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Beyond Flying Geese: The Expansion of East Asia's Electronics Trade

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Abstract. *The flying geese (FG) hypothesis, which asserts the sequential catching-up processes of the latecomers, holds well in the past. Yet a simultaneous boom within the electronics industry across East Asia casts doubt on the applicability of the hypothesis. By using the* RCA *and* NET *indices, the paper finds that the FG pattern shows in the electronics industry as a whole, but not always so at the disaggregated level. This suggests that the FG formation may not appear in other industries, if they are involved in international production fragmentation or have differentiated products, and if certain latecomers have become new leaders.*

JEL classification: *F*2, *F*14, *O*53.

Keywords: Flying geese pattern; East Asia; electronics; trade; *RCA*; net trade index.

1. INTRODUCTION

The East Asian developing economies have been growing rapidly for quite a few decades. While the world economy as a whole grew at an annual average rate of 3.0% for the 1985–2000 period, China and middle-income East Asia grew at 9.6% and 7.5%, respectively, over the same period. East Asia's fast growth has usually been attributed to its outward trade orientation, though controversy remains as to the nature of the causality between exports and growth (Noland, 1997). Indeed the region's exports have increased considerably over time. The combined market shares of the four newly industrializing economies (Hong Kong, Korea, Singapore, and Taiwan; the NIEs hereafter) in world exports rose from an annual average of 3.8% for 1970–84 to 9.0% for 1985–2000.

In the meantime, an orderly shift in terms of comparative advantage from Japan to the East Asian latecomers has been identified (Petri, 1993). Specifically, the NIEs have been found to follow Japan in export structure with a lag of 15 to 20 years, the economies in Southeast Asia are ten years

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further behind, and China trails the Southeast Asian countries by another few years (Pearson, 1994; Lim, 1991). These findings are in line with the 'flying geese' (FG hereafter) hypothesis (Akamatsu, 1961; Kojima, 2000), which asserts that the latecomer economies replicate the industrialization experience of a leader economy. Alternatively, the FG hypothesis regards each economy as climbing a 'product ladder' in stages from simple consumer goods to technically sophisticated products, and each industry as moving down a 'country ladder' from the most advanced economy to the least advanced ones.

Past studies have shown that the FG pattern holds well in the cotton textile, steel, machinery, light electronics, and many other industries in East Asia (Dowling and Cheang, 2000; Kojima, 1958, 1977). However, a simultaneous boom within the electronics industry has started to emerge across the region since the late 1980s. In 1985–98, electronics exports expanded at an annual average rate of 18.6% for the NIEs, 25.8% for five Southeast Asian economies (Indonesia, Malaysia, the Philippines, Thailand, and Vietnam; the ASEAN5 hereafter), and 52.8% for China, all of which have surpassed that of the world's electronics exports (13.5%). This simultaneous expansion poses interesting questions. Does the FG pattern still show up in the electronics industry in East Asia? More fundamentally, when is the FG pattern anticipated to appear or not to appear in other industries? With these questions in mind, the paper looks into East Asia's electronics trade.

This study is primarily an empirical analysis and a methodological use of East Asia's trade data. It aims to provide a better understanding of whether or not a systematic trade pattern exists between leader and follower economies. The paper begins with a review and exposition of the FG pattern. Although the driving forces behind the formation of the pattern are not within the scope of the study, the possible limitations of the hypothesis are considered. To assess the validity of the FG hypothesis, the revealed comparative advantage index, which is the most commonly used measure of comparative advantage, is adopted. In addition, a net trade index is constructed to capture the fact that the electronics industry has experienced heavy intra-industry trade. The FG hypothesis holds in the electronics industry as a whole in terms of both indices, but the results at the more disaggregated level are rather ambiguous. This suggests that the systematic trade pattern may also not appear in other industries, provided that they are intensely involved in international production fragmentation or have many differentiated products, and if certain latecomer economies have already advanced into technological frontiers.

2. FLYING GEESE AND BEYOND

The term 'flying geese' is frequently used but rarely defined explicitly. It is therefore necessary to begin with a clear exposition of the FG pattern, before a discussion of its theoretical credibility and possible limitations.

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2.1. Lead goose and follower geese

The FG hypothesis originated in the 1930s with Akamatsu, who based his studies on the pre-war Japanese textile industry. The various versions of the hypothesis are reviewed in Kojima (2000). Figure 1 reproduces Kojima's (2000) graphical representation of Akamatsu's FG pattern, in which a single industry's growth is depicted by three curves denoting imports, production, and exports. At time t_1, the products of this new industry are all imported. When domestic demand is sufficiently large to support home manufacturing, production techniques are imported from the more advanced countries, and the import substitution phase begins at t_2. As domestic production gains in efficiency with the passing of time, the need for imports gradually reduces. At t_3, exports become possible, and the *E*-curve crosses the *M*-curve at t^*. In view of the successive appearances of the three time-series curves, each having an inverted V shape, the curves resemble a flying geese formation, this being the reason why the term was so coined by Akamatsu.

There are two variants of the basic import–production–export pattern. First, an economy moves up a 'product ladder' when upgrading continuously its industrial structure. In Figure 1, the commencement of domestic cotton textile (consumption goods) production at time t_2 (in the lower part of the figure) necessitates the imports of textile machines (capital goods), and triggers a new cycle of development in the latter industry, which is depicted in the upper-right corner of the figure.

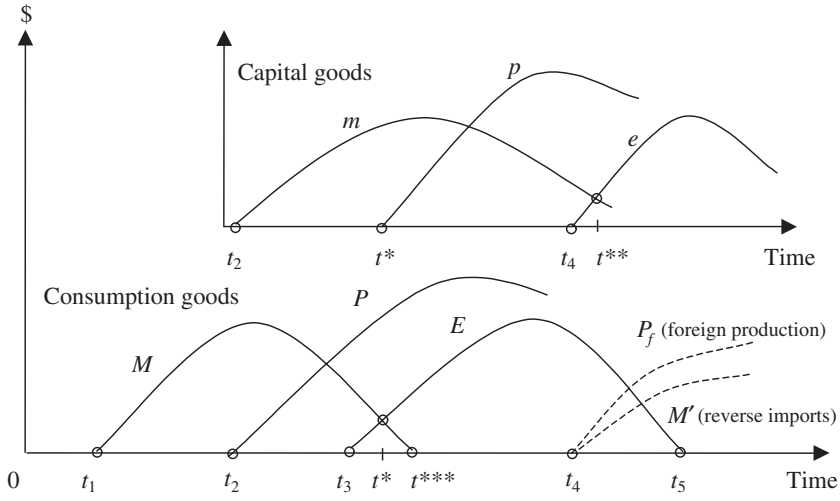

Figure 1 The flying geese pattern of industrial development (*à la* Kojima)

Note: The two points of t^{***} and t_5 are not specified in the original figure of Kojima (2000).
Source: Kojima (2000, p. 378).

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Second, an industry moves down the 'country-ladder' through pro-trade-oriented foreign direct investment (FDI) or similar transmission mechanisms.[1] As an advanced economy upgrades its industrial structure, the technologically less sophisticated goods are put into production in a less advanced economy, where the import–production–export process repeats itself over again. From time t_4 on, the advanced economy 'reverse imports' from the less advanced economy. In due time, the industry will be passed on to economies with even lower technological capabilities.

The well-observed FG pattern has been modelized in various manners. For example, Shibata and Inamura (2000) have formulated the FG hypothesis in terms of the new growth theory. More generally, the FG phenomenon is consistent with both the Heckscher–Ohlin (HO) factor endowment theory and the product cycle theory. Petri (1993) has demonstrated empirically that a static HO model does not fit the case of East Asia. However, 'over time factor ''endowments'' are not given, but evolve in response to the behavior of the countries themselves' (Deardorff, 2001, p. 169). Along similar lines, Jensen and Wang (1997) showed how changes in factor endowments affect the industrial structure and future growth prospects in a neoclassical framework.

Besides factor accumulation, technological diffusion and the subsequent catching-up are the other source of industrial restructuring in the FG process. The celebrated product cycle theory of Vernon (1966) has often been associated with the FG hypothesis. Kojima (2000) amalgamated Akamatsu's (1961) idea of the country ladder with the product life cycle model of foreign direct investment into his 'catching-up product life cycle theory', which is better known today than most other versions of the FG hypothesis. And Dinopoulos *et al.* (1993) combined the product cycles into an HO structure. On top of these studies, there is a large literature on the mechanism of technological diffusion. Van and Wan (1999), for example, proposed a game-theoretic approach of international technology transmission. These rigorous theoretical studies provide a solid support for the FG hypothesis.

2.2. Beyond the flying geese

Although the FG pattern is theoretically credible and empirically well-observed, an uncritical application of it to the present-day East Asian experience can be misleading. For one thing, import substitution does not always precede exports as prescribed in the basic pattern. For example, Taiwan's export capacity of electronics parts and components in the 1960s, established by the multinational corporations, did not build on any substantial import substitution (Tung, 2001). Second, the reversed imports into Japan have never been empirically significant. Japan remains as a net

1. As opposed to an anti-trade-oriented FDI, a pro-trade-oriented FDI is 'undertaken from an investing country's comparatively disadvantaged industry', making its foreign production 'to achieve a stronger comparative advantage through providing appropriate capital goods and technology' (Kojima, 2000, p. 383).

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exporter to its East Asian neighbors till today.[2] Third, no product maintains a static position on the product ladder. Examples abound concerning how the East Asian states have consciously promoted high-tech industries simply because these are considered development musts (Hong, 1997, p. 1).

A priori, it should be asked when one does not expect the FG pattern to show up. One possible scenario is when a country trades relatively little or grows slowly. The FG hypothesis is based on the experiences of the high-growth and high-exporting economies of East Asia. In sharp contrast, Latin America's share in world exports has remained rather stable between the two periods of 1970–84 (3.7%) and 1985–2000 (3.8%). It turns out that no FG pattern has been observed in these 'sitting duck' economies (Mortimore, 1993).

Moreover, the FG process applies to manufactured goods, not primary products (Huang, 2001). Natural rubber is an important export for Indonesia, but the country's comparative advantage in this product has surely not been passed on from the resource-poor NIEs.

Even for manufactured products in East Asia, the FG relations may fail to appear. First, the FG pattern is based on the conventional division of labor among economies. Yet the international production fragmentation, which refers to the fragmentation of the production process across national borders, has become increasingly important in recent years (Cheng and Kierzkowski, 2001). For instance, up until the mid-1980s, most of the integrated circuits in the world had been produced by firms capable of both design and fabrication. By 1987, the separation between manufacturing and design was made possible when a Taiwanese firm innovated to provide fabrication services only. Lately, chips designed in the USA are often manufactured in Taiwan, and packaged in China (Tung, 2001).[3] With the progress of the international production fragmentation, the sequential FG relationships are being critically disturbed.

Second, the FG pattern is a story about a flock of developing economies following an advanced economy. Currently the NIEs are already engaging in own-design manufacturing in certain areas (Hobday, 1995), and have earned reputations as the top fabricators in the world, especially after the finer division of labor under a globalized production scheme (Tung, 2001). By serving as export platforms for foreign multinational corporations to produce the first units of certain new products anywhere in the world, these latecomer economies have become leaders in some areas themselves.

Third, the FG pattern used to work well in industries defined at an adequately high level of aggregation with little intra-industry trade. Most economies nowadays specialize in certain differentiated or niche products within an industry of a broad category. The anticipated FG pattern may thus

2. One likely reason is that Japan has retained high barriers to manufacturing exports from its neighbors (Terry, 1996).
3. The international production fragmentation is accompanied and accelerated by the increase of FDIs by both the old (the advanced economies) and new (the NIEs) investors (Ito *et al.*, 2000).

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become blurred when referring to individual products, such as the Winchester hard drives regarding which Singapore has supplied over half of the world demand in some years (Hobday, 1995).

The above discussion may not be comprehensive. Yet it already seems plausible that the FG pattern may fail to appear in the electronics industry, given that a number of the early followers have become leaders in various areas, and that the industry is involved in international production fragmentation and that it has many differentiated products.

3. REVEALED COMPARATIVE ADVANTAGE

The test of the FG hypothesis is usually based on a measure of the comparative advantage, which governs the pattern of international trade. Two indices of the comparative advantage are calculated in this and the next section, based on the three-digit SITC trade figures from the World Trade Database, which is compiled by the International Trade Division of Statistics in Canada. The data set extends from 1970 to 1998.[4] For the convenience of discussion, the entire observation period is broken down into two sub-periods of 1970–84 and 1985–98. The world total and 11 East Asian economies (Japan, the NIEs, the ASEAN5, and China) are covered. The electronics industry is divided into five sub-sectors, namely consumer electronics (SITC codes 751, 761, 762), IT products (code 752), telecommunications products (code 764), parts and components (codes 759 and 772), and semiconductors (code 776). All data are expressed in current US dollars.

Table 1 summarizes the percentage shares of the electronics industry in East Asia's total exports and imports for 1970–84 and 1985–98. Both the export and import shares have increased substantially between the two periods in all sub-sectors in each of the country groups presented (except for Japan's import of parts and components). A comparison of the export shares of the four country groups for 1985–98 shows that the NIEs have caught up with Japan, while the ASEAN5 and China follow behind. It seems to imply that the FG hypothesis still holds. This rough observation needs to be assessed more carefully, however.

The most commonly used measure of international comparative advantage is the revealed comparative advantage index (*RCA*) *à la* Balassa (1965):[5]

$$RCA_{ik}^{t} \equiv \frac{x_{ik}^{t}}{x_{k}^{t}}$$

4. The Asian Financial Crisis erupted unexpectedly in 1997. Yet the main findings of this study do not seem to be critically affected.
5. Vollrath (1991) has compared ten different *RCA*s. The current formula is exactly his *RCA3*, and is one of the two most preferred formulas among all of them. Since the index is used here at a relatively low level of commodity aggregation, the usual double-counting problem of *RCA3* will not be serious.

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Table 1 Export and import shares of electronics (%)

	Japan		NIEs		ASEAN5		China	
	1970–84	1985–98	1970–84	1985–98	1970–84	1985–98	1970–84	1985–98
(% in total exports)								
Electronics	13.21	24.09	11.22	25.01	2.35	18.70	0.40	6.75
Consumer electronics	5.44	4.11	4.59	6.31	0.17	4.90	0.19	2.79
IT products	0.56	4.05	0.20	5.49	0.01	1.74	0.003	0.94
Telecommunications	4.59	7.38	2.48	4.98	0.10	3.20	0.10	1.95
Parts and components	1.26	2.80	0.82	1.47	0.53	1.01	0.11	0.62
Semiconductors	1.36	5.75	3.13	6.76	1.55	7.84	0.01	0.44
(% in total imports)								
Electronics	2.30	8.23	7.87	19.37	5.65	17.89	2.44	11.32
Consumer electronics	0.39	1.78	1.45	3.28	0.82	2.25	0.78	2.12
IT products	0.38	1.88	0.25	1.93	0.16	0.84	0.31	1.03
Telecommunications	0.33	1.53	1.96	3.62	1.75	3.67	0.70	4.75
Parts and components	0.60	0.58	1.37	1.94	1.02	2.21	0.44	1.27
Semiconductors	0.60	2.46	2.85	8.61	1.89	9.01	0.21	2.15

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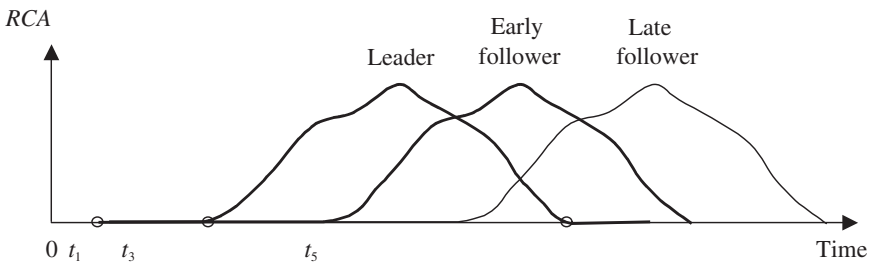

Figure 2 Revealed comparative advantage (*RCA*) during the FG process

where x_{ik}^t is the share of country *i*'s (Japan, the NIEs, the ASEAN5, or China) export to the world in year *t*, accounted for by exports of product *k* (each of the five electronics products, or the electronics industry as a whole), and x_k^t is the share of product *k* in total world exports in year *t*. The index varies between 0 and infinity: 0 indicates no exports at all, 1 is the benchmark value indicating 'average' comparative advantage relative to all exportable goods within the economy, and a high *RCA* indicates large advantage.

Figure 2 idealizes the *RCA* of a product during the FG process, with the *RCA* curve mapping the performance of exports. The index is 0 during both the import stage and most of the import substitution phase. When exports begin at t_3, the index rises above 0. Then it continues to rise as competitiveness improves through learning-by-doing or similar mechanisms. When other new industries become relatively more competitive, the index starts to reduce. Finally, when a lower-rung economy takes over the production and 'reverse exports' to the home country (at t_5), the index becomes 0 again.

As the follower economies are expected to lag behind the leader in terms of industrial and trade structures for a few years, their *RCA* curves will lie to the right of that of the leader. The lower the economy is on the country ladder, the further right its *RCA* curve lies. Depending on the length and starting point of the observation period, the shapes and relative positions of the *RCA* curves being observed may be very different.

The time-series data of the *RCA*s for electronics over the 1970–98 period are illustrated in Diagram 1. The industry and its five sub-sectors are shown separately. In Diagram 1(1), which depicts the electronics industry as a whole, Japan can clearly be identified as the leader. Its *RCA* curve is followed by the NIEs, the ASEAN5, and China in an orderly manner. The NIEs are seen to become more competitive than Japan from 1993 onward, and are in turn overtaken by the ASEAN5 in 1998. China lags behind, but progresses rapidly. Its *RCA* first exceeded the benchmark value of 1 in 1998.

As for the sub-sectors, both Diagrams 1(2) and 1(3) exhibit the typical FG pattern. In consumer electronics, the NIEs overtook Japan in 1986, and were caught up by the ASEAN5 in 1995. In IT products, the NIEs have outperformed Japan since 1989 and reached a higher peak (2.66) in 1996 than Japan ever did throughout the observation period (2.15 in 1988).

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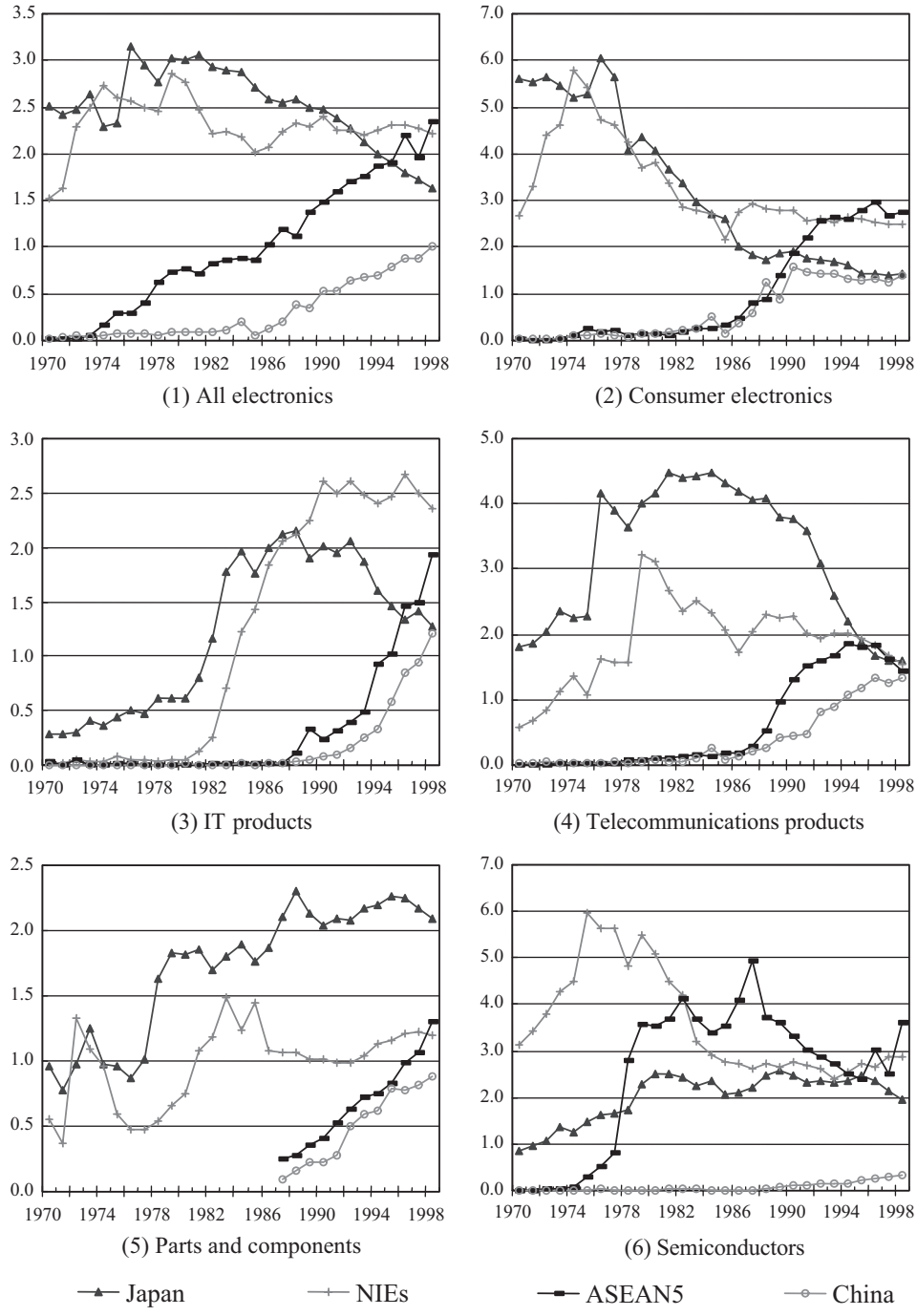

Diagram 1 *RCA*s for the electronics industry (1970–98)

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The country ladder is less apparent in telecommunications products as shown in Diagram 1(4). Japan's *RCA* curve remained above that of the NIEs until 1995. Yet it is hard to tell which economy has been the leader since 1995, as the *RCA*s of both the NIEs and the ASEAN5 are very close after 1995, and the *RCA*s of all four groups are close by 1998.

The sequential relationships are more obscure in Diagrams 1(5)[6] and 1(6). In parts and components, the NIEs were caught up by the ASEAN5, yet Japan continues to have an edge over the NIEs and the ASEAN5 (except for 1973). It is quite the opposite with semiconductors. The NIEs have also been caught up by the ASEAN5, but Japan has never appeared to be competitive enough to play the leader's role, in spite of the fact that it is the second largest producer in the world, and second only to the USA.

To summarize, the results concerning the existence of a country ladder in the electronics industry are mixed. The FG pattern is apparent in the electronics industry as a whole, as well as in consumer electronics and IT products. Yet the other three sub-sectors do not exhibit the sequential relationship among economies.

4. NET TRADE INDEX

To verify the validity of the *RCA* analysis, the net trade index (*NET*), is constructed. The index is an 'on average' indication of 'true' comparative advantage (Deardorff, 1980; Ballance *et al.*, 1987). As no knowledge of the trade performances of other industries is used, the index does not contrast the trade behavior of one commodity with another (Vollrath, 1991). The index is therefore rarely used in past studies, as most of which focus on multi-product comparisons. But it serves the purpose of the current study of single industries well.

The *NET* index is defined as follows:

$$NET^t_{ijk} \equiv \frac{X^t_{ijk} - M^t_{ijk}}{X^t_{ijk} + M^t_{ijk}}$$

where X^t_{ijk} (M^t_{ijk}) is country *i*'s (Japan, the NIEs, the ASEAN5, or China) exports (imports) of product *k* (each of the five electronics products, or electronics as a whole) to country *j* (either the four country groups or the world) in year *t*. By construction, the index varies between –1 and 1: 1 indicates pure exports and the highest comparative advantage; –1 indicates pure imports, and the highest disadvantage; and 0 indicates balanced trade, or the maximal intra-industry trade.

6. Pre-1987 data for the ASEAN5 and China are not plotted because they are too small or fluctuate too much.

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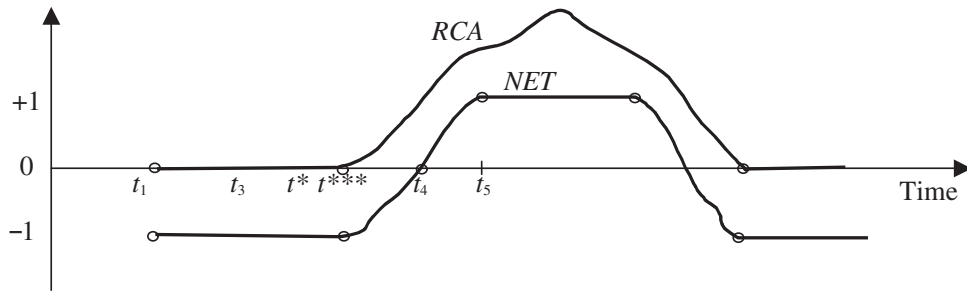

Figure 3 Net trade index (*NET*) during the FG process

Figure 3 idealizes the changes in the *NET* during an FG process. The index is set to rise from −1 to 1 and then decrease back to −1 over its life cycle. Before exports start at t_1, the *NET* equals −1. The index increases with the commencement of exports at t_3. Then at t^* when exports are equal to imports in value terms, it becomes 0. The index continues to rise as the industry gains in competitiveness. As imports come to a full stop at t^{***}, the index stays at 1 until reversed imports take place (at t_4), then the index gradually decreases. When exports stop completely and the economy turns into a pure importer (at t_5), the index becomes –1 again. The *NET* curves of the followers, not drawn in Figure 3, lie to the right of that of the leader.

Note that the sign of the *NET* carries the information concerning the net trade positions of the industry, while the *RCA* does not. The *NET* is therefore a sharper tool with respect to competitiveness than *RCA*, when there is intra-industry trade within the industry (between t_3 and t^{***}, and between t_4 and t_5 in Figure 3). The *NET* index conveys less information than the *RCA* index only in the case when the economy is a pure exporter (between t^{***} and t_4).

The time series of the actual *NET*s are presented in Diagram 2.[7] Both the aggregate electronics industry and the IT products exhibit a rather clear FG pattern in Diagrams 2(1) and 2(3). And the FG pattern is again absent in the telecommunications products, parts and components sub-sectors as shown in Diagrams 2(4), 2(5) and 2(6). These results echo those of the *RCA* analysis, except for some minor differences, such as the gap between China and the ASEAN5 seems to be smaller than in the *RCA* analysis.

Diagram 2 presents other differences. First, it is ambiguous whether the country ladder shows up or not in the consumer electronics sub-sector, as the NIEs are found to have been caught up by the ASEAN5 while Japan was still in the lead during 1990–94, as shown in Diagram 2(2). Second, Japan appears to be more competitive in all the sub-sectors in terms of the *NET* index. The country stays ahead of all the followers during the observation period in the

7. Pre-1987 data for the ASEAN5 in parts and components and for China for all sub-sectors are not plotted in the diagram because they are too small or fluctuate too much.

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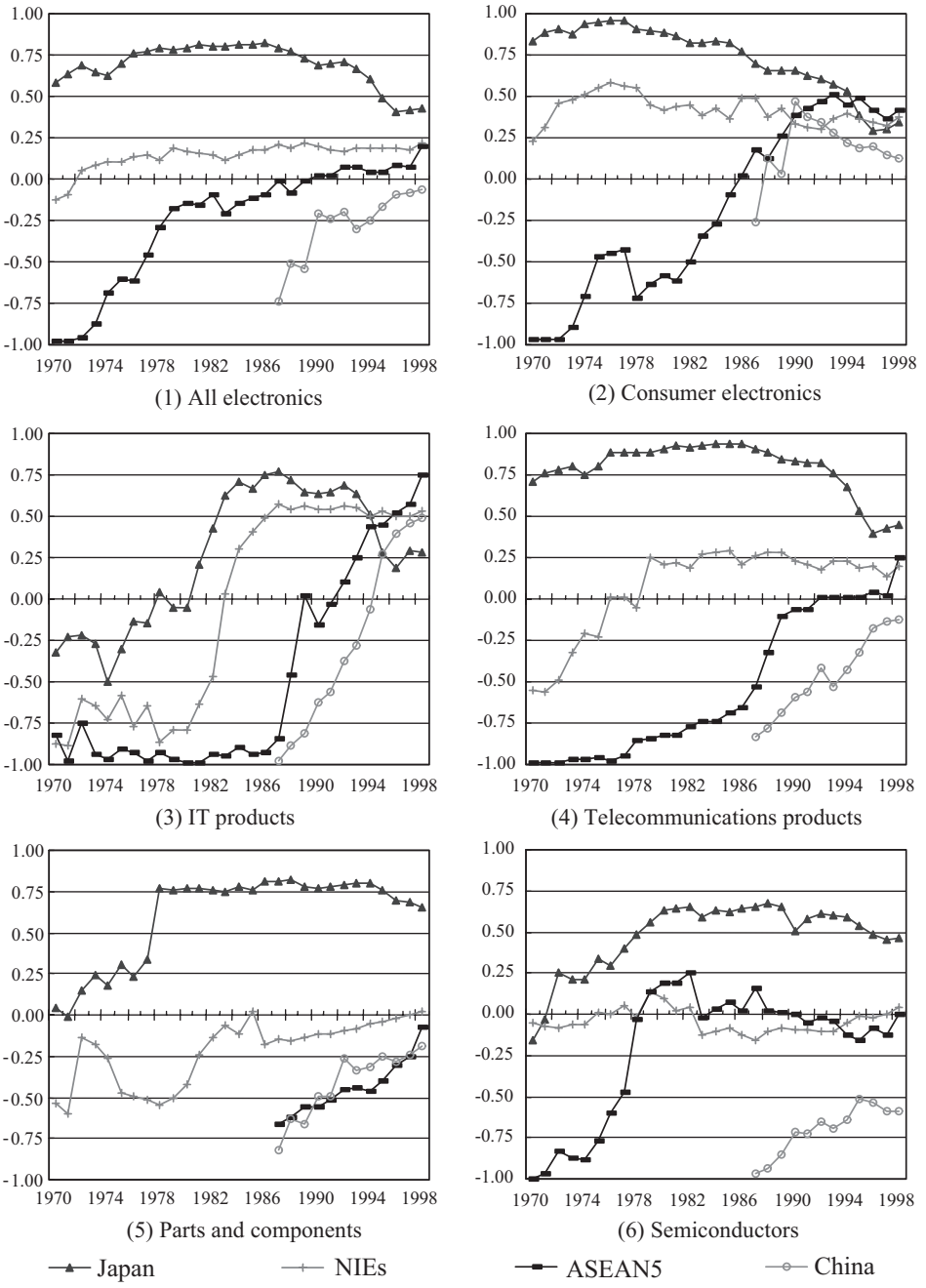

Diagram 2 *NET*s for the electronics industry (1970–98)

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electronics industry as a whole. In consumer electronics and IT products, Japan lost the lead to the NIEs about a decade later than in the *RCA* analysis. More notably, the economy has an edge over all other country groups in semiconductors, despite the fact that its *RCA*s have always been below those of the NIEs.

The inclusion of imports data is at the heart of the differences. As explained above, the *NET* is a more relevant index of competitiveness than the *RCA* when an economy exports and imports the products within an industry at the same time. Specifically, Japan imports a disproportionately lower value of electronics than its Asian neighbors. Recall from Table 1 that for 1985–98, the percentage share of electronics in Japan's total imports was only 8.2%, while the import shares of the NIEs, the ASEAN5, and China were 19.4%, 17.9%, and 11.3%, respectively.

Table 2 shows the overall *NET*s of the four country groups, along with the bilateral *NET*s between the followers and Japan in the electronics industry. The upper part of the table lists the *NET*s of each group's trade with the world. Japan has the highest comparative advantage. The NIEs come second, and are followed by the ASEAN5, and lastly by China. For the industry as a whole, Japan, the NIEs, and the ASEAN5 have all been net exporters for 1985–98, while China remains as a net importer.

The bilateral *NET*s between Japan and the East Asian followers are presented in the lower part of the table. The first two columns report Japan's net trade positions in relation to the ten followers. Again, Japan has been a net exporter to the East Asian latecomers. Yet all the followers have been net importers in relation to Japan in all five sub-sectors, though the bilateral *NET*s of the followers have improved in the second period.[8] What is more, among the followers, the NIEs do not appear to have a clear lead over either the ASEAN5 or China. The bilateral *NET*s of each of the three follower groups in relation to Japan are rather close in the 1990s. For the industry as a whole, China even has a slightly higher bilateral *NET* than the NIEs since 1995. The ranking of the followers has not been expected.

To sum up, the results of both the *RCA* analysis and the *NET* analysis are in part consistent with earlier findings, such as those in Kojima (1977) on the light electronics industries and in Dowling and Cheang (2000) on both the IT industry and the electronics industry (exclusive of the IT products). Yet by extending into a more disaggregated level, the orderly FG formation becomes less clear. To be specific, the telecommunications, parts and components, and semiconductors sub-sectors do not exhibit a clear FG pattern. Furthermore, by taking import data into consideration, the East Asian followers are found to be net importers in relation to Japan despite their successes in world markets, while the sequential order among the followers becomes more blurred.

8. But each of the three groups has managed to export more IT products to Japan than to import from Japan every year in 1995–98.

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Table 2 Net trade index for electronics

	Japan		NIEs		ASEAN5		China	
	1970–84	1985–98	1970–84	1985–98	1970–84	1985–98	1970–84	1985–98
(*NET* with the world)								
Electronics	**0.73**	**0.64**	**0.10**	**0.19**	**−0.49**	**0.02**	**−0.49**	**−0.37**
Consumer electronics	0.89	0.57	0.45	0.38	−0.63	0.31	0.03	0.06
IT products	−0.01	0.55	−0.60	0.53	−0.93	−0.02	−0.93	−0.35
Telecommunications	0.85	0.73	−0.07	0.22	−0.89	−0.15	−0.65	−0.53
Parts and components	0.45	0.77	−0.35	−0.08	−0.34	−0.38	−0.39	−0.49
Semiconductors	0.38	0.58	−0.02	−0.07	−0.38	−0.02	−0.74	−0.74
(*NET* with Japan)								
Electronics	**0.76***	**0.55***	**−0.72**	**−0.55**	**−0.90**	**−0.55**	**−0.99**	**−0.65**
Consumer electronics	0.83*	0.30*	−0.79	−0.33	−0.95	−0.15	−0.96	−0.54
IT products	0.98*	0.33*	−0.96	−0.34	−1.00	−0.25	−1.00	−0.45
Telecommunications	0.84*	0.54*	−0.80	−0.57	−0.99	−0.52	−0.98	−0.57
Parts and components	0.82*	0.75*	−0.78	−0.76	−0.94	−0.79	−0.98	−0.68
Semiconductors	0.51*	0.64*	−0.49	−0.61	−0.74	−0.68	−0.99	−0.87

Note: Figures with an asterisk represent Japan's bilateral *NET*s in relation to the ten East Asian followers.

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5. CONCLUDING REMARKS

This paper begins with a query about whether or not a country ladder exists for the electronics industry in East Asia. The FG hypothesis has served as a good description of East Asia's sequential catching-up experiences of the past. But the new international division of labor since the second half of the 1980s seems to have disturbed the orderly shift in comparative advantages from the leader to the followers. In particular, the simultaneous boom within the electronics industry across East Asia has not been predicted by the FG hypothesis.

Two indices are calculated to analyze the pattern of comparative advantage of the electronics industry. In addition to the frequently used *RCA* index, the *NET* index is also calculated, in view of the heavy intra-industry trade within the electronics industry. The results are mixed. The country ladder is found to exist at the aggregate level, but not necessarily so at the disaggregated level. Moreover, while Japan is found to be the leader when import data are taken into account, there appears no clear order in the ranking among the followers.

It is difficult to answer why the FG hypothesis holds in certain cases but not in others before more empirical evidences on more industries are examined. The purpose of this study, however, is to highlight the fact that the development of some industries has already gone beyond the prescriptions of the FG hypothesis, and to show how the actual experiences differ from anticipation.

The results of the analysis suggest that a country ladder may not appear in other industries, too, provided that they are heavily involved in international production fragmentation or have many differentiated products, and if some latecomer economies have advanced into technological frontiers. Is the electronics industry an exception? Are these industry characteristics rarely found? The answers are probably 'no', as Cheng and Kierzkowski (2001) have reviewed many such industries, including both traditional industries (e.g. apparel and bicycle) and high-tech ones (e.g. electronics). As the world becomes more integrated in terms of production and trade over time, the FG prediction may thus become less applicable.

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