on 'Challenges to Development: Innovation and Change in Regulation and Competition'
13-15 October 2003
Edsa Shangri-La Hotel, Metro Manila, Philippines

The Transformation of Competitive Advantage in East Asia: An Analysis of Technological and Trade Specialisation

Yuichiro Uchida and Paul Cook

1. Introduction

In recent years there has been considerable interest in the relationship between a country's export competitiveness and the role played by technological innovation in creating and maintaining competitive advantage. While the debate has been wide-ranging, examining the determinants of technological capabilities (Dosi, 1988, Lall, 2001), the role of foreign direct investment (Cantwell, 1989, Narula and Wakelin, 1995, Mowery and Oxley, 1997) and the role of technology policy in strengthening endogenous capability (Lall and Teubal, 1998), a central feature of recent empirical research has rested on examining patterns of export and technological specialisation between economies and sectors (Soete, 1987, Amendola, Guerrieri and Padoan, 1998, Laursen, 2000). Two aspects in particular have been pursued. First, examining patterns of export and technological specialisation over time, assessing the direction of change, their stability, and the implications of various patterns for an economy's competitive advantage. Second, assessing the relationship between trade and technological specialisation, and investigating both the significance of whether patterns of specialisation move in the same direction and converge towards those exhibited by the leading economies.

Empirical work on specialisation patterns has predominantly concentrated on the advanced OECD economies. The results appear to be mixed. Archibugi and Pianta (1994) found evidence of increasing technological specialisation. Laursen (2000) found that specialisation patterns for exports and technology among OECD economies were quite similar, economies tended to de-specialise in terms of trade specialisation, although de-specialisation for technology was evident but less pronounced. The finding of de-specialisation for trade supports the earlier finding of Dalum, Laursen and Villumsen (1996), in which trade specialisation among OECD economies became less sectorally dispersed over time. Interestingly, Laursen (2000) did not find support for the notion that within the OECD the catching-up economies experience a higher degree of turbulence in specialisation patterns over time, reflecting structural change in their economies as they move closer to the more advanced OECD economies.

The purpose of the paper is to move attention away from the advanced industrialised economies to examine the trends for trade and technological specialisation among the East Asian developing economies. The analysis is concerned with seven East Asian economies, Hong Kong, South

Korea, Singapore, Indonesia, Malaysia, the Philippines and Thailand. In section two, theoretical propositions and the related empirical evidence on trade and technological specialisation as measures of competitive advantage are briefly reviewed. Section three discusses the data and methods used to derive indices of specialisation for the East Asian economies and the approach taken to examine the relationship between trade and technological specialisation at the country and industry levels. Section four analyses the patterns of trade and technological specialisation for each economy. Section five examines the relationship between trade and technological specialisation and discusses their implications. The final section draws conclusions and discusses the direction for further research.

2. Theoretical Propositions and Empirical Evidence

It is now widely accepted that a contributory factor to success in trade relates to the inherent advantages of specialisation (Krugman, 1994). This can be rationalised from the perspective of traditional trade theory, emphasising factor endowments as an element in a country's comparative advantage and, as argued by new trade theorists, to the scope for specialisation that emerges from opportunities to exploit increasing returns to scale. In turn it is argued that a country's technological capability and specialisation reflect its trade specialisation, and influences the export competitiveness of firms within a country. The analysis of a country's trade pattern over time, therefore, reveals its technological specialisation and changes in its specialisation. This is a particularly neo-Schumpeterian explanation that links national systems of innovation to the sector structure of export performance (Narula and Wakelin, 1995). Indeed, the neo-Schumpeterian view indicates that international trade specialisation, as a measure of competitiveness, is the outcome of country and sector specific learning processes relating to technological capability. The mechanism linking the two leads to a stability of trade specialisation, in which trade patterns are likely to be stable and changes in the pattern of technological specialisation are path dependent.

The importance of learning has been central to the debate over specialisation in relation to trade and technology. Bell and Pavitt (1992) point out that long terms trends of increasing specialisation and increasing production scale have resulted in technological accumulation becoming less built-in to the process of industrialisation. Increasing by scale and knowledge sectors have acted as the basis for the development of mechanical and electronic capital goods production, as has been illustrated by Hobday (1990) in accounts of development in Brazilian industries. In this way the conditions for effective learning have changed as the accumulation of productive capacity in the more advanced of the industrialising economies has become increasingly de-linked or uncoupled from the accumulation of productive capacity. As such policies designed to protect industries are less unlikely to provide the basis for technological increases where production and technological development are separated.

As a consequence of the importance of learning, and specifically learning by doing, it has been argued by Lall (2000) that the best countries can retain their comparative positions even when they are losing their initial advantage. This occurs because the best countries have in place learning systems that allow them to absorb technologies efficiently and react competitively to changing technological conditions. By contrast, countries with weak learning systems find it difficult to establish competitive positions even in simple or resource-based activities.

The theoretical literature provides clear predictions concerning the longer term trend for patterns of specialisation. Stable patterns are predicted for advanced economies on the basis of scale economies (Krugman, 1987), and this pattern is likely to be manifested through the path dependency characteristics of the evolution of technological innovation (Metcalfe and Soete, 1984; Dosi, Pavitt and Soete, 1990). Cumulative experience or learning by doing maintains the impetus for productivity changes among leading economies (Laursen, 2000). Patterns of specialisation over shorter time horizons are more likely to be susceptible to market and policy-induced influences relating to changes in exchange rates, factor prices and promotional policies (Grupp and Münt, 1998). Less stable patterns, and correspondingly higher degrees of structural change in specialisation patterns, are denoted as features of catching-up economies (Beelen and Verspagen, 1994). Krugman (1989) also features structural change in high growth economies as they broaden their product ranges in response to favourable income elasticity. In relation to structural change, the central focus rests on whether changing patterns of specialisation converge towards those displayed by the leading economies, indicating that countries are catching-up. Alternatively, on whether a change in the structure of production is itself a prerequisite for catching up.

In terms of the relationship between trade and technological specialisation, Posner's (1961) technological gap theory suggested that transitory monopoly profits result from a technological lead which would improve prospects for trade in some sectors. In recent years there has been mounting support from empirical research, using both cross-country and panel data, to indicate that competitiveness in trade is indeed influenced strongly by a country's technological capability (Soete, 1981; Dosi, Soete and Pavitt, 1990; Amendola, Dosi and Papagni, 1993; Amable and Verspagen, 1995). The relationship between trade and technology is likely, however, to be more complex. As Lall (1992) indicates, export orientation has also generated competitive pressures and other incentives for technological accumulation, increasing the likelihood that some kind of two way or feedback relationship can be found to exist. Of course, there are factors, as pointed out by Laursen (2000), such as the spatial separation between points of production and research and development, which might also prevent patterns of trade and technological specialisation moving together.

3. Data and Methodology

The paper examines the changes in technological and trade specialisation and the relationship between them for the East Asian developing economies. First, two indices measuring technological and trade specialisation were calculated and analysed on a country and an industry basis. Second, regression analysis was used to examine the relationship between the two indices. Data were obtained from the National Bureau of Economic Research (NBER) US Patent Citations (USPC) (Hall, Jaffe, and Tratjenberg, 2001) and the United Nations Commodity Trade Series (SITC, Revision 2). A concordance table was developed because the two data series have been compiled on the basis of different industrial categories. Using the new concordance table, data has been rearranged into 29 manufacturing industries, based on the International Standard Industrial Category (ISIC). A full list of these industries is presented in Appendix 1.

These datasets formed the basis for the calculation of two indices relating to revealed comparative advantage (RCA) (Balassa, 1965) and technological comparative advantage (TCA). The indices have been calculated as follows:

$$RCA = (X_{ij} / S_{i} X_{ij}) / (S_{j} X_{ij} / S_{i}S_{j} X_{ij}), \qquad (1)$$

where X_{ij} is the value of exports of sector *j* from country *i*.

$$TCA = (P_{ij} / S_{i} P_{ij}) / (S_{j} P_{ij} / S_{i}S_{j} P_{ij}), \qquad (2)$$

where P_{ij} is the number of patents of country *i* in sector *j*.

The range of each index value lies between 0 and positive infinity. If the index equals unity, the share of the country *i*'s exports or patents in industry *j* is identical to its share of exports or patents in all industries. Accordingly, if the index value is greater than unity, it indicates a relative export or technological specialisation of the country in industry *j*. If it is less than unity, the respective specialisation of each country in a given industry is weak.

Two cautionary notes are warranted regarding the derivation and use of the index for TCA. First, in the past many empirical studies collected patent counts based on the grant year, but as Hall, Jaffe, and Tratjenberg (2001) have pointed out, counts ought to be based on the year of application. The reasoning for this is that there is likely to be a time lag (possibly 1 to 3 years) between the granting of a patent and its application owing to bureaucratic delay. As a result, the use of patent counts based on the grant year introduces unnecessary measurement errors into the analysis. Second, Cantwell (1993) has argued that TCA indices are likely to suffer from so-called small number problems. It is reckoned that a minimum of a thousand patent counts distributed across 30 sectors or industries are necessary to generate statistically satisfactory normally distributed indices.

Seeking a solution to the normality problem associated with RCA and TCA indices has proved troublesome, in particular with the latter. The most commonly used method for RCA has been the logarithmic transformation of a RCA index (Soete and Verspagen, 1994). However, a TCA index has often resulted in values of 0 owing to zero patent counts, and in this case the log-transformation could not be applied. Fagerberg (1994) arbitrarily added a small integer, 0.1 to the logarithmic formula (ln(TCA + 0.1)) in order to resolve the zero value problem for TCA and also to improve the normality problem, although it had no statistical foundation. Laursen and Engedal (1995) have developed symmetric RCA and TCA indices (hereafter, SRCA and STCA, respectively) to deal with the zero count problem, as well as normality. These indices have an economic advantage in that they put the same weight to the changes below and above unity and appear to be the best to improve the normality problem (Dalum, Laursen and Villumsen, 1996). Since most East Asian developing economies fail to produce a sufficient number of patents, the possibility of adverse effects have been minimised by transforming the indices into SRCA and STCA indices by the following formula:

$$SRCA_t = (RCA_t - 1)/(RCA_t + 1), \quad (3)$$

$$STCA_t = (TCA_t - 1)/(TCA_t + 1). \quad (4)$$

Accordingly, each value for SRCA or STCA ranges from –1 to 1.

The regression analysis involved the use of Galtonian regression method aimed at analysing bivariate distributions (Hart and Prais, 1956 and Hart, 1976). Previously, Cantwell (1989, 1993) applied this technique in the context of cross-sectoral distributions of innovation. Our analysis applied this technique to examine cross-sectoral distributions of technological and trade specialisation for 28 manufacturing categories during the period 1978-1997 (miscellaneous manufacturing was omitted from the analysis since meaningful concordance was difficult to establish). This period was chosen owing to data availability and consistency, and it was divided into four sub-periods (i.e. period I (1978-1982), period II (1983-1987), period III(1988-1992), and period IV(1993-1997).

The sectoral distribution was estimated for the SRCA and STCA indices at time t, $t =$ period V, and tn, tn = the earlier three periods I, II, or III, for each country in our sample. That is:

$$\text{SRCA}_{ij}^{t} = \alpha + \beta \ \text{SRCA}_{ij}^{tn} + e_{ij}^{t}, \qquad (5)$$

$$\text{STCA}_{ij}^{t} = \alpha + \beta \ \text{STCA}_{ij}^{tn} + e_{ij}^{t}, \qquad (6)$$

where i is country, $i = 1\ldots7$, j is industry, $j = 1\ldots28$, and e is the error term.

The approach adopted has been to examine the longest period between IV-I, and then successively shorten the period by changing the initial period from I to III. This has been done in an attempt to partially capture the dynamic aspects of changes in RCA and TCA following criticism by Quah (1996) that this type of technique considers only the average behaviour of the distribution.

If $\beta = 1$, a country's specialisation pattern is unchanged (i.e. competitive industries remain competitive, and others remain less competitive). When $\beta > 1$, the country's existing pattern of specialisation is reinforced (i.e. the spread between the set of competitive and less competitive industries becomes wider). If $0 < \beta < 1$, the existing pattern of specialisation is unchanged, but the gap between competitive and less competitive industries narrows. The existing pattern reverses when, $\beta < 0$. Thus, the magnitude of $(1 - \beta)$ measures the size of so-called the regression effect. A lower value for the regression effect (high β) indicates concentration of a specialisation pattern, and a higher value signifies diversification (low β).

The Pearson correlation coefficient, ρ, was also calculated to measure the movement of industries in the SRCA or STCA distribution. A high coefficient value indicates that the relative position of industries is unchanged. A low value indicates that the relative position of industries has changed where some industries move closer together and others move apart. More specifically, the value of $(1-\rho)$ measures the so-called mobility effect. A lower value for the mobility effect (high ρ) indicates stability of a specialisation pattern, whereas a higher value (low ρ) points to change. A combination of stability (weak mobility effect) and concentration (weak or negative regression effect) suggests a strengthening of an established pattern of specialisation. Conversely, a combination of change and diversification implies a change in the pattern of specialisation.

The variance of the SRCA or STCA indices measures the degree of specialisation, which can also be measured as β / ρ. If $\beta > \rho$, the degree of specialisation has increased. If $\beta < \rho$, then it has decreased. When $\beta = \rho$, the dispersion of the distribution is unchanged. Thus, $\beta / \rho < 1$, in which the regression effect outweighs the mobility effect, suggests a widening of the specialisation. The opposite occurs when $\beta / \rho > 1$.

4. Patterns of Technological and Trade Specialisation

Analysis of Patterns by Country

Table 1 reports the results of the Galtonian regression analysis of technological specialisation for the East Asian developing economies by applying equation (6). Greater differences between countries were revealed for the pattern of technological specialisation than for trade specialisation. Initially, the hypothesis $\hat{\beta} = 1$ was tested to examine whether or not patterns of specialisation are persistent and technological change is cumulative or path-dependent. The tests on the longest period (IV-I) show the randomness of technological change in all economies, except for Hong Kong and to a lesser extent, Indonesia. The random patterns are most evident in Thailand and the Philippines over the entire period. There is, however, a sign of the build-up of cumulative technological change for South Korea and Singapore, while Hong Kong continuously shows cumulative technological development over the whole period.

Table 1: Technological Specialisation Indices

	Period	$\hat{\beta}$	Degree of specialisation	Regression effect	Mobility effect
Korea					
	IV-I	-0.09	0.56	1.09	1.16
	IV-II	0.27	0.75	0.73	0.64
	IV-III	0.73***	0.87	0.27	0.16
Hong Kong					
	IV-I	0.42***	0.75	0.58	0.44
	IV-II	0.49***	0.78	0.51	0.38
	IV-III	0.80***	0.94	0.20	0.15
Singapore					
	IV-I	-0.01	0.66	1.01	1.02
	IV-II	0.05	0.75	0.95	0.93
	IV-III	0.38**	0.80	0.62	0.53
Indonesia					
	IV-I	0.69***	1.34	0.31	0.48
	IV-II	0.34	0.96	0.66	0.65
	IV-III	0.47**	1.00	0.53	0.53
Malaysia					
	IV-I	0.11	1.00	0.89	0.89
	IV-II	0.13	0.93	0.87	0.86
	IV-III	0.10	0.99	0.90	0.90

Philippines					
	IV-I	-0.22	0.98	1.22	1.23
	IV-II	0.50	1.14	0.50	0.56
	IV-III	-0.18	0.97	1.18	1.18
Thailand					
	IV-I	0.07	1.26	0.93	0.94
	IV-II	0.26	0.84	0.74	0.69
	IV-III	0.08	0.94	0.92	0.91

Note: Period I =1978-1982, Period II = 1983-1987, Period III = 1988-1992, and Period IV = 1993-1997.
*, ** = statistically significant at the 0.05 level and 0.01 level, respectively: H_0: $\hat{\beta}$ =1
The degree of specialisation = $\hat{\beta}$ / $\hat{\rho}$, the regression effect = (1 - $\hat{\beta}$), and the mobility effect = (1- $\hat{\rho}$)

The values for the degree of technological specialisation ($\hat{\beta}$ / $\hat{\rho}$) indicate that Hong Kong, South Korea and Singapore have broader technological specialisation than the other economies, although specialisation narrows over time, reinforcing technological specialisation in some areas. In particular, South Korea's value for the period IV-I suggests that the speed of broadening technological specialisation is higher than the others, followed by Singapore. In contrast, the other economies tend to specialise in a narrower range of technology. In Indonesia and the Philippines, weak signs of widening technological specialisation are detected, but essentially these economies still remain highly specialised in a narrow range of technology.

These findings are confirmed by analysing the regression and the mobility effects. The analysis suggests that South Korea has been establishing and reinforcing a specific pattern of technological specialisation over time. This is indicated by the reduction in both the regression effect values (increasing technological concentration) and the lowering of the mobility effect values (increasing stability of technological specialisation). A similar effect is being experienced in Hong Kong and Singapore. The Philippines, Thailand, and to a lesser extent Malaysia, also followed this trend until the final period, when the emerging pattern of technological specialisation erodes, as values for the regression effect and the mobility effect rise (indicating diversification of technological specialisation and a change in technological specialisation respectively). Indonesia experienced an opposite trend, where the values for the two effects increased substantially between the first and the second periods and decreased in the last. The results for these economies suggest that they were subjected to various internal and external shocks, possibly relating to domestic policy changes and foreign investment in the late 1980s and early 1990s.

Table 2 shows the trade specialisation indices calculated by applying equation (5). In contrast to the technological specialisation indices, all economies exhibit almost the same trend, revealing a cumulative pattern of trade specialisation (the hypothesis, $\hat{\beta}$ = 1, is statistically significant at the

0.01 level for all economies, except Thailand). The values for the degree of trade specialisation indicate that most economies have gradually been increasing their pattern of trade specialisation over time, while Singapore and Indonesia show a degree of diversification, and they remain highly specialised in terms of trade.

Table 2: Trade Specialisation Indices

	Period	$\hat{\beta}$	Degree of specialisation	Regression effect	Mobility effect
Korea					
	IV-I	0.46^{***}	0.81	0.54	0.43
	IV-II	0.67^{***}	0.86	0.33	0.21
	IV-III	0.84^{***}	0.92	0.16	0.08
Hong Kong					
	IV-I	0.78^{***}	0.87	0.22	0.10
	IV-II	0.81^{***}	0.87	0.19	0.07
	IV-III	0.89^{***}	0.92	0.11	0.03
Singapore					
	IV-I	0.78^{***}	1.11	0.22	0.30
	IV-II	0.93^{***}	1.07	0.07	0.14
	IV-III	0.98^{***}	1.02	0.02	0.04
Indonesia					
	IV-I	0.77^{***}	1.07	0.23	0.28
	IV-II	0.79^{***}	0.97	0.21	0.18
	IV-III	0.85^{***}	0.93	0.15	0.08
Malaysia					
	IV-I	0.58^{***}	0.79	0.42	0.27
	IV-II	0.68^{***}	0.85	0.32	0.20
	IV-III	0.81^{***}	0.91	0.19	0.11
Philippines					
	IV-I	0.58^{***}	0.90	0.42	0.35
	IV-II	0.75^{***}	0.91	0.25	0.18
	IV-III	0.85^{***}	0.91	0.15	0.07
Thailand					
	IV-I	0.41^{**}	0.91	0.59	0.55
	IV-II	0.66^{***}	0.95	0.34	0.30
	IV-III	0.84^{***}	0.89	0.16	0.05

Note: Period I =1978-1982, Period II = 1983-1987, Period III = 1988-1992, and Period IV = 1993-1997.
*, ** = statistically significant at the 0.05 level and 0.01 level, respectively: H_0: $\hat{\beta}=1$

The degree of specialisation = $\hat{\beta}$ / $\hat{\rho}$, the regression effect = (1 - $\hat{\beta}$), and the mobility effect = (1- $\hat{\rho}$)

The longer period (IV-I) analysis shows that trade specialisation among all economies is characterised by stability and concentration. This result supports the hypothesis of new trade theory that arbitrary patterns of trade specialisation are likely to persist and extend over time, once they have been established. Over the longer period, Hong Kong, and to a lesser extent

Singapore and Indonesia, maintained relatively stable patterns of trade specialisation which are concentrated in a number of industries, as indicated by the much lower values for the regression and mobility effects. The other economies, particularly South Korea and Thailand, experienced a slight degree of diversification and change in their trade specialisation patterns.

In summary, the results of the Galtonian regression analysis for technology and trade clearly indicate that the pattern of technological specialisation are far more consistent in Hong Kong, and South Korea and Singapore also began to move in this direction. Patterns of technological specialisation are more random for the developing or catching-up East Asian economies. The conclusion to be drawn from this analysis is that the latter economies have undergone a process of continued diversification and change with respect to their patterns of technological specialisation. Despite the differences between the two sets of economies with respect to patterns of technological specialisation, all economies maintained cumulative and established patterns of trade specialisation.

Analysis of Patterns by Industry

A set of graphs (graph 1) are used to show the changes in technological and trade specialisation for the seven East Asian economies on an industry basis. The initial period reported is 1978-82 on the x-axis, and the final period is 1993-97 on the y-axis. Each graph is divided into four quadrants at the points (0,0). The upper right quadrant of the graph represents the industries that have cumulative patterns of technological or trade specialisation. The lower right quadrant includes the industries that lost trade or technological advantages in the last period. The upper left quadrant shows the industries that have gained technological or trade advantage in the last period. Finally, the lower left quadrant includes industries that do not have trade or technological advantage between the periods.

The graph for Hong Kong indicates path dependent technological development in the cases of toys (28), woods (3), electricals (21) and textiles (2), among others. In this case, Hong Kong's technological specialisation continues to exist in relatively low technology industries. Interestingly, Hong Kong's high-tech industries, electronics (22) and computers (20), have lost their technological advantage during the last period. In relation to trade specialisations, industries that have technological advantage also possess trade advantage (textiles (2), electricals (21), toys (28)). On the other hand, those industries that lost their technological advantage still exhibit trade advantage (instruments (27) and electronics industries (22)).

In South Korea, only the electrical industry (21) shows a weak tendency towards a cumulative nature of technological change. Those industries that had technological advantage, such as shipbuilding (25), toys (28) and textiles (2), substantially lost their advantages in the last period. On the other hand, the three industries that did not have technological advantage in the first period, namely the electronics (22), non-ferrous metals (14) and computers (20), have gained technological advantage in the last period. It appears that South Korea's patterns of technological specialisation are not path-dependent between the periods examined. In other words, South Korea experienced rapid changes in technological development in a short period of time. In contrast, South Korea's trade specialisation exhibits a cumulative nature of development. Industries, such as shipbuilding (25), textiles (2) and electronics (22), that had a comparative advantage in the first period retained it in the last period. The toy industry (28) has lost its advantage substantially. These industries are exhibiting path-dependent trade specialisation without corresponding technological specialisation, except electricals (21) where both cumulative technological and trade specialisation are indicated.

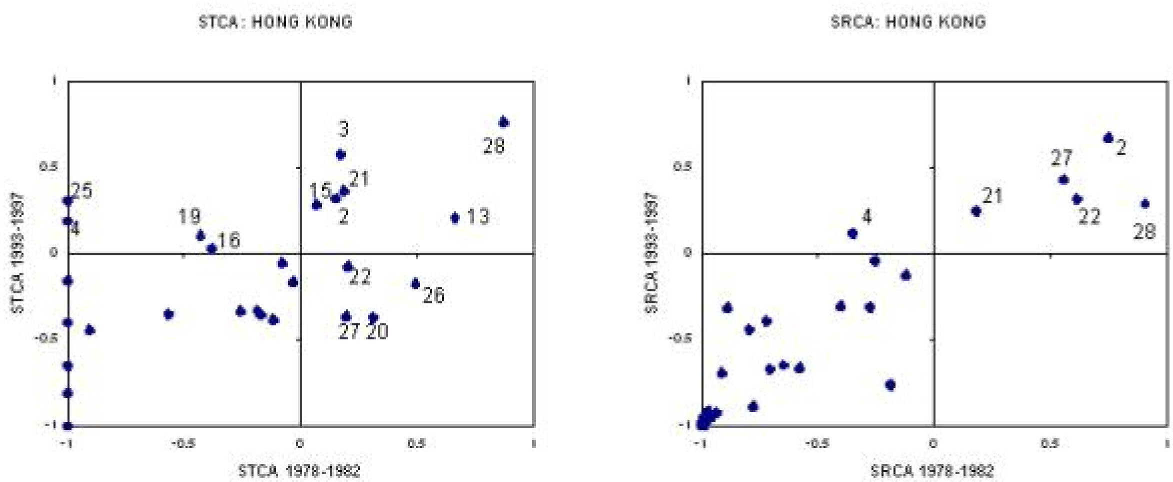
Singapore's patterns of technological specialisation are more or less similar to those of South Korea. Only two industries, foods (1) and electricals (21), show a cumulative pattern of technological change over time. The technologically advantaged industries in the first period, such as toys (28), shipbuilding (25), instruments (27) and textiles (2), lost their advantages, while those that did not have any advantage in the first period, primary ferrous products (13), petro-refinery (10), electronics (22) and computers (20), gained technological advantage in the last period. In relation to trade comparative advantage, industries such as electronics (22) and electricals (21), show a path dependent pattern, while computers (20) gained comparative advantage more noticeably in the last period. This suggests that Singapore has rapidly been shifting its export base towards high-tech industries.

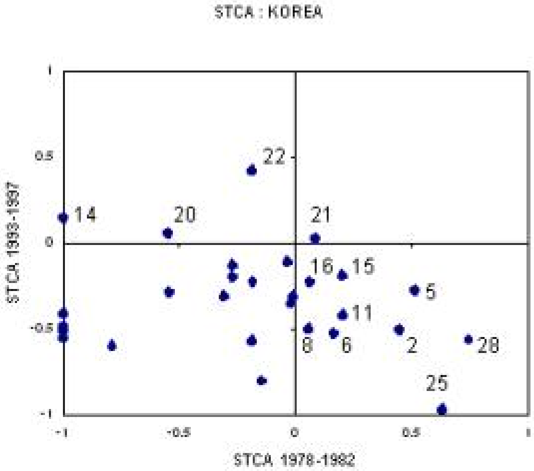
It can be visually confirmed that Indonesia's technological and trade specialisation lie in a much narrower range of industries and are characterised by the absence of the industries in the lower right quadrant of each graph. Exceptions are fabricated metals (15) and the emergence of several industries in the upper left quadrant in the graph for STCA. Those industries that exhibit a path dependent development and that gained technological specialisation in the last period are low- and medium-technology and/or labour intensive in nature.

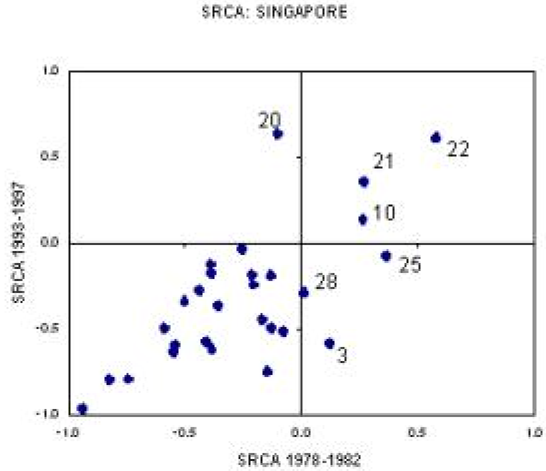
Malaysia's technological specialisations are similar to those of Indonesia with a bunching of industries in the upper left quadrant and those appearing in the upper right and left quadrants of the graph are low- and mid-tech/labour intensive industries. In contrast, Malaysia's trade specialisations are a mixture of relatively low-tech and high-tech industries (electronics (22), woods (3), electricals (21), foods (1) and toys (28)). The absence of technological specialisation in the electronics industry may imply that Malaysia's electronics industry's SRCA is not a reflection of its technological advancement but that the index is simply picking up labour intensive or assembly type activities in the industry.

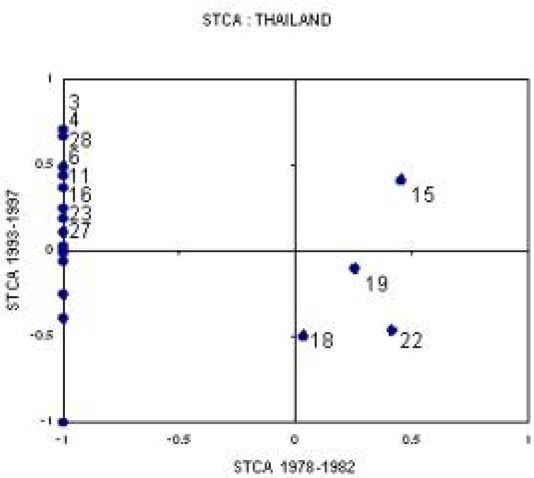
A similar story can be told for the Philippines, although ten industries lost their technological advantage, while several low- and medium-tech industries, in particular foods (1), gained advantage over the period examined. Similar to Malaysia, the Philippines has a mixture of low and high-tech industries in the upper quadrant of the graph for trade specialisation. These include electronics (22), toys (28), electricals (21) and foods (1). Thailand's patterns of technological and trade specialisation also resemble those of Indonesia and Malaysia. Interestingly, the electronics industry (22) lost its technological advantage while improving its comparative advantage substantially in the last period. Thus, similar to Malaysia, Thailand's SRCA index for the electronics industry may be capturing assembly type of activities in the industry. Most notable is that eight industries appear to have gained technological advantage in the last period, once again suggesting that Thailand experienced substantial positive internal and/or external shocks in the late 1980s and early 1990s.

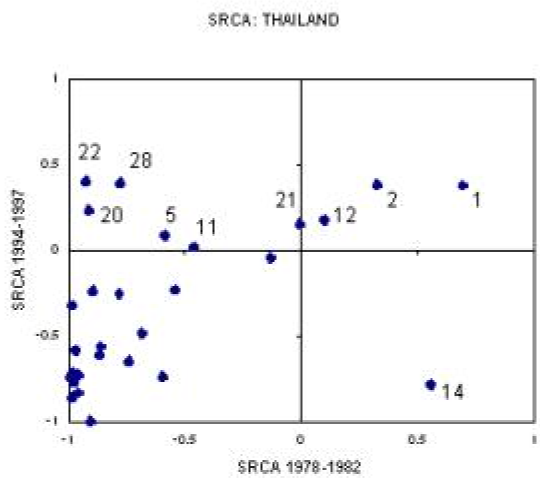
Graph 1: Changes in STCA and SRCA Indices











5. Causal Relationship between TCA and RCA

This section discusses the relationship between TCA and RCA at the country and industry levels. Following the methodology adopted by Amendola, Guerrieri and Padoan (1998), among others, we examine the direction of causality that runs from STCA to SRCA and in our case, also investigate the reverse causality by regressing $STCA_t$ on $SRCA_{t-1}$ and $SRCA_t$ on $STCA_{t-1}$, respectively. Table 3 reports the results. The results are highly indicative of the possible causal relationship between technology and trade. A range of relationships between technology and trade are confirmed for the more advanced East Asian economies, Hong Kong, South Korea and Singapore, whereas no strong relationship was indicated for the other East Asian economies.

Analysis of Relationships by Country

The results for Hong Kong reveal an interesting causal relationship between STCA and SRCA, which are clearly established but switch over time. In the latest period (IV-III), there appears to be a two way or feedback relationship taking place between technological and trade specialisation. The findings for the second period (III-II) imply that technology influences trade specialisation, as indicated by the higher values of $\hat{\rho}$ (Pearson correlation coefficient) and adjusted R^2. The results for the first period (II-I) are somewhat mixed, with evidence of weak feedback between the two, although the direction of causality that runs from trade to technology is more evident in this case.

The results for South Korea imply that the STCA determines subsequent SRCA, although the relationship is not found for the latest period (IV-III). The results for Singapore may suggest that industries in the early periods were undergoing a period of significant transformation. This is affirmed by the mixed pattern of results, switching from trade influencing technological specialisation in period two (III-II) to the reverse causality in the next period (IV-III). It is interesting to note that in the cases of Hong Kong and Singapore, the reverse causality that runs from trade to technology precede the conventionally accepted causality running from technology to trade, which has been empirically found in the advanced industrial economies. This may suggest that in the earlier period the reverse causality may indicate a process of learning by doing is taking place, possibly through the adaptation of foreign technology, and this may represent a significant prerequisite to technological development.

The other East Asian economies provide a less conclusive picture, with few statistically significant relationships being established. The results for Thailand for the final period (IV-III) imply a mild causality running from STCA to SRCA, and a reversed but similar conclusion can be reached for Malaysia in the final period.

Table 3: The Relationship between Technology and Trade

	Period	$\hat{\beta}$	$\hat{\rho}$	$\bar{R}^2$		Period	$\hat{\beta}$	$\hat{\rho}$	$\bar{R}^2$
Hong Kong									
STCA → SRCA	IV-III	0.54 (2.83)***	0.49	0.21	SRCA → STCA	IV-III	0.35 (2.54)**	0.45	0.17
	III-II	0.71 (5.11)***	0.71	0.48		III-II	0.48 (3.86)***	0.60	0.34
	II-I	0.46 (2.65)**	0.46	0.18		II-I	0.65 (4.80)***	0.69	0.45
Korea									
STCA → SRCA	IV-III	0.30 (1.24)	0.24	0.02	SRCA → STCA	IV-III	0.03 (0.23)	0.04	-0.04
	III-II	0.45 (2.11)**	0.38	0.11		III-II	0.10 (0.77)	0.15	-0.01
	II-I	0.47 (2.90)***	0.49	0.22		II-I	0.23 (1.63)	0.30	0.06
Singapore									
STCA → SRCA	IV-III	0.48 (4.67)***	0.68	0.44	SRCA → STCA	IV-III	0.57 (2.93)***	0.50	0.22
	III-II	0.14 (1.09)	0.21	0.01		III-II	0.82 (3.26)***	0.54	0.26
	II-I	0.15 (1.51)	0.28	0.05		II-I	0.27 (0.83)	0.16	-0.01
Indonesia									
SRCA → STCA	IV-III	-0.004 (-0.03)	-0.01	-0.04	STCA → SRCA	IV-III	0.31 (1.29)	0.25	0.02
	III-II	-0.09 (-0.63)	-0.12	-0.02		III-II	0.29 (1.15)	0.22	0.01
	II-I	-0.19 (-1.00)	-0.19	0.00		II-I	0.14 (0.49)	0.10	-0.03
Malaysia									
STCA → SRCA	IV-III	0.22 (1.70)	0.32	0.07	SRCA → STCA	IV-III	0.44 (1.84)*	0.34	0.08
	III-II	-0.18 (-1.35)	-0.26	0.03		III-II	0.07 (0.31)	0.06	-0.03
	II-I	-0.13 (-0.82)	-0.16	-0.01		II-I	-0.29 (-1.23)	-0.23	0.02
Philippines									
STCA → SRCA	IV-III	-0.06 (-0.43)	-0.08	-0.03	SRCA → STCA	IV-III	0.17 (0.64)	0.12	-0.02
	III-II	0.08 (0.48)	0.09	-0.03		III-II	-0.09 (-0.34)	-0.07	-0.03
	II-I	-0.05 (-0.43)	-0.07	-0.03		II-I	0.03 (0.12)	0.02	-0.03
Thailand									
STCA → SRCA	IV-III	0.23 (1.72)*	0.32	0.10	SRCA → STCA	V-IV	0.15 (0.67)	0.13	-0.02
	III-II	0.09 (0.65)	0.13	-0.02		IV-III	0.01 (0.04)	0.01	-0.04
	II-I	-0.13 (-0.64)	-0.13	-0.02		III-II	-0.10 (-0.36)	-0.07	-0.03

Note: Period I =1978-1982, Period II = 1983-1987, Period III = 1988-1992, and Period IV = 1993-1997.
*, **, and *** = statistically significant at the 0.10 level, at the 0.05 level, and the 0.01 level, respectively.
t-statistics are in the parenthesis.

Analysis of Relationships by Industry

The set of graphs shown in graph 2 visually indicate the relationship between technological and trade specialisation at the industry level for each economy. Two periods, 1978-82 and 1993-97, are used separately this time, and quadrants depict the existence, non-existence, or the combination of both technological and trade comparative advantages. In this case, industries in the upper right quadrant have comparative advantages in both technology and trade. Industries in the lower right quadrant have technological advantage but no trade advantage. Industries in the upper left quadrant have comparative advantage in trade but not technology. Finally, industries in the lower left quadrant have no comparative advantages.

Higher levels of Hong Kong's technological and trade specialisation in the first period (1978-82) are found in relatively low-tech and labour intensive, such as textiles (2) and toys (28), and in high-tech industries, such as electronics (22). In the second period (1993-97), the traditionally advantaged industries, toys and textiles, continued to have technological and trade advantage, while the electronics and instruments (27) industries lost their technological advantage. Despite this, electronics and instruments still exhibited high trade specialisation. On the whole, Hong Kong's traditionally established industries remained specialised, although the toy industry seems to be losing its comparative advantage. The textile and electrical industries show a relatively cumulative pattern of trade and technological specialisation.

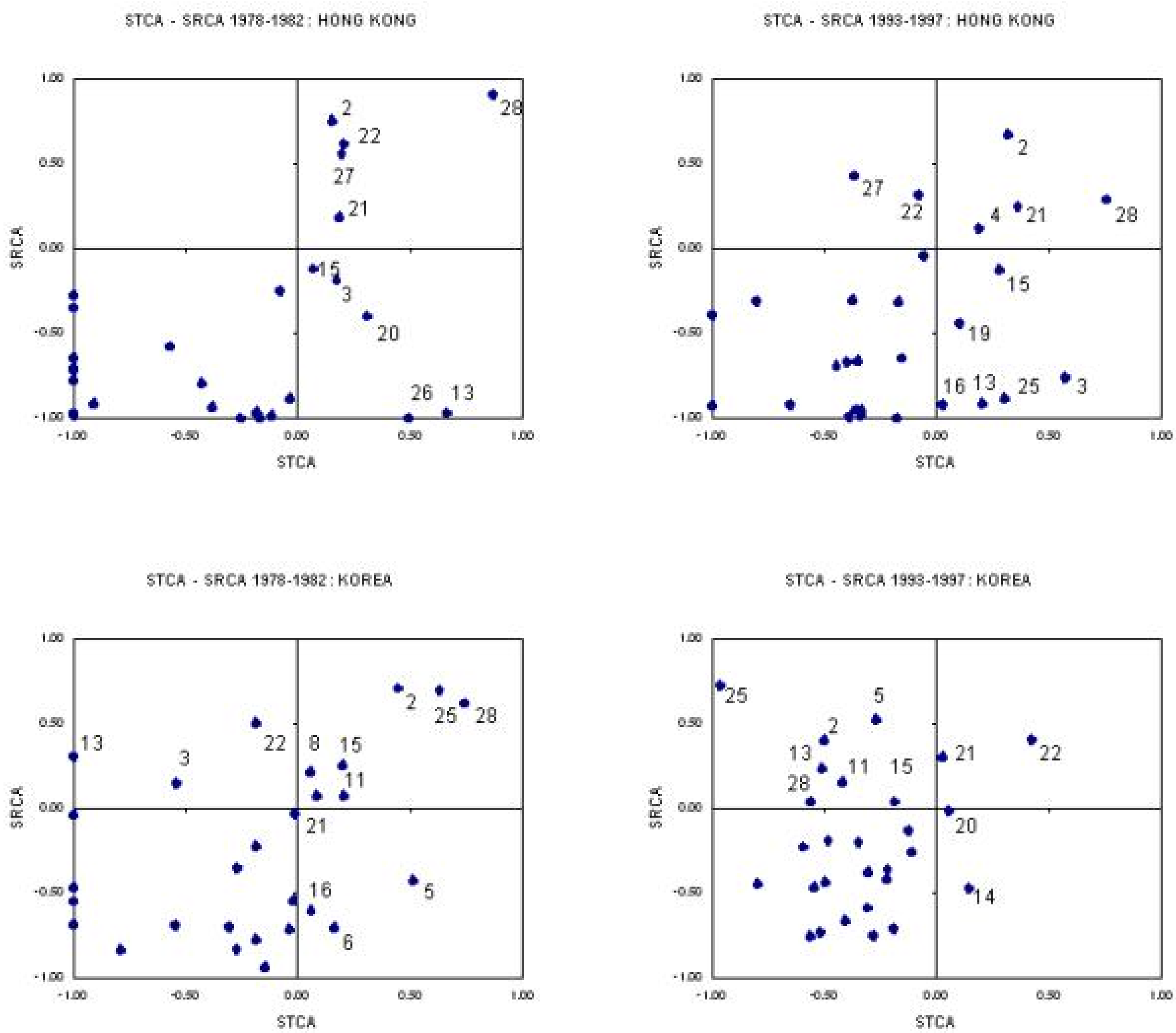
South Korea's textile (2), shipbuilding (25), and toy (28) industries showed higher levels of trade and technological specialisation in the first period. The electronics industry (22) exhibited a high level of trade specialisation without technological advantage in the same period. In the second period, the trade and technological specialisations of these industries reversed: the electronics industry became technologically more advanced, while keeping a higher level of trade specialisation. The textiles, and in particular shipbuilding industries, lost their technological advantages but retained their high levels of trade performance in the second period. Findings such as these indicate that South Korea has rapidly been shifting its specialisation towards high-tech products. One of the most notable characteristics in relation to South Korea's technological and trade specialisation is that several South Korean industries that had both technological and trade specialisation in the first period (textiles (2), synthetic resins (5), rubber (11), fabricated metals (15), shipbuilding (25), and toys (28)) kept trade specialisation while losing corresponding technological specialisation in the second period. Only the electrical industry reveals a cumulative pattern of trade and technological specialisation. In short, it appears that South Korea experienced a significant transformation of its industrial structure between the two periods.

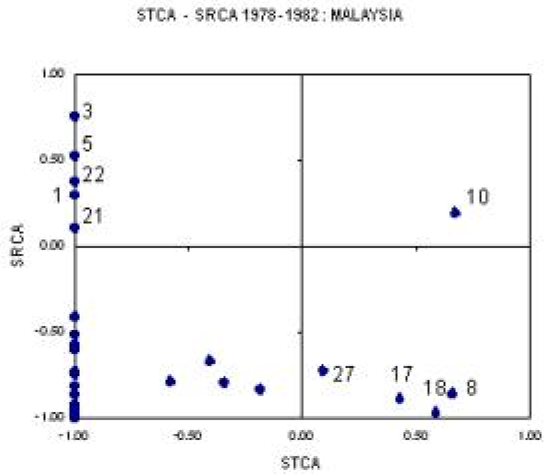
Singapore's patterns of changes in technological and trade specialisation are similar to South Korea's in terms of its shift towards high-tech industries. In the first period, the shipbuilding (25) and toy (28) industries showed a higher level of technological advantages while maintaining trade advantages. In contrast, the electronics industry (22) had the highest level of trade specialisation but did not have any technological specialisation at all in the first period. The second period completed Singapore's rapid shift towards high-tech industries, as indicated by higher levels of technological and trade specialisation for the computer (20) and electronics (22) industries. The distinctive difference between Singapore and the others is that no industry existed in the upper left side of the graph in the second period. On the whole, the established industries consisting of shipbuilding and toys are losing their technological and trade comparative advantages, while the computer, electrical, and electronics industries generally show a cumulative pattern of trade and technological specialisation.

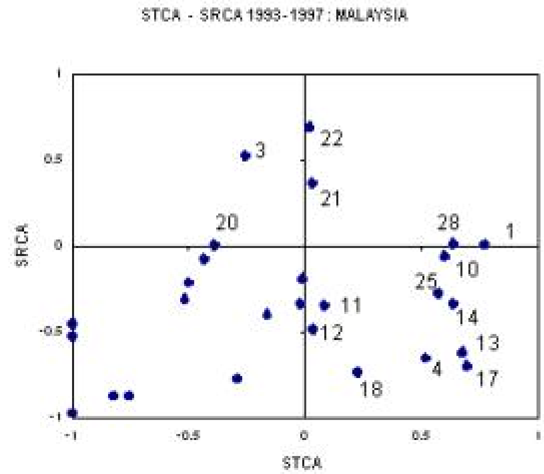
The other East Asian economies' industries share similar trends for changes in the pattern of trade and technological specialisation. The first period is characterised by the absence of industries in the upper right quadrants where no industry operated with both technological and trade specialisation, except for the petroleum refinery (10) in Malaysia and the wood (3) and toy (28) industries in the Philippines. In the second period, several industries emerged in the upper right quadrant. These industries are more or less those that were traditionally advantaged in the advanced economies in East Asia but were losing or lost their comparative advantages, such as textiles (2), woods (3), and toys (28). Thus, the traditional industries, whose comparative advantages were diminishing in the more advantaged East Asian economies, were gaining ground in these economies.

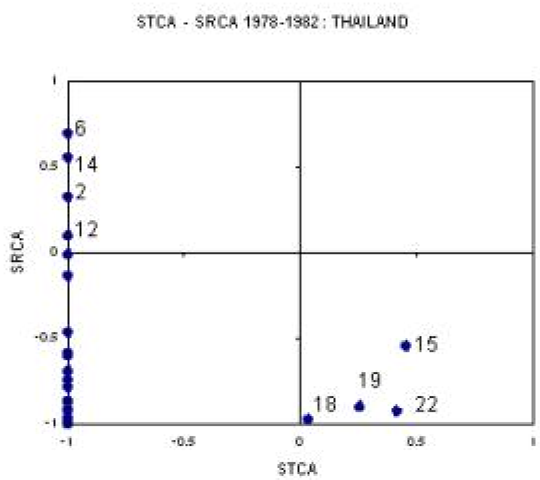
Along with these changes, a few medium- and high-tech industries also gained both technological and trade specialisation or trade specialisation alone in the second period, these included industries in Malaysia, the Philippines and Thailand. In Malaysia, a weak technological specialisation appears to accompany higher levels of trade specialisation in the electrical (21) and electronics (22) industries, while the computer industry began to gain trade advantage. The electrical (21) industry in the Philippines gained technological and trade advantages, whereas its electronics (22) industry recorded the highest level of trade advantage without technological advantage. Similarly in Thailand, the computer (20), electrical (21) and electronics (22) industries gained higher trade advantages without technology in this period. In short, in these economies, a mixture of traditional or low-tech labour intensive industries co-exist with relatively high-tech industries. While the role of indigenous effort in these economies cannot be underestimated, the transformations experienced are likely to be influenced significantly by foreign direct investment and multinational corporations' activities. In particular, in industries, particularly high-tech ones, that do not have corresponding technological specialisation, then measurements of trade specialisation are most likely capturing assembly type of activities.

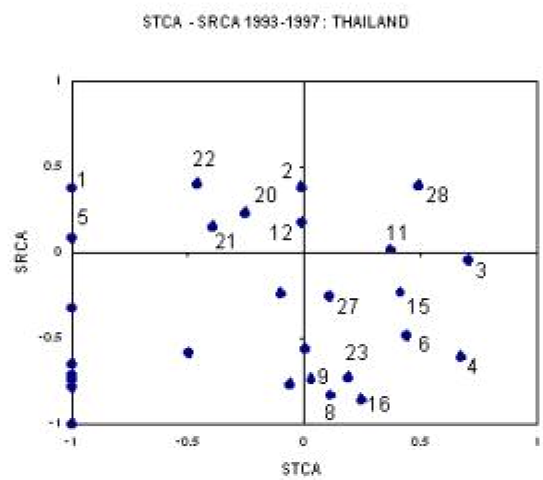
Graph 2: The Relationship between STCA and SRCA





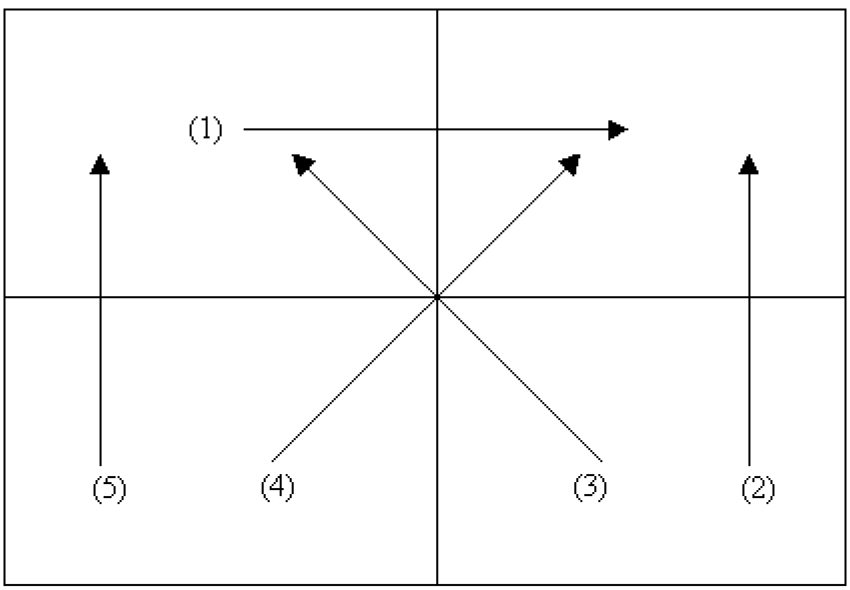






Interesting implications can be revealed from the analysis so far by examining the movement of industries between the two periods. These movements are shown in the chart below. An improvement in competitiveness occurs in several ways but the most preferred move is to the upper right quadrant. These movements can be portrayed as follows: (1) a movement of industries from the upper left to the upper right quadrant may signify the outcome of a successful process of learning by doing and reflect a relatively stable trajectory of cumulative technological and trade specialisation; (2) a movement from the lower right to the upper right quadrant reflects a successful technological push; (3) a movement from the lower right to the upper left quadrant may depict an initial technological push; (4) a movement from the lower left to the upper right quadrant indicates that simultaneous advances have been made with respect to technological and trade specialisation, possibly requiring a substantial internal or external shock; finally (5) a movement from the lower left to the upper left quadrant may indicate that an initial stage of learning by doing is taking effect.

Chart 1 The Movement of Industries



Significant movements have been taken place between the upper left and upper right quadrants as indicated by arrow (1). This movement was potentially particularly in the electronics industry but other industries were also involved. These industries included the electronics (22) industry in South Korea, Singapore and Malaysia, the petroleum refining (10) industry in Singapore and Indonesia, the wood (3) industry in Indonesia, the electrical (21) industry in Malaysia, and the food (1) and textile (2) industries in the Philippines. It seems apparent that the high-tech or electronics industry has required a prior period of successful learning by doing, characterised by a high trade comparative advantage without a corresponding technological advantage, to eventually achieve high degrees of technological and trade specialisation.

Interestingly, although not entirely unexpected, no industries followed the direction of arrow (2) reflecting a pure technological push. The third movement, involving the synthetic resins (5) industry in South Korea, agricultural chemical (8) in the Philippines and electronics (22) in Thailand reflect the results of an initial technological push contributing to advantages in trade. The forces behind the initial tendency towards technological specialisation may have resulted from indigenous initiatives, although with this movement technological advantage is not maintained. As a consequence, the direction these industries will take in the future is unclear.

Eight industries followed the direction indicated by arrow (4). These involved the printing (4) industry in Hong Kong, the computer (20) industry in Singapore, the textile (2) industry in Indonesia, the food (1) and toy (2) industries in Malaysia, the electricals (21) in the Philippines, and the rubber (11) and toys (28) in Thailand. In these cases foreign direct investment and multinational corporations activities are likely to have played a significant influence in the rapid advance of these industries, and particularly in the catching-up economies.

The movement depicted by arrow (5) is characteristic of many of the industries in the catching-up economies of East Asia. It applies to paper and printing (4), agricultural chemicals (8), and non-ferrous product industries (14) in Indonesia, the computer (20) industry in Malaysia, the toy (28) industry in the Philippines, and the food (1), synthetic resins (5), computer (20), and electrical (21) industries in Thailand. It appears these economies achieved initial success through learning by doing that was most likely linked to foreign direct investment and multinational corporations activities between the two periods. Whether trade specialisation is to be accompanied by future technological specialisation among these industries remains uncertain.

Finally, it ought to be pointed out that there is a noticeable movement that can be observed only in Hong Kong and South Korea, from the upper right to the upper left quadrant. This occurred in the textile (2), rubber (11), fabricated metal (15), shipbuilding (25), and toy (28) industries in South Korea and the electronics (22) and instruments (27) industries in Hong Kong. South Korea's shift clearly reflects the transformation of its industrial structure towards more high-tech industries. However, the finding for Hong Kong may indicate that it is losing its technological edge in the high-tech industries, in particular in the electronics industry.

In summary, the regression analysis has revealed some support for the hypothesis that technological specialisation determines subsequent trade specialisation in the cases of Hong Kong, South Korea and Singapore. An interesting finding is that this causal relationship appears to have been preceded in the past by the reverse causality that runs from trade to technology as far as Hong Kong and Singapore are concerned. With respect to the rest of the economies, any firm evidence to support the existence of the causal relationship between technology and trade could not be found. More importantly, the analysis of the movements of industries between the two periods, as shown in graph 2, suggests that success in exporting is a significant prerequisite to establishing technological specialisation in a wide range of industries in all economies. Accordingly, a period of successful learning by doing appears to be critical to determining subsequent technological specialisation in these economies.

6. Conclusions

The paper has examined the patterns of trade and technological specialisation and measured the relationship between them in the East Asian developing economies. The country level analysis indicated that differences in the patterns of specialisation among the East Asian economies was greater for technology than trade. Cumulative or path-dependent technological change was found to be important in Hong Kong, South Korea and Singapore. These economies have broader degrees of technological specialisation than the other economies in East Asia. The other economies appear to be experiencing diversification and change in their patterns of technological specialisation, indicating that they are undergoing structural change as they attempt to catch up to the leading East Asian developing economies. In contrast, all economies, leading and catching up, appear to have cumulative patterns of trade specialisation. In this respect, trade specialisation is characterised by stability and concentration.

The industry level analysis reveals that only Hong Kong has strong path dependent technological development in a wide range of industries. Fewer industries in South Korea and Singapore show tendencies of cumulative or path-dependency with respect to technological specialisation. Hong Kong's specialisation continues to be found in low technology industries while South Korea and Singapore appear to be moving to a greater extent towards high-tech industries. Technological and trade specialisation is established in a narrower range of industries in the other East Asian developing economies.

The study has also provided partial support for the hypothesis that technological specialisation determined trade specialisation among the leading East Asian economies. Although even among them the causality was in the reverse direction earlier on in their development. This is reaffirmed by the findings from the industry level analysis, which indicated that export success was required in order to establish technological specialisation. Further, the analysis suggests that learning by doing has been significant in developing trade specialisation in all the economies, although it has only been a feature in strengthening technological advantage for the leading East Asian developing economies. A future paper is being developed to examine the way in which competition and policy influence competitive advantage with respect to trade and technology. It is expected that this research will provide statistical measures of the impact of competition and associated policies on innovation and trade.

References:

Amable, B. and Verspagen, B. (1995), 'The role of technology in market shares dynamics,' *Applied Economics*, Vol.27, 197-204.

Amendola, G., Dosi, G., and Papagni, E. (1993), 'The dynamics of international competitiveness,' *Weltwirtschaftliches Archiv*, Vol.129, 451-471.

Amendola, G., Guerrieri, P. and Padoan, P.C. (1998), 'International patterns of technological Accumulation and trade,' in Archibugi, D. and Michie, J. (eds.)(1998), *Trade, growth and Technological change*, Cambridge: Cambridge University Press.

Archibugi, D. and Pianta, M. (1994), 'Aggregate convergence and sectoral specialisation,' in innovation," *Journal of Evolutionary Economics*, Vol.4, 17-33.

Balassa, B. (1965), 'Trade liberalisation and 'revealed' comparative advantage,' *Manchester School of Economic and Social Studies*, Vol.32, 99-123.

Beelen, E. and Verspagen, B. (1994), "The role of convergence in trade and sectoral growth," in Fagerberg, J., Verspagen, B., and Tunzelmann, N. (eds.), *The Dynamics of Technology, Trade and Growth*, Brookfield: Edward Elgar.

Bell, M. and Pavit, K. (1992), "Accumulating technological capability in developing countries," *Proceedings of the World Bank Annual Conference on Development Economics*, pp.257-281.

Cantwell, J. (1989), *Technological Innovation and Multinational Corporations*, Oxford: Basil Blackwell.

Cantwell, J. (ed.) (1993), *Transnational Corporations and Innovatory Activities*, London: Routledge.

Dalum, B., Laursen, K. and Villumsen, G. (1996), 'The Long Term Development of OECD Export Specialisation Patterns: De-specialisation and 'Stickiness',' *DRUID Working Papers 96-14*, Copenhagen Business School.

Dosi, G. (1988), 'Sources, procedures and microeconomic effects of innovation,' *Journal of Evolutionary Economics*, Vol.36, 1126-71.

Dosi, G., Pavitt, K., and Soete, L. (1990), *The Economics of Technological Change and International Trade*, Hemel Hempstead: Harvester Wheatsheaf.

Fagerberg, J. (1994), 'Technology and international differences in growth rates,' *Journal of Economic Literature*, Vol..32, 1147-75.

Grupp, H. and Münt, G (1998), 'Trade on high-technology markets and patent statistics – leading-edge versus high-level technology,' in Archibugi, D. and Michi, J. (eds.), *Trade, Growth and Technical Change*, Cambridge: Cambridge University Press, 168-187.

Hall, B. H., Jaffe, A. and Tratjenberg, M. (2001), 'The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools,' *NBER Working Paper 8498*.

Hart, P. (1976), 'The dynamics of earnings, 1963-1973,' *Economic Journal*, Vol.86, 541- 565.

Hart, P. and Prais, S. (1956), ‘The analysis of business concentration: a statistical approach,’ *Journal of the Royal Statistical Society*, Series 2, Vol.119, 150-191.

Hobday, M. (1990), Telecommunications in Developing Countries: the Challenge from Brazil, London: Routledge.

Johnson, D. (1992), ‘The OECD Technology Concordance (OCT): Patents by Industry of Manufacture and Sector of Use,’ *OECD Science, Technology and Industry (STI) Working Papers 2002/5*, Paris:OECD.

Krugman, P. (1987), ‘The narrow moving band, the Dutch disese, and the competitive consequences of Mrs Thatcher: notes on trade in the presence of dynamic scale economies,’ *Journal of Development Economics*, Vol.17, 15-32.

Krugman, P. (1989), ‘Differences in income elasticities and trends in real exchange rates,’ *European Economic Review*, Vol.33, 1031-1054.

Lall, S. (1992), ‘Technological capabilities and industrialisation,’ *World Development*, Vol.20, 165-186

Lall, S. (2000), ‘The technological structure and performance of developing country manufactured exports, 1985-1998,’ *Oxford Development Studies*, Vol.28, 337-369.

Lall, S. and Teubal (1998), ‘Market stimulating technology policies in developing countries: a framework with examples from East Asia,’ *World Development*, Vol.26, 1369-1385.

Laursen, K. (2000), ‘Do export and technological specialisation patterns co-evolve in terms of convergence or divergence? Evidence from 19 OECD countries, 1971-1991,’ *Journal of Evolutionary Economics*, Vol.10, No.4, 415-36.

Laursen, K. and Engedal, C. (1995), ‘The Role of the Technology Factor in Economic Growth: A Theoretical and Empirical Inquiry into New Approaches to Economic Growth,’ *Unpublished MA dissertation*, University of Aalborg.

Metcalfe, S. and Soete, L. (1984), ‘Notes on the Evolution of Technological and International Competition,’ in Gibbons, M., Gummett, P. and Udgnombar, B. (eds.), *Science and Technology Policy in the 1980s and Beyond*, Essex: Longman.

Mowery, D. and Oxley, J. (1997), ‘Inward technology transfer and competitiveness: the role of national innovation systems,’ in Archibugi, D. and Michi, J. (eds.), *Technology, Globalisation and Economic Performance*, Cambridge: Cambridge University Press.

Narula, R. and Wakelin, K. (1995), ‘Technological Competitiveness, Trade and Foreign Direct Investment,’ *Research Memoranda No.19*, Maastricht Economic Research Institute on Innovation and Technology, University of Limburg.

Posner, M. (1961), ‘International trade and technical change,’ *Oxford Economic Papers*, Vol.13, 323-341.

Quah, D. (1996), ‘Empirics for economic growth and convergence,’ *European Economic Review*, Vol.90, 1353-75.

Soete, L. (1981), ‘A general test of the technological gap trade theory,’ *Weltwirtschaftliches Archiv*, Vol.117, 638-666.

Soete, L. (1987), ‘The impact of technological innovation on international trade patterns: the evidence reconsidered,’ *Research Policy*, Vol.16, 101-130.

Verspagen, B., van Moergastel, T., and Slabbers, M. (1994), MERIT concordance table: IPC – ISIC (rev.2), *MERIT Research Memorandum 2/94-004*, Maastricht Economic Research Institute on Innovation and Technology, University of Limburg.

Appendix 1: Industrial Classification

A concordance table has been developed drawing on the following sources: Johnson (1992), Verspagen, van Moergastel and Slabbers (1994), Amendola, Guerrieri and Padoan (1998), Jon Haveman's Industrial Concordances (www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeConcordances.html), and IFI CLAIMS Patent Services, Patent Intelligence and Technology Report (www.ificlaims.com/ifipitx/pitindx.htm).

The industrial categories used broadly correspond to the International Standard Industrial Category (ISIC). For East Asia, a new category relating to amusement devices (toys and games) has been added. Where an industry's product belongs to more than one industrial category, the number of patents and export values are divided by the number of industrial categories that belong to the industry.

1	Food and Kindred Products
2	Textiles, Apparel and Leather
3	Furniture, Wood Products and Home Fixtures
4	Paper, Paper Products and Printing
5	Plastic Materials and Synthetic Resins
6	Soaps, Detergents, Cleaners, Perfumes, Cosmetics and Toiletries
7	Chemistry and Chemical Products
8	Agricultural Chemical
9	Pharmaceuticals
10	Petroleum Refineries and Natural Gas Extractions
11	Rubber and Plastic Products
12	Stone, Clay, Glass, and Concrete Products
13	Primary Ferrous Products
14	Primary and Secondary Non-Ferrous Products
15	Fabricated Metal Products
16	Engines, Turbines, Motors and Parts
17	Farm, Construction, Mining and Material Handling Machinery and Equipment
18	Metal Working Machinery and Equipment
19	Industrial Machinery and Equipment
20	Computing and Office Machines
21	Electrical Apparatus, Equipment and Machinery
22	Electronics
23	Motor Vehicles and Parts
24	Aircraft and Parts
25	Ship and Boat Building and Repairing
26	Railroad Equipment
27	Professional and Scientific Instruments
28	Amusement Devices
29	Miscellaneous Manufacturing