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Author

Ernst, Dieter

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**New Opportunities and Challenges for Taiwan's
Electronics Industry — The Role of
International Cooperation**

Dieter Ernst

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Dieter Ernst, Ph.D., is BRIE's Project Director for research on foreign direct investment. Before joining BRIE, Dr. Ernst had been a senior advisor at the OECD Development Centre (Paris). For over two decades, Dr. Ernst has written about technology and international competition in various industries and implications for firms' strategies and government policies. His most recent books are What are the Limits to the Korean Model? The Korean Electronics Industry Under Pressure and Competing in the Electronics Industry: The Experience of the Newly Industrialising Economies, with David O'Connor.

Introduction

Over the last decade, the Taiwanese electronics industry has emerged as a serious international competitor, especially for a variety of PC-related hardware products. What matters in particular is that Taiwan today has moved beyond labor-intensive products like keyboards and computer mouse, and is now a leading producer of computer monitors, motherboards, scanners, a variety of add-on cards and portable PCs.

Rapid capacity and market share expansion however is only part of the story. In the first part of this chapter, I will briefly state what I consider to be the main achievements and strengths of this industry. This, I feel, is necessary in order to avoid possible misunderstandings on what are the causes for success.

Taiwan's electronics industry today is confronted with new challenges that I will review in the second part of this chapter. I argue that major changes are necessary in the Taiwanese model, in order to cope with this new competitive environment. The current rapid expansion of overseas production by Taiwanese electronics firms needs to be complemented by a progressive deepening of the domestic production system, if serious "hollowing-out" effects are to be avoided. Some Taiwanese firms and the state have started to address this problem, yet progress so far appears to be limited.

In the last part of this chapter, I will describe one possible approach to facilitate this task. Over the last few years, Japanese electronics firms have been forced to gradually open up their international production networks in Asia. I argue that this creates a unique chance

for Taiwanese electronics firms to develop new and more sophisticated forms of international cooperation that could help them to overcome some of their weaknesses. I will use a few illustrative examples to show how Taiwanese firms could enter such arrangements, and demonstrate why both sides could benefit from closer interaction.

I. Achievements and Strengths

What are the main achievements and strengths of the Taiwanese electronics industry?

Based on a number of interviews in this industry over the last years, I would like to single out the following two major achievements:

First, Taiwanese computer firms have been able to sustain their position as leading low-cost OEM (original equipment manufacturing) suppliers, despite the substantial increase in the cost of domestic labor and land. This was made possible by two strategic decisions: to concentrate on cloning established PC architectures and to engage early on in the rapid expansion of overseas production in low labor cost production sites in ASEAN (Association of South East Asian Nations) countries and mainland China. The result is that, in terms of cost, Taiwanese firms in general out-compete their Korean rivals who have relied primarily on automating their domestic mass production lines. The Korean approach has two major disadvantages: it continues to rely on market share expansion through exports when import restrictions have increased both in the US and Europe: and it makes it almost impossible to rapidly adjust to changing market requirements.

This brings me to a second important achievement of Taiwanese firms: their capacity to react very fast to changing market requirements and technological change. By combining incremental product innovation with an incredibly fast speed-to-market, Taiwanese firms

have been able to establish a strong international market position relatively early in the product cycle.

Let me just mention one example: For years, Taiwanese computer firms have accumulated design cells for ICs (integrated circuits) with the result that they can now offer new designs at very short notice. For instance, Taiwanese firms can change a motherboard in 2 to 3 weeks, much faster than even the fastest American company.¹

The primary source of this flexibility appears to be the specific organization of the domestic supply base, especially for parts and components. Speed and flexibility result from two main features of this domestic supply base:

(a) An extreme form of specialization: By engaging in single tasks and by producing, purchasing and selling in small lots, subcontractors avoid heavy fixed capital cost burdens. This makes it relatively easy to shift specialization at relatively short notice and with a minimum of switching costs.

(b) A focus on multiple, volatile and short-term links that involve only limited financial and technology transfers. Short-lived spot-market transactions play an important role, as do “temporary spider web” arrangements that are assembled for the duration of a particular job. Individual firms often bid for contracts beyond their own capacities. Once

¹ Interview with Dr. Cheng, Director, CCL (Computer and Communications Laboratories)/ITRI, May 1995.

a supplier gets the contract, it calls on other firms, often competitors, to help fill the order.²

The goal is to maximize the number of jobs in order to compensate for the razor-thin profit margins that can be gained per job. As a result, every firm tries to avoid to be locked into a particular production network. “Always keep various options open” appears to be a basic rule of business. Taiwan’s domestic supplier networks thus have been “highly flexible and capable of rapid change, but short-lived and centrifugal”(Deyo, Doner and Fields [1993], p.7). They thus represent an extreme form of open and volatile production networks, arguably even more so than the highly flexible production networks that characterize California’s Silicon Valley.

Under such highly volatile circumstances, how do firms manage to cooperate? What mechanisms allow for a reasonably efficient coordination of this system?

In order to correct some popular misconceptions, let me just mention two important factors: the role of the Taiwanese government, especially its industrial policies; and the role of large firms, both Taiwanese and foreign TNCs (trans-national corporation).

² For details, see Shieh [1993]; and Lam and Lee [1993], p.112.

The Role of Industrial Development Policies

In addition to sound macro-economic management, the focus of government policies in Taiwan consistently has been on facilitating market entry by SMEs (small and medium-sized enterprises) rather than on the promotion of large business groups. This is a very different approach, and arguably a superior one, compared to both the Korean and the Japanese approach, where industrial policies in essence have generated strong domestic oligopolies. Unlike in Korea and Japan, the Taiwanese government granted incentives to manufacture and export across the board, and these were certainly not limited to a handful of large business groups.

This particularly type of industrial policy has played a crucial role in the development of Taiwan's domestic subcontracting system. This system has played an important positive role, as long as the main purpose was catching-up. Once the limits of catching-up have been reached, this system however displays some fundamental weaknesses: Most of the SMEs have a very limited capacity to accumulate capital and technological capabilities and thus are severely constrained in their attempts to upgrade their product mix. I will come back to this in a moment.

The Role of Large Firms

Contrary to conventional wisdom, large firms have played a central role in the coordination and development of the Taiwanese production system:

In other words, the separation between SMEs and big business groups has never been that clear-cut in Taiwan as is often assumed in popular debates. Over the last few years, the

enterprises at low cost and high quality(Wade [1990]).

• Finally, SMEs critically depend on the supply of basic materials provided by large public

Matsumita and others that have substantial production platforms in Taiwan.

fulfillment of an OEM contract. The same is true for foreign TNCs like Philips,

affiliated domestic suppliers to which they can pass on the different tasks required for the

The result is that large companies like Tatung, Nanya Plastics and Acer rely on a variety of

bargaining clout with the foreign customer to negotiate profitable contract conditions.

arrangements. Size is essential to secure economies of scale and to achieve sufficient

electronics industry with its heavy dependence on international subcontracting and OEM

are independent only for tax purposes(Amsden [1991]). This is especially true in the

• Many SMEs are for all practical purposes members of a particular business group, and

p. 194).

higher rates through trade credit and loans on the informal curb market(Biggs [1991]).

equipment and working capital to smaller customers, subcontractors and suppliers at

most of their funds to large domestic public and private firms who then on-lend money for

• They have acted as an intermediary source of capital for SMEs. Taiwan's banks direct

importance of big business groups and TNCs has further increased. My impression is that this is especially true for procurement. Important sectors of the electronics industry depend heavily on imports of key components. This has given rise to very complex coordination requirements that only large firms can adequately deal with. Especially for higher-end key components, imports are likely to be concentrated in the hands of a few large companies, as they are the only ones that can reap scale economies and that have a sufficiently strong bargaining position vis-à-vis foreign suppliers.

In short, Taiwan's achievements in the electronics industry have been impressive. In addition to an extremely rapid expansion of production capacity and international market share, what really matters are important organizational and policy innovations. Taiwanese firms thus have been able to develop flexible forms of organization that are essential for any attempt to compete in the fast changing PC industry. This is true in particular for the development of an open, diversified and extremely adaptable domestic subcontracting system.

Probably of greatest importance is that Taiwan has succeeded in developing its own version of late industrialization that is very different from both the Japanese and the Korean role models and that is much more appropriate for a rapidly changing industry like electronics and for the limited resources available to small developing countries.³

³ One should add that the Taiwanese model of late industrialization has many features in common with the industrialization experience of small European countries in the 19th century.

2. New Challenges: What Changes are Necessary in the Taiwanese Model?

Taiwan cannot rest on its achievements. Its flexible, yet highly volatile production system has been tremendously successful, as long as the goal was catching-up in labor-intensive products. It appears however to be ill-equipped to deal with a number of new and much more complex challenges that the Taiwanese electronics industry is facing today. Coping with these new challenges requires fundamental changes in government policies and industry structure, and in the organization and competitive strategies of Taiwanese electronics firms.

What are these new challenges?

Price Wars and Cost Reduction

The first challenge goes back to Compaq's decision in 1991 to shift from a premium price to a low-price strategy. Since then, pervasive price wars have swept through the international PC industry. Taiwan's PC industry has been heavily affected and has suffered a major shake-out. In the end, the result has probably been positive, as the remaining companies are now much stronger. One should note however that Taiwan's vulnerability contrasts with the situation in Singapore where deep and durable links with American PC and HDD companies have helped to shield local firms from negative consequences. One could certainly argue that Taiwan's greater vulnerability to

international price wars result from the fact that its links with foreign computer companies have been relatively loose, shallow and volatile.

In any case, cost reduction now has become the most critical issue in the computer industry. This is especially so for Taiwanese firms which continue to rely heavily on OEM contracts. In a situation where Taiwan's original cost advantages have rapidly eroded, one option would have been to invest in factory automation and to modernize the domestic supply base. While some companies like Tatung have pursued this road, most others have chosen to respond in a very different way. They have engaged in an incredibly fast expansion of overseas production, well before they were able to consolidate and upgrade their domestic production activities. Between 1992 and 1994, the overseas production of Taiwanese computer firms more than tripled, from around \$970 million to more than \$3 billion.

ASEAN countries and China have attracted a large share of these investments. Over time, important changes have occurred in the motivations. A first wave of overseas production was driven primarily by defensive investments of small- and medium-sized producers of labor-intensive products (like keyboards and computer mouse). The main motivation was to cope with the severe price reduction pressures of their foreign OEM clients. Overseas production, for these firms, was the only way to survive the appreciation of the NT (New Taiwan)-dollar, spiraling land costs and severe labor shortages. Investing in mainland China with its lack of investment regulations seemed to offer an easy way out.

Since around 1992, larger firms have entered the fray and have rapidly increased their offshore production lines for monitors and motherboards. For monitors, the share of offshore production has since then exploded. In unit terms, it increased from 12.5% in 1992, to 24% in 1993 to 40% last year. South East Asia accounts for roughly three quarters of the overseas production value, with China adding another 23%.⁴ As demand for these products keeps growing very rapidly, the main motivation for this type of investment has been to expand production capacities, especially for lower-end products, without having to shoulder the very high fixed capital cost burdens that are characteristic today for investments in Taiwan.

Finally, access to newly emerging growth markets in Asia, especially the potentially huge China market, has emerged as a third important motivation. Most countries in the region are still characterized by very low levels of computerization. At the same time, governments nearly everywhere in the region are now very serious in supporting the diffusion of computers in order to modernize their economies. As a result, there are now much better chances that the huge demand potential for computers will be translated into significant effective demand, especially for lower-end PC desktops. Taiwanese computer firms are well positioned to benefit from this growing demand, and have expanded point-of-sale assembly lines in East Asia.

⁴ Data collected at MIC/III, May/June 1995.

What counts for our purposes is the result: The Taiwanese production system for electronics today has to be coordinated across national boundaries. It has become much more complex and is difficult to manage. The Taiwanese electronics industry now has to serve three major regions with very different markets. It also has to cope with sometimes contradictory requirements. The requirements of export platform production differ from those of domestic market-oriented production. International production complicates logistics. Sustaining speed and flexibility under such conditions becomes much more difficult, while at the same time speed-to-market remains crucial for competitive success. Obviously, there is a real danger that the shift to international production could obstruct one of the main achievements of Taiwan: its unparalleled capacity for rapidly adjusting to changing market requirements and technological change.

Upgrading the Product Portfolio

Let us now look at what happened with the domestic production system. While a rapid expansion of overseas production can help to reduce cost, it fails to cope with the second major challenge that Taiwanese firms are confronted with: the need to upgrade their product portfolio and to strengthen their brand recognition. Unlike in the case of Japan, the spread of overseas production has not been accompanied by a sufficient deepening of the domestic production system. Industrial deepening occurs when a country succeeds in establishing an increasingly dense web of reasonably stable forward and backward linkages; a broad mix of technological and organizational capabilities; strong support industries for key components; and close interactions between its R&D infrastructure and

industrial production. It is hard to deny that on each of these four counts, Taiwan's electronics industry still displays some major weaknesses.

The result has been a serious mismatch between the speed of expansion of overseas production and the speed of upgrading the domestic production system. What are the causes for this mismatch? Two fundamental weaknesses that result from the peculiar pattern of Taiwanese late industrialization in my view have played an important role. These weaknesses did not matter very much as long as the goal was catching-up. Today however they are of critical importance: they severely constrain Taiwan's capacity to mobilize and harness the financial and human resources and the knowledge that is necessary to upgrade its electronics industry.

Insufficient size

Obviously there is a problem of size. Left on their own, SMEs are simply unable to cope with the huge investment and R&D expenditures that are necessary for a continuous upgrading of their product mix and production efficiency. Important corrections have already occurred, but they are certainly not sufficient. Taiwan's electronics industry has recently witnessed a rapid increase of concentration. In the PC industry, the top 10 firms today control roughly 80% of total production. And some of the most powerful Taiwanese business groups (Formosa Plastics, HwaHsin, China Steel, YFY Paper etc.)

have entered the production of key components, like DRAMs (dynamic random access memory), CRTs and displays.⁵

In my view, the real issue goes beyond the size of individual firms: What changes are necessary in Taiwan's industry structure so that the scale advantages of large firms can be combined with the speed and flexibility of smaller firms?

One attempt to overcome this weakness has been the government's Center-Satellite Program, launched in 1984, in response to the private sector's unwillingness to vertically integrate production through either merger or inter-firm cooperation. The objective of this program has been to eliminate cutthroat competition and destructive price cutting practices of the SMEs by encouraging closer, interdependent and long-term ties between larger "center" firms (upstream suppliers, final assemblers, large trading companies) and their "satellites" (especially component suppliers). Most assessments argue that success so far has been limited (Wade [1990], p.167; Hamilton and Biggart [1991], p.1004). I will show in a moment why closer links with international production networks that exist today in east Asia could help to break this deadlock.

Acer's recent shift to a "Client-Server Organization Structure" that tries to combine scale with flexibility, is another such attempt.⁶ Each of the different members of the Acer group are separated by product lines and by geographic region, and each operates independently

⁵ Interviews at ERSO/ITRI, December 1994 and May 1995.

⁶ Based on interviews with Acer Corp., June 1995 and with Acer Peripherals, December 1994.

form each other. This allows them to make decisions quickly in response to market changes and work and define the market segments where they feel fit for leadership. At the same time, however, all of these businesses have ready access to the full range of products and support that the Acer group provides.

One important element of this re-organization is a new approach to overseas PC assembly. (Similar approaches have been developed by other leading Taiwanese computer manufacturers, like MITAC and FIC). In order to reduce cost and to increase speed-to-market for new products Acer has established 15 modular assembly sites around the world. Each of these assembly subsidiaries is located close to important markets and performs only very limited activities: it receives PC housings and floppy disk drives by sea, with motherboards flown in directly to ensure delivery of the newest technologies. CPUs(central processing units), hard drives and memory are sourced locally to fill individual user requirements, and the modular components are assembled quickly according to a standardized procedure. This strategy allows Acer to maintain control over product quality and keep inventory to a minimum, while providing fast assembly of competitively priced PCs that always contain the latest microprocessor generation.

A Weak Domestic Supply Base for Key Components

Let us now turn to a second major weakness that I call the problem of the “inverted production pyramid”. Despite all its achievements in hitting the right markets for final products, Taiwan’s electronics industry is still based on a weak foundation. For most of

the key components that determine the price and the performance features of its major export products, Taiwan continues to rely heavily on imports, primarily from Japan.⁷

Take CRTs for computer monitors. Taiwan's success in the monitor industry has come at a very heavy cost: nearly 2/3 of the CRTs that go into these monitors have to be imported, either from Japan or from Japanese affiliates in SE Asia. The result is that last year, Taiwan had to pay \$1.35 billion for CRT imports, making CRTs the largest item of imports from Japan.

The situation is equally severe for ICs and LCDs (liquid crystal display). In 1993, 85% of all ICs used in the Taiwanese electronics industry had to be imported. While the Taiwanese SC industry over the last five years has experienced a spectacular average annual growth rate of 35%, this has clearly not been sufficient to address this major bottleneck. Taiwan today spends about \$3 billion on imports of memory devices. The five largest suppliers of DRAMs in Taiwan are Goldstar, MELCO, NEC, Samsung and TI, while domestic manufacturers have a mere 5.5% domestic market share. And for microprocessors, the dependence is even higher: 99% of all MPUs consumed by Taiwanese electronics firms had to be imported, from the US, and the main suppliers are AMD, Cyrix, Intel, Motorola and TI.

⁷ These and the following figures are data collected at MIC/III, May/June 1995.

One last example relates to display panels, a key component for Taiwanese thriving portable PC industry. For this industry, the ability to purchase display panels in the necessary quantities, at the right time and at a reasonable price will decide over their competitive success. Taiwan has to import virtually all of the high-end flat panel displays that are used in its portable PCs, and the supply of these devices is controlled by a tightly knit oligopoly consisting of Sharp, a Toshiba-IBM joint venture and NEC, with Hitachi and Matsushita being important second-tier producers. In 1993, Taiwan had to spend \$500 million on imports of LCDs, with more than \$350 million spent alone on advanced TFT-LCDs. Over the last few months, prices for these devices have rapidly increased, with the result that, in value terms, these imports are likely to have further increased.

Why does this matter? A first reason is Taiwan's ballooning bilateral trade deficit with Japan which in 1994 has reached a record \$14.6 billion. Most of this deficit is due to the rapidly growing imports of key components and machinery. There are those who claim that the prevalence of "triangular trade" would make it possible for Taiwan to use its trade surpluses with the US and Europe to compensate for the trade deficits with Japan. While this may have been true till the late 1980s, this is not true anymore today, as Taiwan's trade surplus with the US and Europe keeps rapidly declining. At the same time, there are those who claim that the increase of Japan's reverse imports from East Asia could also help to compensate. This is even less true than the triangular trade argument, especially for Taiwan which does not host any of the major Japanese transplants producing AV equipment and household appliances that are responsible for the bulk of these reverse

imports to Japan. Since 1993, Japanese electronic imports from Taiwan have increased, especially for OEM products and electronic components. Yet, these reverse imports to Japan continue to be orders of magnitude smaller than the key component imports from Japan.

Let us now look now at a second even more important reason why Taiwan's import dependence on key components matters: Taiwanese monitor producers are having severe problems to procure large-size CRTs at sufficient volume and at a reasonable price. If they will not succeed in breaking this procurement deadlock soon, they will have great difficulties to upgrade their product mix and to establish themselves as suppliers of large-size, higher-end computer monitors.

Necessary Changes

We have seen that Taiwan's electronics industry today has to struggle with a twofold challenge: It has to shift a substantial part of its production overseas at an unprecedented early stage of industrial development. Simultaneously, it is forced to upgrade rapidly into more sophisticated products that are characterized by greater capital intensity and technological complexity, (i.e., by greater asset specificity). Both challenges are a threat to Taiwan's two original strengths: its cost leadership and its flexibility.

Under such conditions, it is obvious that major changes are required in the organization of the Taiwanese production system: The ad hoc management of stand-alone facilities, both

at home and abroad, has to give way to attempts to integrate these activities into more structured international production networks. Taiwan's electronics industry must synchronize the expansion of overseas production with a continuous upgrading and deepening of domestic production.

Why is this so? We have identified two reasons: In order to reduce the threat of "industrial hollowing-out", Taiwan needs to develop its domestic supply base for key components. Otherwise, there is no way to compensate for the decline in domestic production and exports that result from the expansion of overseas production. At the same time, developing a strong domestic supply base for key components is an essential prerequisite for the successful upgrading of Taiwan's product mix. Such an upgrading in turn is crucial, if Taiwan wants to penetrate further into new markets, both as an OEM and as an OBN (own brandname) supplier.

3. New Opportunities: The Role of International Cooperation

Can Taiwan implement these changes? I am quite optimistic. Over the last two decades, the Taiwanese electronics industry has experienced a breath-taking development of its organizational and technological capabilities, which is now complemented by a considerable financial clout, available in hard currencies. At the same time, both the government and private firms have always remained sufficiently flexible and willing to learn from past mistakes. Such mistakes have been many to no-one's surprise. What

matters is that they have rarely been repeated. The internal conditions thus seem to be in place for implementing the afore-mentioned changes in the Taiwanese model.

New Opportunities

At the same time, important new opportunities have emerged on the international scene. I argue that Taiwanese firms are well placed to benefit from these new opportunities, and that, if that happens, this could speed up the process of necessary change.

A New Wave of OEM Contracts

As computer firms worldwide are forced to cut costs and to slim their often overextended product portfolios, Taiwan is currently flooded with an increase of OEM contracts from all major PC manufacturers in the US, as well in Japan, Europe and East Asia. The result is that 77% of Taiwan's portable PC shipments today are for OEM clients that include all the major players in the industry.⁸

From the US, this includes Apple, AST, DEC, Dell, IBM, AT&T and HP. While US firms have since long engaged in OEM arrangements which they had originally pioneered, the new development is that now also all leading Japanese PC producers have signed up Taiwanese manufacturers for major OEM contracts. NEC for instance gets monitors and motherboards from Tatung and Elite, and Fujitsu, Epson, Canon, Hitachi, Sharp and

⁸ Data collected at MIC/III, May/June 1995.

Mitsubishi are all now major OEM customers. A second important new development is that Singaporean and Hong Kong PC firms have also lined up as OEM clients.

The OEM web of who is making what using whose design for whom has become pretty complicated today. For instance, both DEC and Acer are competing to become the lead OEM producers for Apple's latest PowerBook portables, based on Motorola's Power Chip. At the same time, DEC is also an important customer for Taiwanese producers of monitors and PCs. Or take another example: AST is an OEM client for PC portables produced by two Taiwanese firms, at the same time that Samsung Electronics has acquired a 35% equity share. As Samsung competes for OEM contracts with Taiwanese firms, it will be interesting to see how this affects AST's Taiwanese OEM contracts.

The importance of this surge in OEM contracts is that it provides for a welcome growth of Taiwan's foreign exchange earnings that can be used for investments in the upgrading of the domestic production system. At the same time, some of these contracts have helped to increased Japanese "reverse imports" from Taiwan. Together with a similar growth of Japanese component imports from Taiwan, this has given rise to expectations that Taiwan's bilateral trade deficit with Japan may shrink this year to around \$13.5 or even \$13 billion. Compared to Korea, where the bilateral trade deficit with Japan keeps increasing rapidly, this is certainly a positive development.

Finally, the recent surge in OEM contracts may help Taiwanese computer firms to deepen their linkages, especially with Japanese electronics firms. Japanese firms are famous for developing such linkages in a step-by-step manner. If Taiwanese firms use the current OEM contracts to build up trust and mutual understanding, this could pave the way for a much deeper relationship. Building such deeper relationships with Japanese firms is possible today, as they are all under tremendous pressure to gradually open up their international production networks.

The Gradual Opening-up of Japanese International Production Networks

This brings me to the second opportunity that I feel could tremendously facilitate the task of upgrading Taiwan's domestic production system. I am referring to the gradual opening-up of Japanese international production networks that I have analyzed in chapter II.1 of this book. I argue that this creates a unique chance for Taiwanese electronics firms to engage in more sophisticated forms of international cooperation with Japanese firms that could help them to overcome some of their weaknesses.

In chapter II.1, I show that the international production networks that Japanese electronics firms have established in East Asia had remained fairly closed to outsiders, at least until the early 1990s. Most of the transactions that constitute the network took place within the boundaries of the firm or a larger business group, and thus were restricted to foreign affiliates and affiliated suppliers. This was true for manufacturing, as well as for

procurement and marketing, product and market development, the development of human resources, research and finance.

In most of these intra-firm networks, there has been a very limited decentralization of control. Japanese electronics firms in general have relied much less on local managers and engineers in their Asian affiliates than their American and European counterparts; they have tightly controlled their Asian affiliates and have left them little scope for autonomous decisions; their transfer of technological capabilities has been limited and hardly went beyond “on-the-job” training and basic manufacturing support services; and, finally, Japanese electronics firms have been reluctant to broaden their links with local investors.

A typical example of this closed nature of Japanese production networks has been the organization of procurement. Japanese electronics firms have based their Asian supplier networks on longer-term relations with their suppliers, almost all of them Japanese firms. Suppliers in general were “captive,” or highly dependent on one or a small number of key customer firms. Buyer-supplier relationships were often formed among affiliates of the same industrial group. The qualification process for new suppliers has been extremely tedious; 9 months and more were usually required. The barriers to entry and exit these Japanese supplier networks thus were very high, which in turn has given rise to structural rigidities in the system, technological conservatism and low speed-to-market.

I show that recent developments since the early 1990s constitute an important watershed - new challenges have emerged that have forced Japanese electronics firms to gradually open up their Asian production networks. I argue that the Yen appreciation has played an important catalytic role in determining the timing and the speed of these changes. In essence, the Yen appreciation has forced Japanese production affiliates in Asia to reduce their input imports from Japan and to increase their reliance on regional component sourcing. Those Japanese component suppliers that produce relatively complex and higher value-added components have substantially increased their investment in East Asia, primarily in Malaysia and Thailand, and increasingly also in China. Once these suppliers have established production in East Asia, they are much less inclined to stick to their traditional clients. In order to amortize as quickly as possible their substantial investment outlays and in order to gain economies of scale, these affiliates are now actively searching for new clients, with the result that they frequently supply not only Japanese firms, but also American, European, Taiwanese and even Korean firms.

Once the higher-level Japanese component suppliers have set up shop in East Asia, they begin to face an increasing pressure to involve local supplier firms for lower-end subcontracting and contract manufacturing activities. This is due to the fact that many Japanese suppliers of low-end, general purpose components have either been forced to close down production or cannot raise the funds required for overseas production. Japanese affiliates in Asia also have begun to increase their purchases from both Taiwanese and Korean suppliers. Tatung's Chunghwa Picture Tube affiliate in Malaysia

for instance supplies today a number of Japanese TV set makers in Malaysia, Singapore and Thailand.⁹ The same is true for other Tatung affiliates. Take for instance FDK Tatung (Thailand) CO., LTD/Bangpakong, Thailand, an affiliate of Tatung's joint venture with Fujitsu, called Tatung Fujidenka Co., Taiwan. The mother company is in Yangmei, Taiwan and produces high-end soft-ferrite cores for TV sets, video display terminals and a variety of electronic devices. FDK Tatung today is one of the market leaders for the capital and knowledge-intensive production of soft ferrite cores. The sales of this affiliate are mainly destined for affiliates of National (Matsushita), JVC, Murata and Tatung's Makolin affiliate in Thailand and Malaysia.

This last affiliate, located in Malaysia, is an interesting case which indicates what unusual forms of international cooperation are possible today. It is a joint venture between Tatung's affiliate Chungliwa Picture tubes and the Korean Dugo Electronics Company. Its main products are deflection yokes for 14, 20 and 21-inch color tubes. Again, this affiliate supplies Tatung's affiliates in the region as well as affiliates of Japanese TV set makers.

The Yen appreciation also has been an important driving force behind the spread of OEM contracts that Japanese computer companies have recently placed with both Taiwanese and Korean companies that I have already discussed before.

⁹ Interviews at Tatung group secretariat, December 1994 and April 1993.

In addition, Japanese electronics firms are beginning to explore today the potentially important benefits that could result from the gradual blending of different types of business organization. Take for instance linkages between Japanese and the Asian production networks of Taiwanese computer firms. By linking up with Taiwanese networks, Japanese electronics firms could benefit from the capacity of Taiwanese firms to develop forms of international production that suit whatever environment in which they find themselves, as well as their more international education and management skills. At the same time, Japanese firms could also benefit from the ability of most Taiwanese firms to make rapid decisions, unencumbered by the organized structures of Japanese firms, able to move in a “one-man” decision style, in contrast to Japanese companies’ committees and consensus seeking.

Conclusions: New Opportunities for Taiwanese Electronics Firms

What are the new opportunities that this gradual opening-up of Japanese international production networks will generate for Taiwanese electronics firms? And what needs to be done so that Taiwanese firms can grab these opportunities and use them as a vehicle for overcoming some of their weaknesses that we have discussed before?

Let me highlight here the following five new opportunities:

- First, Taiwanese affiliates that produce monitors and other PC-related products in East Asia now have a realistic chance to tap into established Japanese supplier networks in the

region. Take for instance Acer Peripherals' monitor plant in Penang/Malaysia which sources most of its CRT picture tubes from Hitachi and Matsushita affiliates in the region.¹⁰

- Second, Taiwanese computer companies can establish new and more complementary forms of cooperation with Japanese electronics firms in order to overcome their weakness in the production of key components. Japanese second-tier DRAM producers like Oki and MELCO have recently concluded important technology licensing, second-sourcing and joint development projects with some of the newly established Taiwanese DRAM producers. The same may happen sooner or later for large-size CRT picture tubes for monitors, where Hitachi or another Japanese producer may link up with a group of Taiwanese firms.

- Third, Japanese electronics firms, since around 1992, have announced plans for relative large investment projects in Taiwan. The Yen appreciation again has acted as a catalyst, by increasing the cost of Yen-denominated imports of CNC controllers, ICs and auto parts. Taiwan's bilateral trade deficit with Japan has become a major bone of contention. Japanese firms are forced to react, and establish import-substituting production facilities in Taiwan, as Taiwanese computer companies have become their major customers for key components. Japanese component suppliers no longer cannot afford today to loose these

¹⁰ Interviews with K.Y. Lee, president of Acer Peripherals, December 1994, April 1993 and May 1992.

customers. Finally, clever support policies by the Taiwanese government have helped to increase Japanese FDI (foreign direct investment).¹¹

- Fourth, Taiwan could play an important intermediary function for Japanese electronics firms and help them to penetrate East Asia's new frontier markets in China and Vietnam. For instance, Sony as well as Sanyo and Sharp have used their joint ventures in Taiwan to establish sales offices and consignment assembly in China in cooperation with their parent companies.
- Finally, and probably of greatest importance in a longer-term perspective, will be the impact of the de facto opening up of the Japanese PC market, since around 1992. Two factors have been of primary importance: the introduction of IBM's Japanese language DOS/V system, and the domestic price war for PCs in Japan started by Compaq. As a result, NEC has lost its dominant market position, and the rules of the game have radically changed. So far, only American PC producers have benefited from this opening-up of the Japanese PC market. But why should Taiwanese computer companies not be able to do the same? The example of the Taiwanese IC producer Macronix International can illustrate how new and unconventional forms of international cooperation can help to break this deadlock.¹² By establishing a strategic link with NKK, the Japanese steel

¹¹ Three of these policies have been of particular relevance: (a) The announcement by the Ministry of Economic Affairs to establish a Centre in Japan, staffed by Japanese experts that help Taiwanese firms to improve their absorption of Japanese technologies and management approaches. (b) Policies to strengthen support industries, especially for key components. And (c) Requests submitted to the Japanese government to remove barriers to imports from Taiwan (from Japanese transplants or OEM partners).

¹² Interview with Miin Wu, President of Macronix international, December 1994 and February 1995.

company that has diversified into semiconductor manufacturing, Macronix has been able to establish itself as a serious competitor in the Japanese market. Today, nearly 55% of Macronix sales go to Japan, up from 40% in 1993. In other words, by linking up with a cash-rich and well connected Japanese partner, Taiwanese firms do have realistic chances to penetrate the Japanese market.

To conclude, Taiwan's success has been due to flexible specialization. Now that the importance of size has increased, it is important to find ways to preserve this original flexibility. New and unconventional forms of international cooperation may substantially facilitate this task. This, I argue, applies in particular to closer interaction with the international production networks that leading electronics firms from Japan, the U.S., Europe and Korea have established in East Asia.¹³

¹³ For a more systematic treatment of such links, see Ernst, D. "Hybrid Forms of Organization - The International Production Networks of Taiwanese Electronics Firms". BRIE-IGCC. [forthcoming].