

DANISH **R**ESearch **U**NIT FOR **I**NDUSTRIAL **D**YNAMICS

DRUID Working Paper No. 97-3

**Partners for the China Circle?
The Asian Production Networks
of Japanese Electronics Firms**

by
Dieter Ernst
March 1997

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THE ASIAN PRODUCTION NETWORKS OF
JAPANESE ELECTRONICS FIRMS.**

by

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**to appear in: Barry Naughton (editor), *The China Circle*, The Brookings
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Abstract

The focus of this paper is on the evolution of international production by Japanese electronics firms. In the first two parts, I trace the development of Japanese production networks in Asia through three different periods. Each of these periods reflects fundamentally different strategic rationales for engaging in Asian production activities and hence gives rise to very different incarnations of Japanese production networks. *Part I* deals with the period of domestic market orientation which lasted roughly until the early 1980s, and with the shift to export platform production which has gathered momentum especially after 1986. I show that Japanese production networks have started out with a loose, locally embedded structure during the period of domestic-oriented production. This dramatically changed, once the focus shifted to export platform production, which has led to the establishment of highly centralized governance structures and very limited local roots.

A new stage is reached in this zig-zag movement during the early 1990s. *Part II* deals with recent developments since 1991, the year of the “bursting of the bubble economy” in Japan. The pendulum now swings back again toward decentralization and local embeddedness. I analyze four sets of objectives that have guided this reorganization of Japanese Asian production networks: a regionalization of procurement; the penetration of Asia’s contested growth markets; attempts to harness the region’s improved capabilities, and a shift to more decentralized governance structures.

Some possible implications for local capability formation are discussed in *Part III*. I first describe the regional specialization that is now beginning to emerge for Japanese production networks in Asia, with particular reference to the role of China. I conclude with a brief discussion of new opportunities and challenges that are likely to emerge for Taiwanese electronics firms.

(to appear in: Barry Naughton (editor), *The China Circle*, The Brookings Institution, Washington, D.C., 1997)

Keywords

Industrial dynamics; networks; learning; capabilities; foreign investment; economic development; Japan; China; Taiwan; electronics industry

JEL Classification

D21, F21, O53, O19

ISBN(87-7873-022-8)

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Preface

We are quite happy to integrate international scholars in the DRUID network and to publish their work in the DRUID working paper series. Even more so when as in this case their contribution forms an input to a project connected to DRUID.

In the application for the Disko-project (The Danish Innovation System in a Comparative perspective - which is 3-year project financed by the Danish Council for Industrial Development) we pointed to the process of globalisation as one of the major new trends which create new conditions for Danish firms. In this context we have been able to establish a collaboration with leading experts on international business and attached them as visiting scholars. Dieter Ernst, former OECD-economist and later attached to BRIE at Berkeley has been a visiting scholar at Aalborg University during this period he produced this paper on the Japanese production networks. (A second contribution aspects of globalisation and its impact on the opportunities of Danish firms by another outstanding expert in the field - John Zysman from BRIE, Berkeley University -will appear as working paper no. 97-5)

Some years ago a paper on Japanese industrial networks might have been regarded as interesting mainly because of the fact that it treated a far away and exotic phenomenon. In the present era the distance has become much smaller and it is realised that there is something to be learnt from practices developed elsewhere. The changing pattern of centralisation and decentralisation in these networks also works as an efficient warning against believing that the very latest fashion in terms of production organisation has come in order to stay for ever.

Bengt-Åke Lundvall

Introduction

The “China fever” that has raged through the Japanese industry over the last few years, has drastically changed the locational patterns of Japanese investment within East Asia. The share of China in the investment of Japanese electronics firms abroad has increased by leaps and bounds: from the measly 0.6% of 1990 (the year after the Tianmen massacre), it has now reached almost 7%, catching up fast with the 7.7% share of ASEAN.¹

Japanese electronics firms thus have substantially extended the geographic coverage of their East Asian production activities.² At the same time, they have proceeded to integrate their erstwhile stand-alone operations in individual host countries into increasingly complex international production networks.³

This has had important implications that I will document in this chapter. I will show that Japanese electronics firms are now in a much better position to act as partners for the China circle. In order to cope with increasing complexity, their Asian production networks have become more open and locally embedded. Japanese firms now have a vested interest to develop and harness the region’s resources and capabilities. They are also now more willing to interact with local companies⁴ and to increase their Asian value-added. The Asian production networks of Japanese electronics firms

¹ MOF figures, as quoted in JETRO, 1995, p.17.

² Over time, the focus of such investments has shifted twice: first from Northeast Asia (Korea, Taiwan and Hong Kong) to the ASEAN region (primarily Singapore, Malaysia and Thailand); and, since around 1992, from the ASEAN region primarily to China. While in sheer numbers, the shift to China clearly dominates, Japanese electronics firms have also expanded their production networks into Indonesia (already since around 1990), as well as into India, and now also into Vietnam, Myanmar and the Asian republics of the former Soviet Union.

³ The concept of an "international production network" is an attempt to capture the spread of broader and more systemic forms of international production that cut across different stages of the value chain and that may or may not involve equity ownership. This concept allows us to analyze the globalization strategies of a particular firm with regard to the following four questions: 1) Where does a firm locate which stages of the value chain? 2) To what degree does a firm rely on outsourcing? What is the importance of inter-firm production networks relative to the firm's internal production network? 3) To what degree is the control over these transactions exercised in a centralized or in a decentralized manner? And 4) how do these different elements of the IPN hang together? For details, see Ernst, 1992; 1994 a; 1994b; 1996a; 1996b; Ernst and Guerrieri , 1997; and Ernst and Ravenhill, 1997.

⁴ Examples of linkages with Asian companies will focus on companies from the China Circle, especially from Taiwan.

no longer exist in splendid isolation. They now interact with a variety of newly emerging production networks in Asia that have been established by firms from Korea and the China Circle.⁵ Originally focused on subcontracting and OEM arrangements, such interactions now cover more complex value chain stages, including engineering and product development.

How does this match with a widespread perception that, especially in Asia, Japanese firms have kept their production networks as closed as possible to outsiders, by centralizing almost all strategic decision-making and high value-added activities in Japan? It has been argued that Japanese electronics firms have fallen back relative to their American competitors in large part because they have failed to establish an equally efficient regional supply base in Asia, and that this is primarily due to the relatively closed and Japan-centered nature of their Asian production networks.⁶

In my view this argument needs to be taken with a grain of salt. This chapter will add two important qualifications: First, a clearcut distinction between closed Japanese and open American production networks in Asia has existed only for a relatively short period, roughly from 1986 till around 1992. Both before and after this period, Japanese production networks in Asia were fairly open and locally embedded.

Second, one should also not underestimate the capacity of Japanese firms for rapid learning and organizational adjustment.⁷ They have clearly understood the constraints that result from closed, Japan-centred production networks. Over the last few years they have seriously moved to establish a regional supply base in Asia, in order to improve their access to the region's capabilities and contested growth markets. Japanese electronics firms now have a good chance to recapture terrain that they have lost during the 1980s.

The chapter is organized as follows: In the first two parts, I trace the development of Japanese production networks in Asia through three different periods. Each of these periods reflects fundamentally different strategic rationales for engaging in Asian production activities and hence gives rise to very different incarnations of Japanese production networks. **Part I** deals with the

⁵ Three of these newly emerging production networks are of particular importance: those established by Korean chaebol; those established by Taiwanese producers of PC-related products and components in Southeast Asia and China; and those networks of suppliers of parts and sub-assemblies based in Hong Kong, Taiwan, Singapore and mostly owned by ethnic Chinese. For an analysis of some of these newly emerging Asian production networks, see Ernst, 1997b and Kim Youngsoo, 1996

⁶ For a presentation of this argument, see chapter XX in this book.

⁷ For an excellent theoretical treatment, see Nonaka and Takeuchi, 1995

period of domestic market orientation which lasted roughly until the early 1980s, and with the shift to export platform production which has gathered momentum especially after 1986. I show that Japanese production networks have started out with a loose, locally embedded structure during the period of domestic-oriented production. This dramatically changed, once the focus shifted to export platform production, which has led to the establishment of highly centralized governance structures and very limited local roots.

A new stage is reached in this zig-zag movement during the early 1990s. **Part II** deals with recent developments since 1991, the year of the “bursting of the bubble economy” in Japan. The pendulum now swings back again toward decentralization and local embeddedness. I analyze four sets of objectives that have guided this reorganization of Japanese Asian production networks: a regionalization of procurement; the penetration of Asia’s contested growth markets; attempts to harness the region’s improved capabilities, and a shift to more decentralized governance structures.

Some possible implications for the China Circle are discussed in **Part III**. I first describe the regional specialization that is now beginning to emerge for Japanese production networks in Asia, with particular reference to the role of China. I conclude with a brief discussion of new opportunities and challenges that are likely to emerge for Taiwanese electronics firms.

I. From domestic market-oriented to export platform production

Over the last three decades, Japanese electronics firms have substantially extended their overseas production activities in East Asia. Originally, tariff-hopping and attempts to reap the substantial windfall profits available in highly protected domestic markets were the main motivations. Since the late 1970s however, practically all the leading Japanese electronics firms have begun to invest in a variety of export platform production activities, often in a close symbiotic relation with their main small- and medium-sized Japanese component suppliers. Especially since 1985, periodic Yen appreciations have played an important catalytic role and have led to a massive expansion of such export-oriented FDI.

In what follows, I will show that Japanese production networks have started out with a loose, locally embedded structure during the period of domestic-oriented production. This, however, has changed dramatically, once the focus has shifted to export platform production, which has led to the establishment of highly centralized governance structures⁸ with very limited local roots.

1. Domestic market-oriented production

There is a widespread consensus that Japanese companies, once they move abroad, in general are less obsessed, compared to American companies, with equity control.⁹ This obviously reflects the heavy focus on the domestic markets that has characterized Japanese production in Asia until quite recently - the penetration of these heavily protected markets frequently requires local partners. A weaker preference for equity control may also reflect important differences in the

⁸ Governance describes how, within any particular firm or international production network, control and coordination is exercised and by whom. It consists of common methods and procedures that shape the behavior of network nodes, such as budgetary rules and procedures; evaluation procedures; personnel management practices; database management, quality control norms, etc.. Network nodes can be equity-owned affiliates and those legally independent firms that participate in the core company's inter-firm networks.

Governance structures can be centralized or decentralized, and they can be strong or weak. A centralized governance structure implies that the core company (the network centre) exercises full control over all network activities. A decentralized governance structure implies that individual network nodes have a certain degree of decision autonomy. Strong governance implies that control and coordination are enforced over a broad range of value chain activities and are shared by a large number of network nodes. Weak governance, in turn, implies that control and coordination can be enforced only over a limited range of activities and that only a limited number of network nodes are subordinated to them. The following indicators have been used to establish whether a governance structure is centralized or decentralized: ownership patterns; the degree of local decision autonomy; local linkages; the role of regional headquarters; and the degree of local funding through re-investments and a listing on local stock exchanges. For details, see Ernst, 1996 b.

⁹ See, e.g., Dobson 1995, p.38; Graham and Anzai 1994; and Petri 1995.

domestic capital markets of both countries and the fact that Japanese firms, until quite recently, had ample access to patient capital.

Some observers also claim that Japanese firms, especially in East Asia, are more willing to engage in joint ventures and other forms of inter-firm cooperation than especially American companies and are thus presumably more locally embedded than their Western counterparts. Take for instance a widely quoted book on Asian business practices by two researchers from INSEAD: "...[A]ccustomed to operating in their home market through an extensive network of cooperation agreements, [Japanese firms] show a higher propensity to enter partnerships in Asia than American firms."¹⁰ Until around the mid-1980s, the electronics industry fits quite well with this general perception of relatively loose and open governance structures. Japanese subsidiaries in Asia had relatively strong local roots, as long as their main objective was the penetration of protected domestic markets in this region. In most cases, joint ventures with local partners were necessary to implement such rent-seeking investments. Local partners provided access to distribution channels and facilitated relations with the government.

Throughout this period, Japanese affiliates in Asia had considerable decision autonomy not only for employment, work practices and salary, but also on how to organize production, support services (quality control and maintenance) and procurement. A considerable amount of local linkages was generated by these investments: local content was substantial, and this has given rise to the development of some domestic support industries, especially for low-end general purpose components. This often however came at the expense of cost efficiency and quality which, due to the heavy protection provided to such import substitution markets, were only of secondary concern.

Two companies have pioneered such domestic market-oriented production facilities in Asia: the huge and powerful Matsushita group and Sanyo, a company which, due to its smaller size, has been the first to develop a regional supply base in East Asia.

In terms of sheer size, Matsushita Electric Industrial Co., Ltd. (MEI) stands out among its Japanese competitors, being surpassed only by NTT. Both in terms of consolidated sales and

¹⁰ Lasserre and Schuette, 1995, p.176. See also Abegglen, 1994.

employment, MEI is one of the biggest companies in the world electronics industry.¹¹ For quite some time, this giant conglomerate has been run like a loose network of (almost) independent business units., with headquarters, particularly under the charismatic leadership of Konosuke Matsushita, playing the neutral role of an arbiter. As long as markets kept growing, this loose network organization was widely considered to be a great strength, as it enabled the company to remain reasonably flexible despite its huge size. Until quite recently, Matsushita was in fact considered as a role model in the Japanese literature on networking strategies which, in analogy to Toyota's role in the car industry, singles out Matsushita as the pace setter for the electronics industry.¹² Once however demand growth could no longer be taken for granted, the debate has fundamentally changed and now focuses on the hidden costs of excessive decentralization and decision autonomy, such as duplication, foregone economies of scale and self-generated price pressures.

Matsushita's core competencies are size-related advantages in distribution and high-end manufacturing (in specialized affiliates like Matsushita Kotobuki). Due to its tight control over the domestic distribution channels for consumer electronics, Matsushita used to be under much less pressure to become a low-cost leader. This explains why its expansion into East Asia, for a long time, was geared primarily to the heavily protected domestic markets rather than to the establishment of low-cost export platform production.

Matsushita's involvement in East Asia started in the early 1960s with minority joint ventures strictly targeted at the heavily protected domestic markets:¹³ the so-called “mini-Matsus” originally produced simple products like batteries, radios, electric fans, rice cookers and other low-end home appliances, small TV sets and some related components. The real breakthrough came in September 1965, when Matsushita established its first large manufacturing plant, MELCOM, in Malaysia.¹⁴ Most earlier plants had been restricted to “screw driver” assembly with very limited local

¹¹ Matsushita Electric Industrial Co., Ltd. (MEI) is the world's largest manufacturer of consumer electronics and household appliances. Since the mid-1980s however, it has diversified aggressively into communications and factory automation equipment, semiconductors and video software, with the result that today the share of industrial electronics and electronics components in its overall sales is roughly equal to the share of consumer and household goods.

¹² Typical examples are Imai, 1988 and Imai and Baba 1991.

¹³ The first of these “mini-Matsus” was a minority joint venture with a local partner in Thailand, established in December 1961. This was followed, during 1962 and 1963, by two joint ventures in Taiwan and one in Indonesia.

¹⁴ MELCOM is a publicly listed company at the Kuala Lumpur stock exchange, with Matsushita holding a 43% equity share.

linkages.¹⁵ MELCOM established a radically different pattern that, since then, has characterized domestic market-oriented Japanese affiliates in Asia. Most of the key components were now produced in-house, i.e. by the overseas affiliate, involving metal stamping and forming, surface treatment (electro-plating and painting), plastic injection and die casting. Over time, a large share of these activities have been outsourced to local suppliers, giving rise to a substantial body of domestic support industries. In addition to procurement, decision autonomy was gradually increased also for marketing and distribution and for local investment. Already in June 1974, Matsushita established its regional headquarters in Singapore, well before any of its main competitors followed suit. Right from the beginning, this RHQ was endowed with fairly broad responsibilities, covering procurement, inventory control for parts and components, technical guidance and training for maintenance, quality control and support for negotiations with local authorities.¹⁶

Sanyo went even further than Matsushita in developing early on in developing a locally embedded Asian production network.¹⁷ Sanyo's founder was the brother-in-law of Konosuke Matsushita, who took over most of the operations of the Matsushita group when it was broken up under the U.S. Occupation Authority. In Japan, Sanyo always remained a second-tier competitor. One way of compensation has been an aggressive shift early on into international production. Sanyo's move to East Asia preceded that of Matsushita. It also started much earlier with fully integrated local assembly. Already in the early 1970s, Sanyo developed the so-called "one-third" strategy for manufacturing capacity: one third domestic manufacture for the domestic market; one third domestic manufacture for foreign markets(especially higher-end segments); and one third foreign manufacture for foreign markets. What distinguishes Sanyo from Matsushita is the higher degree of vertical integration that is typical for Sanyo's overseas affiliates. Already during the second half of the 1970s, Sanyo began to develop a regional component supply base in East Asia, much earlier than any of its Japanese rivals.

2. A belated shift to export platform production

After 1985, rent-seeking gave way to a radically different concern. Once the focus shifted to export platform production, Japanese firms insisted on 100% affiliates or at least majority joint

¹⁵ They were either SKD (= assembly of of prefabricated kits, with no circuit board done by affiliate) or CKD (= parent company provides all materials and components, but circuit board assembly is done by affiliate). Author's interview at MELCOM, June 1984.

¹⁶ Author's interview at Matsushita headquarters, November 1993

¹⁷ Author's interview at Sanyo headquarters, November 1993

ventures. Governance structures became highly centralized and outsiders had limited opportunities to enter these production networks. For a limited period of time, roughly from 1986 till around 1991, there was thus a distinct difference in the organization of Asian production networks: Japanese electronics firms chose a centralized approach with limited roots within the region, while American companies relied more on decentralization which gave rise to a certain degree of local embeddedness.

There are two reasons why Japanese electronics firms choose to rely on centralized control: the vintage factor and proximity.

a) The vintage factor: Latecomers in international production

What distinguishes Japanese electronics firms is their belated shift from exports to international production. Until the mid-1980s, Japanese electronics firms had stubbornly resisted to shift to international production. For quite some time, they have tried to reap the maximum advantages from certain basic features of their domestic production system which, they knew, would be difficult to reproduce abroad.¹⁸

Once this shift finally occurred, Japanese firms were under tremendous pressure and did not have time to proceed in a gradual manner. Under the impact of the Yen appreciation¹⁹, Japanese producers of consumer electronics were quickly losing market share in the US and Europe, especially to the aggressive new competitors from Korea and Europe. A quick response on a massive scale was required to roll back these challengers. The solution was to establish huge export platform plants in lower-cost production sites in Southeast Asia that would drastically cut production costs and thus help to sustain market share in the US and Europe. Production ramp-up had to occur quickly, and cost and quality had to be tightly controlled. Under such conditions, tight centralized management control, exercised by the parent company, was a perfectly rational choice. As latecomers to international production, Japanese firms had to minimize risks. Developing local capabilities and linkages through “trial-and-error” is a time-consuming process and thus had to be discarded.

¹⁸ For an excellent analysis of the rationale that has induced Japanese electronics firms to postpone overseas production, see Tachiki and Aoki, 1991; and Tejima 1994 and 1996.

¹⁹ From around 240 in the fall of 1985, the yen’s exchange rate to the US-dollar experienced a breath-taking decline to below 80 in the summer of 1995 before rising again to around 110 in the first half of 1996.

We know from innovation theory that firms need time to develop their capabilities.²⁰ Time is of even greater importance for developing a firm's capacity to manage international production, hence the importance of the "vintage factor." Stopford [1995, p.2], for instance, argues that "... firms progress over time from the simplest to more complex forms [of international production networks] as they learn how to manage [them]." Such learning also takes place in the foreign affiliates: "As skills and resources accumulate within the various foreign units, new options and more complex projects can be undertaken without relying heavily on the parent organization for help and guidance (ibid., p.16). The result is that latecomers to international production are likely to differ in their organizational approaches from firms that have had a much longer learning experience."²¹

Japanese electronics firms obviously did not have time to follow the gradual approach described in the textbooks on foreign direct investment. Their first response was to try to transplant key features of the Japanese production system with as little change as possible. They soon found out that this does not work. Key features of the institutions in Asian host economies, like labor and capital markets, were simply too different to sustain the wholesale transfer of the Japanese production system. Japanese firms thus have been forced to adjust many of the original features of their domestic organization.²² The result has been the spread of hybrid forms of organization that require especially strong forms of control. A preference for centralized control results from the fact that key features of these hybrid forms of organization were poorly understood by Japanese managers.

b) Proximity

A second factor that explains the closed and Japan-centered nature of Japanese production networks in Asia is proximity which has facilitated centralized control. The scope for centralized control diminishes with increasing distance. Once a firm extends its value chain across national boundaries, it is faced with complex coordination problems and the risk of abrupt disruptions.

²⁰ Penrose, 1959; Nelson and Winter, 1982; Dosi et al (eds.), 1988; Lundvall, 1988 and 1992; Carlsson and Stankiewicz, 1991; Teece, Pisano and Shuen, 1995; Christensen, J.F., 1996; Foray and Lundvall, 1996; Foss, 1996; Llerena and Zuscovitch, 1996; Malerba and Orsenigo, 1996; and Maskell 1996.

²¹ For instance, recent research on learning processes in international production networks has shown that the more dispersed such networks are, the more difficult it becomes to impose standard procedures and to exercise centralized control. For an interesting theoretical approach, see McKendrick, et al, 1994.

²² See the discussion in part I.3.

Four sources of disruption can be discerned: (1) those caused by suppliers, either through late delivery or through the delivery of defective materials; (2) unforeseen fluctuations in demand and abrupt changes in demand patterns; (3) a variety of production problems that result from the transfer of immature products and production processes: and (4) abrupt changes in management decisions, for instance last-minute corrections of product launch dates and performance features.

Firms have tried to reduce the likelihood of such disruptions - yet so far with only limited success.²³ While production-related disruptions decline with increasing product maturity, this has not been the case for demand-related disruptions and for abrupt changes in management decisions that have been imposed by financial markets.

In Asia, Japanese firms are in a much better position to manage these risks than American and European firms. Japanese firms can control their East Asian affiliates from Tokyo, because the region is part of the same time zone: as a rule of thumb, a Japanese parent company is willing to loosen and decentralize control only once the affiliate is more than six hours flying time away from Tokyo. Both in Asia and in Europe, American firms never had this option. Probably this is one of the main reasons why, early on, companies like Intel and Motorola, were willing to grant a certain degree of decision autonomy to their Asian affiliates.²⁴

3. Shortcomings of centralized control

Throughout this period, Japanese electronics firms thus have all tried to keep their Asian production networks as closed as possible to outsiders, by centralizing almost all strategic decision-making and high value-added activities in Japan. As a result, local content remained limited and most components and materials were imported from Japan. One indicator is that Japanese electronics affiliates in Asia relied much more on component imports from Japan than similar affiliates in North America and Europe: while the share of components in Japan's electronics exports to Asia has exceeded 30%, it has been less than 15% for Japan's electronics exports to North America and Europe.²⁵ Another indicator is that component exports are by far the main cause for Japan's huge trade surplus in electronics with Asia: In 1990, components were

²³ For a detailed discussion, see Levy, 1994 and 1995, and the literature cited in both articles.

²⁴ For a case study on Intel's affiliate in Penang, see Ernst, 1996 b

²⁵ MITI 1994, p.6

responsible for 55% of Japan's trade surplus in electronics with Taiwan, and almost two third in the case of Malaysia.²⁶

In their Asian export platform affiliates, Japanese electronics firms in general have relied much less on local managers and engineers than their American and European counterparts; they tightly controlled their Asian affiliates and left them little scope for autonomous decisions; and the transfer of technological capabilities remained limited and hardly went beyond "on-the-job" training and basic manufacturing support services.²⁷

The same has also been true for some of the organizational innovations that have been the hallmark of the Japanese production system. In most Asian affiliates of Japanese electronics firms, there was no attempt to transfer seniority-based wage systems, job rotation and "life-long" employment. Surprisingly, this has also been the case for quality control circles and just-in-time management techniques. Often a crude Fordism prevailed, at least during the initial phase.²⁸ This contrasts with the situation in the US and Europe, where Japanese firms have made serious attempts to transfer key elements of their domestic production system and to adapt them with great care to the peculiarities of local institutions, policy frameworks and labor markets.²⁹

As long as the focus was on export platform production, Japanese electronics firms thus have tried to minimize the transfer of value chain activities to East Asia. Yet, this also came at a heavy cost. It prevented Japanese firms from harnessing the resources and capabilities that have been accumulated in East Asia; it slowed down the penetration of the increasingly important growth markets of the region; and it obstructed attempts to establish a regional supply base and to improve the specialization of these Asian production networks.

²⁶ Ernst, and Guerrieri, 1997

²⁷ For detailed evidence, see Ernst, 1994b and 1996a

²⁸ Similar findings are reported in: Tachiki, 1994, Sedgewick, 1995, and UNCTAD, 1995.

²⁹ For evidence, see Abo (ed.), 1993; Encarnation, 1992 and 1996; JETRO, 1993; Kenney and Florida, 1993; and Gittelman and Graham, 1994.

II. Recent changes: increasing specialization and local embeddedness

Since 1991, the combined effect of the Yen appreciation, the bursting of the bubble economy and the domestic recession have acted as a watershed: Japanese firms are now forced to change key features of their Asian production networks. As a result, we are witnessing a shift to more open and locally embedded Japanese production networks.

Leading Japanese electronics companies apparently have made a strategic decision that, from now on, Asia would play a critical role. Lower labor costs continue to matter. Of equal importance however are the following four objectives: a regionalization of procurement; the penetration of Asia's contested growth markets; attempts to harness the region's improved capabilities; and a shift to more decentralized governance structures. Coping with these complex requirements necessitates a greater focus on a regional strategy.³⁰

Let us now take a brief look at how Japanese electronics firms have proceeded to implement these four objectives.³¹

1. The catalytic effect of the Yen appreciation: the regionalization of procurement

The most immediate concern relates to the reorganization of procurement. Here, the Yen appreciation has acted as a powerful catalyst: it has eroded the cost competitiveness of the Japanese production base; and it has drastically increased the price of components and capital equipment that Japanese affiliates in Asia import from Japan. This has led to four important changes in procurement patterns: a) the parent company in Japan now increases its imports from Asia, both for final products and components; b) major Japanese electronics companies develop much more systematic regional procurement strategies; c) Japanese component suppliers redeploy production to Asia, with some of them beginning to develop their own regional production networks, often in close interaction with local producers; and d) Japanese affiliates in Asia substitute some of their component imports from Japan with procurement from regional or local sources.

³⁰ The emerging regional specialization of Japanese Asian production networks, with special reference to the China Circle will be discussed in *part III*

³¹ The four objectives obviously hang together. Yet, for analytical purposes, I will discuss them separately. Their interactions will be dealt with, when I discuss the rationale for decentralized governance structures.

This has set in motion a complex process of regionalisation of procurement. Let us first look at the increase of Japan's electronics imports from Asia.

a) Increasing imports from Asia

Until very recently, Japan has imported only a tiny fraction of the electronics goods and services that it consumes at home; this is in sharp contrast to the high import propensity that has characterized the electronics sectors of the US and Europe. Asia, despite its close proximity to Japan, has played a much less prominent role as a source of electronics imports for this country than it did for the US.

Yet, important changes have occurred since around 1992: Japan's imports of electronics products are now growing very rapidly, and Asia has become the most important source of these imports. Foreign imports now account for a larger portion of domestic demand, resulting in a significant rise in Japan's import ratio for electronics from 10.3% in fiscal year 1985 to an estimated 17.5% in FY 1993.³² The most rapid increase has occurred for electronic components, where the import ratio shot up from 16% in 1985 to more than 35% in 1993. More than one third of all electronic components consumed by the Japanese electronics industry today have to be imported. Most of these component imports are lower-end, general purpose electronic components that Japanese firms, in response to the Yen appreciation, are now increasingly procuring from East Asia. Japan's import ratio has also increased for consumer electronics (CE) and household appliances: from 2.1% in 1985, it has risen almost fivefold to 10.2% in 1993. While in terms of growth, this is an impressive change, a ten percent import ratio still indicates a quite low domestic market penetration. The only exception are color TV sets which, in 1993, have recorded an import penetration of almost 35%.³³ Since 1993, Japan imports more TV sets and audio equipment than it exports.

Today, Asia has become the most important source of Japanese electronics imports: the share of imports from Asia have surged from less than 31% (Y384.6 billion) in 1988 to more than 44% (Y

³² The import ratio is defined as import value minus domestic demand for electronic products, divided by domestic demand. The data have been provided by the *Electronics Industries Association of Japan*, June 1995

³³ Figure provided by JETRO from its 1994 report "Nihon no Seihin Yunyu 1993" (Japan's Manufactured Goods Imports in 1993). Import penetration is defined as $\text{imports} + (\text{production} - \text{exports} + \text{imports}) \times 100$.

962 billion) in 1993.³⁴ Asia's share in Japanese electronics imports is especially high for CE and appliances: in 1993, this share was close to 84%.

Asia however also has been able to strengthen its role as a supply base for electronic components and PC-related products. While in 1988, the US was the only source of imported ICs and computers, today Japan imports roughly the same amount of ICs and computers from Asia and from the U.S. Korean chip makers have especially benefited: In 1995, the value of computer chips (mainly DRAMs) imported from South Korea accounted for almost 28% of Japan's total chip imports, or more than three times the 1990 level of 8.7%.³⁵ This clearly indicates that important changes have occurred in the composition of Japanese imports from East Asia, and the share of higher-end, and technologically more complex products has increased considerably.

Take the case of Fujitsu which, since 1994, has been able to triple its share of the domestic PC market in Japan.³⁶ In addition to innovative design features of its product, the main reason for Fujitsu's success arguably has been a radical shift in component procurement. While in 1994, almost all PC-related parts and components were sourced in Japan, this has dramatically changed two years later: in the first quarter of 1996, Fujitsu estimates that 95% of the parts for the PCs sold in Japan are now imported, most of them from Taiwan.³⁷

b) Regional procurement strategies

A questionnaire survey conducted by JETRO in October 1993 found that more than 80% of Japanese firms with substantial overseas production activities indicated that during the next five years they would considerably increase their current levels of international procurement. About one-quarter of the responding companies in fact claimed that they were planning during this five-year period to double their current levels of international procurement. This is confirmed by the most recent annual questionnaire survey of the Export-Import Bank of Japan:³⁸ "It is noteworthy, in particular, that reinforcing parts procurement bases overseas is the most important strategy for

³⁴ This and the following figure are from a study by the Sakura Institute of Research, as quoted in: Takayasu and Ishizaki, 1995, p.15. This trend is confirmed by data from the most recent 1994 MITI survey: the share of sales to Japan out of the total sales of the affiliates of Japanese electronics firms in ASEAN has substantially increased, from 17.5% in 1989 to almost 28% in 1992, the last year covered. (Urata, 1995, table 7)

³⁵ Information provided by the Electronics Industry Association of Japan (EIAJ), January 1996

³⁶ Based on telephone interview with Fujitsu, May 22, 1996

³⁷ Fujitsu has relied primarily on OEM supplies from Acer Inc of Taiwan.

³⁸ As reported in Tejima, 1996

the automobile assembling industry and the electric/electronic industry.”³⁹ The survey concludes that, today “... Japanese companies have tried to reconstruct their advantages internationally through building more flexible and open international networks between parts suppliers and assemblers....” (p.16)

The challenge is how to achieve these cost savings without losing too much in terms of quality, speed and reliability of delivery. This is a formidable challenge. Until the early 1990s, procurement management has been characterized by a strong domestic bias, with local Asian suppliers only playing a marginal role. Not only were procurement decisions mostly made by the parent company. In many cases, individual product divisions and profit centers were entitled to decide on their own where to procure. All of these domestic procurement offices have developed strong ties with domestic suppliers; procurement engineers were trained to handle the multi-layered networks of Japanese suppliers, but had no incentive, and also lacked the relevant expertise, to search for, qualify and upgrade independent local suppliers in East Asia.

As long as this system prevailed, it has been very difficult for the local managers of Japanese affiliates in Asia to overcome the decisions made by the home procurement office. Suppose a local supplier has been selected and qualified. The part must then be approved by the parent company. This process can take up to nine months. By the time an Asian affiliate gets approval, that part is often not needed anymore. This has had very negative consequences: it has given rise to structural rigidities in the procurement system and has fostered technological conservatism and low speed-to-market.

Japanese firms are now systematically increasing their reliance on international procurement. Take the case of Hitachi,⁴⁰ a behemoth whose consolidated sales today equal roughly 2% of Japan's GNP, the world's second largest economy. Earlier than many of its Japanese rivals, Hitachi has internationalized procurement; and it keeps upgrading these activities to changing competitive requirements. In the early 1970s, Hitachi was among the first Japanese electronics firms to set up overseas procurement bases in the US and Hong Kong. In 1979, a European procurement base was added in Germany. Following the Plaza agreement of 1985, Hitachi established an International Procurement Department which was separate from its Materials Department that traditionally had handled all purchasing activities. The original motivation was to soften trade frictions with the US by increasing the share of foreign imports. This focus on arms'- length imports is reflected in the fact that one of the first activities of this new department was to send

³⁹ Tejima 1996, page 3

⁴⁰ The following is based on interviews with Hitachi in November 1993.

import missions to the US, China and Korea whose main purpose was to identify and check the quality of parts that Hitachi could import.

Since 1989, Hitachi has made a consistent effort to upgrade its international procurement function. Rather than relying on arms'-length imports from independent foreign suppliers, the focus shifted to reverse imports from foreign affiliates and to OEM imports from technical tie-ups with foreign companies, for instance Goldstar in Korea. At the same time, Hitachi established a number of new IPOs (=International Procurement Offices) in San Francisco, Singapore, Seoul and Taipei. It also began to provide assistance to cut prime costs and to train foreign suppliers.

For quite some time however, Hitachi's attempts to deepen its international procurement function remained fairly limited. It was only after the Hitachi group announced a major reorganization in August 1993 that this process of deepening really got under way in a serious manner. In the same month, Hitachi established a Center for the Promotion of Procurement in Asia in Singapore. While Hitachi's IPOs for all practical purposes have been commercial purchasing offices staffed primarily by buying agents, in the new Center engineers (both from Hitachi and its suppliers) will be involved throughout all stages of the procurement decision, including component design and materials specification. The Center thus would act as a mechanism for bringing in foreign suppliers into Hitachi's internal design processes and for shifting to longer-term supply arrangements. The Center is also supposed to provide training for local/regional materials experts and to coordinate Hitachi's procurement plans with the sales efforts of different host governments.

One important aspect relates to the role of policy incentives provided by both the Japanese government and by various host countries in the region, that have induced Hitachi to rely more on procurement in Asia. For instance, tax incentives for import promotion developed by the Japanese government have helped Hitachi to reduce the cost of importing components from East Asia. The irony is that these incentives were originally developed in response to pressures from various US administrations which were meant to increase the domestic market share for US companies, while in reality they have facilitated some overdue organizational adaptations of Japanese firms.

At the same time, host country policies have also been of great importance. In Malaysia for instance, Hitachi as much as Matsushita and others have closely cooperated with the government's programs for promoting domestic industries. One example for instance is the Penang Skill Development Center of the Penang Free Export Zone where Hitachi together with Japanese parts manufacturers participate in training programs for local parts manufacturers.

c) A redeployment of Japanese component production

Important changes have also occurred in the role of Japanese component suppliers: the tight linkages that traditionally have bound together Japanese electronics firms and their domestic suppliers are losing much of their earlier vigour. Those 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 a number of Japanese firms as well as American, Taiwanese, Korean and some European firms.⁴¹

The higher-level Japanese component suppliers that have set up shop in East Asia are now under increasing pressure to involve local supplier firms for lower-end subcontracting and contract manufacturing activities. This is due to the fact that many small 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.

Most lower-level Japanese subcontractors are relatively small firms that, since the recession started in 1991, have been under tremendous pressure by their customers and parent companies to lower prices. Most of them are reported to have “..a terrible time coping with the steps taken by their parent companies to deal with the higher yen”⁴² and have reached the limits to comply to these requests.⁴³ They are thus “.. faced with the choice of investing overseas or closing down.”(JETRO [1994], p.20). Many of these lower-level Japanese component suppliers may however not be able to raise the funds required for such investments. The cost of domestically raised investment capital has substantially increased and this affects especially SMEs which, in contrast to the big MNEs, have to rely on bank loans for funding their overseas production. Given such severe financial constraints, most lower-level Japanese component suppliers have not been able to invest on their own in overseas production affiliates. Many of them went out of business. The affiliates of Japanese higher-level component suppliers thus increasingly have to rely on domestic Asian

⁴¹ Acer Peripherals’ monitor plant in Penang/Malaysia for instance sources most of its CRT picture tubes from Hitachi and Matsushita affiliates in the region. Interview with K.Y. Lee, president of Acer Peripherals, December 1994.

⁴² Central Bank for Commercial and Industrial Cooperatives, 1993, p.5

⁴³ For evidence, see JETRO, 1994a, p.18 and Miyashita and Russell, 1994, pages 199 passim.

subcontractors, mostly through a variety of contractual, non-equity arrangements such as consignment production and contract manufacturing.

d) A shift to regional supply sources

A fourth important consequence of the Yen appreciation is that Japanese affiliates in Asia have also increased their direct purchases from both Taiwanese and Korean suppliers. Take for instance Taiwan's Tatung group. Tatung's Chunghwa Picture Tube affiliate in Malaysia supplies today a number of Japanese TV set makers in Malaysia, Singapore and Thailand.⁴⁴ 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-ferrit 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 ferrit cores. The sales of this affiliate are mainly destined for affiliates of National (Matsushita), JVC, Murata and 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 Chunghwa 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 has also been an important driving force behind the spread of OEM and contract manufacturing arrangements with Asian companies, primarily from Taiwan. Since 1994, Japanese PC manufacturers have drastically increased their purchases of PCs, motherboards, terminals and monitors, and a variety of other PC-related products from Taiwanese computer companies. NEC for instance gets monitors and motherboards from Tatung and Elite, and Fujitsu, Epson, Canon, Hitachi, Sharp and Mitsubishi have all become major OEM customers.⁴⁵

A note of caution needs to be added. It is important to emphasize that, while Japanese affiliates in Asia have increased their reliance on regional and local procurement sources, this has not

⁴⁴ Interviews at Tatung group secretariat, December 1994 and April 1993

⁴⁵ This new wave of OEM contracts has had important implications for Taiwan's electronics industry that I will discuss in part III of this paper.

prevented a further rapid growth of component imports from Japan.⁴⁶ One possible explanation for this apparent contradiction⁴⁷ is that the expansion of Japanese production networks in Asia has been so fast that it is compatible with both an increased regional sourcing and increased component imports from Japan. An additional explanation may be that most key components still have to be sourced from Japan or from Japanese firms producing in the region.⁴⁸ Still another explanation might be that, as more components are sourced within the region, so more capital equipment has to be imported from Japan to produce these components.⁴⁹

2. Penetrating Asia's growth markets - a shift to a broader product mix

A second important concern is market penetration, especially for companies with a substantial stake in consumer electronics. Japanese electronics firms are now eager to penetrate the rapidly growing markets of Asia in order to compensate for the slower growth of demand at home, and in the US and Europe. This is no longer restricted to low-end consumer products, but involves complex and differentiated products like high-precision components and industrial electronics. Effective market penetration requires a redeployment of production as well as closer linkages with local firms.

2.1. Motivations

Pressures to open up regional production networks may also result from demand-related factors. Most Japanese electronics companies traditionally have focused on rapid market share expansion based on a shortening of the product cycle and a reliance on "product variety wars". Constant product differentiation has been the main vehicle of market share expansion. This has been a tremendously successful strategy - as long as rapid demand growth could be taken for granted. This is no longer the case today, as most electronics markets have shifted from sellers' to buyers'

⁴⁶ As demonstrated in part II.2.4. *A broader product mix: components and industrial electronics*, Asia continues to be a major market for electronics components, as reflected in the rapid growth of component imports from both the US and Japan.

⁴⁷ I am grateful to John Ravenhill for drawing my attention to this contradiction.

⁴⁸ This is shown in part III to have happened for the Taiwanese electronics industry. For an earlier presentation of such evidence, see Bernard and Ravenhill, 1995

⁴⁹ It is beyond the scope of this paper to test this hypothesis. This will require a systematic analysis of MITI's most recent firm-level survey which the author expects to conduct in the fall of 1997.

markets⁵⁰, as demand for consumer electronics remains muted both in Japan and Europe, and as competition for the US electronics market has considerably intensified.

The result is that Japanese electronics firms are now under tremendous pressure to create new product markets. Yet, despite continuously high investments into product development, only a few potentially successful “high-growth products” have emerged.⁵¹ The main emphasis thus has to be on geographic market diversification, especially into the rapidly growing markets of East Asia. This is why Japanese electronics firms today are all anxious to expand their market shares in East Asia. Compared to the second half of the 1980s, when supply considerations were by far the dominant concern, today Japanese overseas investment in East Asia is driven by “... a completely new logic” (Kinoshita [1994], p.4), and market share expansion within the region is now a much more prominent objective. This is especially true for China. Almost all the leading Japanese electronics firms are committed to major new investment projects in this country: getting a foot into this potentially huge growth market has been the main motivation for such investments, overriding the still quite substantial concerns about political and macroeconomic instability and the huge investment risks involved.

2.2. A strategic market for the electronics industry

Until quite recently, the Triad, consisting of North America, Europe and Japan, was considered as a proxy for the world market. All other countries were lumped together under a residual category called “ROW”, meaning: “the rest of the world”. This is no longer possible today. East Asia (exclusive of Japan) today accounts for roughly 22% of world GDP, which clearly indicates a quite considerable market size. This share is expected to grow to roughly 35% until the year 2010.⁵²

For the electronics industry, East Asia has already become a strategic growth market since the late 1980s. High domestic savings ratios and the integration into international production networks has led to extraordinarily rapid growth: since 1990, most countries in the region had annual GDP

⁵⁰ See Ernst and O'Connor [1992], chapters I and II.

⁵¹ Some important examples are: Canon for compact copiers, laser and bubble-jet printers and a new enabling technology for liquid crystal displays, called ferro-electric LCD; Sony for walkmans and camcorders; Sharp for active matrix -LCDs , a miniaturized and user-friendly camcorder based on Sharp mini liquid-crystal video displays, called VideoCam, and refrigerators based on "neural network" technology; and Fuji Photo Film's new 3.5 inch floppy disc which is capable of recording 50 times as much data as those currently in use, opening up the possibility for floppy discs to dominate future markets for portable recording media for digital data.

⁵² World Bank 1995

growth rates between 6 to 8%. This has led to a rapid growth of disposable income for urban middle classes that are familiar with the latest consumer gadgets and computer wizardry and who are able to pay for them. Pockets of extreme wealth have emerged in all countries of the region, including “new frontier” countries like China, India, Indonesia and Vietnam.

But disposable income has also increased for lower income groups. Direct labor costs (i.e. wage levels for workers) in the region began to rise during the 1980s, first in Hong Kong and Singapore, then in Taiwan and Korea, and now also in Malaysia and Thailand.⁵³ This is due to the fact that most of the production activities of foreign firms and of their local partners are highly labor-intensive, and female workers, often just recently immigrated from the countryside, constitute a very large share of this labor force. The result is that income growth has moved beyond a small urban labor aristocracy, the hallmark of earlier rounds of industrialization, and has trickled down to a fairly broad segment of the population. At the same time, however, large disparities exist in income distribution and among regions, and per capita income levels, in absolute terms, are still orders of magnitude lower than in most OECD countries.

Such skewed patterns of income growth has had a twofold effect on the domestic market: It has drastically increased the effective demand for homogeneous products like (mostly low-end) consumer durables. At the same time however, it has also given rise to more sophisticated patterns of demand, with the result that East Asia now also has become an important market for differentiated products.

This has important implications. It will force Japanese electronics firms to broaden the mix of products they produce within the region. As a result, the complexity of their Asian production networks is bound to increase. This will make it even more difficult to control and coordinate these networks in a centralized manner.⁵⁴

2.3. Consumer electronics

Japanese consumer electronics firms today are faced with two important changes in their markets: For standard, mass-produced devices, like AV equipment and appliances, major OECD markets stagnate, except for periodic (yet, mostly ephemeral) growth blips, due to the introduction of new product generations. In Asian markets however, standard products face very rapid growth.

⁵³ For evidence, see the annual World Employment Reports of the ILO, Geneva

⁵⁴ See part II.4. *A shift towards decentralized governance structures*

Take the example of Sony. The share of Asia (including India, but excluding Japan) in Sony's total sales has increased from 6% in 1985 to 20% in 1995. What really matters however is that Asia is, to quote Sony's marketing chief: "a goldmine for **existing** products."⁵⁵ Sony expects that Asia's share in its sales of existing products will increase to more than 50% over the next few years. In other words, Sony expects that East Asia will become its main market for homogeneous products, which would enable it to buy time and breathing space, and to generate the income required for implementing its diversification strategy. For companies like Sony, as well as for Matsushita and Sanyo, this could be of critical importance: these companies desperately need a new cash cow that can provide the funds for new product development.⁵⁶

This has important implications for the organization of international production. The rapid demand growth for standard consumer goods implies that moving down-market is a sensible strategy - all Japanese producers of consumer devices in fact have implemented such a strategy. Due to the razor-thin profit margins that characterize most of these products, their production however has to be located at low-cost sites and close to their main growth markets, primarily in Asia. Yet, new challenges are already emerging. Japanese firms still dominate most markets in the region, but firms based in Korea, Hong Kong and China have rapidly caught up, and they are now aggressively moving up-market. The result is that Japanese firms have ceased to be able to charge premium prices, and this is true even for "new frontier" markets like China, Vietnam and Myanmar.⁵⁷

2.4. A broader product mix: components and industrial electronics

Until the late 1980s, most of the Asian production networks of Japanese electronics firms covered only a limited variety of products, markets and production activities. In most cases, the focus has been on the final assembly of low-end household appliances and consumer goods that require fairly

⁵⁵ Telephone interview, March 1996

⁵⁶ In terms of the market growth potential for such products, the orders of magnitude involved are mind-boggling. Since 1992, East Asia's demand for consumer electronics has grown on an average by 15-20% annually. For China, demand growth for consumer electronics was even higher and exceeded 20% p.a.. Market research in China (roughly 1.1 billion inhabitants) and Indonesia (more than 180 million inhabitants) shows that, in these countries, roughly 10% of the population can afford to buy a variety of consumer durables. It is thus hardly surprising that Japanese and Korean producers of consumer electronics, as well as Philips and Thomson, consider East Asia a strategic market. An important caveat needs to be added: these projections talk about potential markets and fail to analyze the often quite substantial constraints to the transformation of potential into effective demand. See our discussion of Matsushita's current problems in China in section III.1.

⁵⁷ For an analysis of the competitive strategies of Japanese and Korean electronics firms in Vietnam, see Ernst, 1995.

conventional mass production techniques. This has been complemented by the production of electronics components that are not leading-edge, but capital-intensive and essential for the performance of consumer products, with small-screen TV picture tubes being a typical example. The same applies to some parts forming and die- and tool-making activities.

Over the last few years, substantial changes have occurred in this traditional product mix which has imposed new pressures on Japanese electronics firms to open up their Asian production networks. Take for instance electronics components. East Asia now has become a major market for a variety of high-precision components like for instance microprocessors, displays and large-size picture tubes, and components needed for hard disk drives and computer printers.

In 1993, the value of Japan's exports of electronic components to East Asia was almost \$ 13 billion, roughly 45% of its total electronics exports to the region.⁵⁸ For some countries, this share was substantially higher: More than 61% of Japanese exports to Taiwan and Korea are components, nearly 59% for Malaysia. In the same year, the value of US exports of electronics components to East Asia was almost \$10 billion, roughly 55% of total US electronics exports to the region. For Malaysia, a major US supply base for IC assembly and PC-related products, this share was 83%. Components are also by far the most important product group of US electronics exports to Taiwan: their share has consistently increased since 1985 from more than 31% to almost 56%.⁵⁹ Most of these components are semiconductors that are shipped to Taiwan as inputs to its burgeoning PC industry. The growing share of components in Japanese and US exports to Taiwan clearly reflects the increasing importance of Taiwan as a global supply base for the world PC industry.

It is important to note the continuous rapid growth of the East Asian market for electronic components. The more these countries proceed to upgrade their electronics industry, the more they are dependent on component imports. Take one example: Both in 1994 and 1995, Japanese exports of components to Asia increased by almost 35%.

The shift to a broader product mix now also includes industrial electronics, especially computer-related products and telecommunications equipment. Again we find the same dual market structure

⁵⁸ Ernst and Guerrieri, 1997. This study analyzes how the spread of American and Japanese production networks in Asia has shaped their trade links with this region in the electronics industry.

⁵⁹ A very different pattern however prevails for China: the share of components in US electronics exports to this country has actually declined from more than 12% in 1990 to less than 2% in 1993, while EDP and telecommunications equipment are by far the most important export categories. To a large degree, this results from the successful market penetration strategies of AT&T and Motorola in the Chinese market for telecommunications equipment.

as for consumer electronics: mass markets for homogeneous products coexist with increasingly important emerging markets for differentiated products. Desktop and laptop PCs are examples of homogeneous products; differentiated products include a variety of equipment required for computer networks (especially PC servers) and specialized work stations.

Computer-related products face a huge and still largely untapped demand potential in this region. Most Asian countries still display very low levels of computerization:⁶⁰ Malaysia only has 13 computers per 1000 people, while these shares are substantially lower for Indonesia (3 per 1000) and China (2.1 per 1000). Ranking at the bottom is Vietnam with a measly penetration ratio of 0.3 computers per 1000 people. If one compares this with the region's leader Singapore,⁶¹ which currently has around 80 computers per 1000 inhabitants, it becomes clear that these countries have a huge potential for future market growth. In ASEAN countries (exclusive Singapore), annual growth rates of demand for PCs are estimated to be around 40%. Most noteworthy is the exploding demand for computers that China has experienced since 1992: in unit terms, sales volume has increased from 180,000 units in 1991 to almost 1.7 million in 1995, with annual growth of demand on average exceeding 50%.⁶²

Most governments in East Asia consider the spread of information technologies to be an essential prerequisite for economic development, and are eager to involve foreign computer companies in the development of both IT applications and IT production. Import restrictions however are quite pervasive, with the result that market penetration requires local production.⁶³ At the same time, Japanese electronics firms are forced to increase local content and to deepen their links with local suppliers. As a *quid pro quo* to improved market access, Japanese firms may thus face increasing pressure to comply to host country government requirements to open up their supplier networks and to localize component sourcing, key management functions and R&D.

⁶⁰ Computer penetration rates, as published by International Data Corp. The figures for Taiwan are courtesy to Market Intelligence Centre, Institute for Information Industry, Taiwan

⁶¹ Taiwan, despite its flourishing PC industry, still has an unremarkable domestic computer market, compared to the world's advanced nations: its computer penetration rate is now estimated to have reached roughly 77 per 1000.

⁶² Figures provided by Market Intelligence Centre, Institute for Information Industry, Taiwan

⁶³ Almost without exception, local computer markets in Asia are heavily protected, and thus are difficult to penetrate. The only exceptions are Hong Kong and Singapore. Foreign companies are unlikely to succeed without powerful local joint venture partners that can guarantee access to distribution channels. Penetrating these markets normally involves three steps: first the foreign computer company establishes sales and marketing JVs which, if successful, will be followed by consignment assembly by a local company. Only if these first two phases were successful, will the foreign company consider to invest in its own manufacturing affiliate. This gradual approach is meant to reduce the risk of international production and to balance the limited resources available with the need to match production sites and major potential growth markets.

This is especially true for telecommunications equipment (ranging from fax machines, pagers, cellular phones, to switching and transmission equipment) where Asia is now the most important growth market. Competition for these markets is extremely intense, with the result that all major manufacturers of telecommunications equipment are expanding their production in the region. In order to penetrate for instance the closed public procurement markets for transmission and switching equipment, foreign firms are required to establish domestic production. The typical entry strategy into such markets requires the foreign company to accept offset production agreements that allow local firms to participate in production. For most of the necessary support services required to install and upgrade telecommunications equipment, it would simply be too costly and time-consuming to provide them from abroad. As a result, Japanese firms have had to expand those circuit design and software activities in East Asia that are required for the installation of telecommunications systems.

Probably the most dramatic pressures for an opening-up of regional production networks result from the relocation of production of computer-related products. This process has started only very recently. During the fall of 1992, US firms such as Compaq and Dell, followed later by Apple and others started a blistering price war in Japan, offering Japanese-language machines for roughly half of the price of NEC machines. Most of these machines are actually produced at locations in the China Circle: both Apple and Compaq have production affiliates in Singapore and both rely heavily on OEM arrangements with Taiwanese computer companies.⁶⁴

This for the first time has posed a serious threat to NEC's dominance of the heavily overpriced Japanese PC market that so far had appeared to be invincible. NEC's immediate reaction was to gather its main subcontractors, just before Christmas 1992, for a secret meeting in rural Gumma Prefecture north of Tokyo, asking them to come up, within three weeks, with "... 50% cuts across the board, all parts, all assemblies, everything." (Miyashita and Russell [1994], p.200). During the following months it became clear however that many of NEC's suppliers had no more leeway to cut costs, and some were even starting to rebel. The traditional response to price competition, i.e. shifting the burden of cost reduction onto the shoulders of subcontractors, clearly had reached its limits. As a result, NEC was forced to shift, fairly ad hoc and without much preparation, a growing share of its production abroad, especially to lower-cost locations in East Asia.

For its main product line, the PC 9800 series, NEC has chosen a two-pronged approach. In April 1994, it has shifted the design of the motherboard (the main circuit board for PCs that contains the central processing unit) to its Hong Kong subsidiary NEC Technologies Hong Kong Ltd. The main objective was to redesign the board so that it could use more of the cheaper standard

⁶⁴ Ernst, 1996b

components available from Korean, Taiwanese and Chinese producers.⁶⁵ By 1995, NEC had increased the share of these East Asian components to around 70% of the board's value. Since around mid-1995, NEC is assembling an increasing number of these new PC models in its new joint venture in Shanghai that originally was established to assemble NEC workstations for China's domestic market.

This example clearly indicates that, confronted with an increasingly pervasive price war, Japanese computer manufacturers have cast aside most of their earlier inhibitions to forge close ties with Asian suppliers and that they are now engaged in a somewhat belated attempt to tap into and replicate the production networks that American computer companies have established in the region.

This is an important new development. Very little over-lapping and rivalry has occurred so far between American and Japanese sourcing strategies: the Americans focused on PC-related products, while the Japanese focused on consumer electronics and appliances. This is now rapidly changing, as Japanese firms are shifting a variety of PC-related products to East Asia. This implies that for the first time, American and Japanese firms will have to compete for the same potential supply sources in East Asia. How will this affect American strategies? Will they be forced to expand their in-house component manufacturing activities in Asia, like Seagate does? Will they be forced to establish centralized control, in order to keep a tighter rein on technology leakage which could benefit their Japanese rivals? In other words, will the pendulum now swing back, after a long period of extended outsourcing, to more integrated forms of organizing the international production networks of American computer companies?⁶⁶ And how will this affect the approaches of American electronics towards their external suppliers and contract manufacturers? Will they be forced to establish longer-term links with local suppliers in order to establish effective control? Presumably, American firms have to act, in order to prevent Japanese firms from developing East Asia into their exclusive supply base in the future.

3. Mobilizing and harnessing the region's capabilities

Japanese electronics companies are equally attracted by supply-side factors: East Asia's excellence in low-cost manufacturing continues to remain a major attraction. The region however can now

⁶⁵ Most of these Chinese suppliers are affiliates of Taiwanese computer companies. For further discussion, see *part III*.

⁶⁶ See the excellent analysis of the dialectics of outsourcing and integration in the hard disk drive industry, in Christensen, 1994

also provide a variety of higher value-added support functions like flexible specialization, engineering, and product and component design. Access to the region's improved capabilities is now considered to be an essential prerequisite for a successful upgrading of Japan's domestic production system. In order to mobilize and harness these capabilities, Japanese firms are forced to broaden their capability transfer to East Asia, and to internationalize their innovation management.

3. 1. East Asia's improved capabilities

Simple cost considerations are no longer the only factor that attract electronics firms to this region. Gone are the days when East Asia was just a source of cheap labor for final assembly activities. Since the mid-1980s, substantial improvements have occurred in the locational advantages of East Asian production sites. The overall picture is encouraging:⁶⁷ investment in infrastructure is booming; every country has increased its efforts to educate and train people across all levels of the occupational ladder; financial systems have been liberalized; domestic firms have deepened their technological capabilities; especially in the export sector, domestic firms have drastically improved their organization and management approaches; and, finally, government policies overall have become much more pragmatic in dealing with foreign investment, and are attempting to foster closer links between foreign investors and domestic firms.

As a result, East Asia has seen the emergence of specialized centers of expertise in the production, and often also in the design of certain products, e.g., semiconductors in Korea, a variety of PC-related products and components in Taiwan, for disk drives, printers and sound cards in Singapore, and for household appliances and consumer electronics in Malaysia and Thailand. Hong Kong and China consistently have concentrated on two product groups: household appliances and consumer electronics. Since 1990 however, the share of computer-related products has rapidly increased. To a large degree, this is a reflection of the rapid expansion of Taiwanese production networks into China, with a focus on motherboards and monitors.⁶⁸ Leading electronics firms, both in the U.S. and Japan, are now eager to capture some of the externalities generated in these

⁶⁷ Ernst, Ganiatsos and Mytelka (eds.), 1997

⁶⁸ Changes in the product composition of China's electronics exports to the US clearly indicate this upgrading in capabilities. Traditionally, China's electronics exports consistently have been dominated by two product groups: CE and household appliances. The combined export share of both products reached a peak of 80% in 1989, and has fallen since then to roughly 64% in 1993. Since 1990, the share of computer-related products has increased at a very rapid pace: it doubled from less than 6% to nearly 12% between 1990 and 1992, and increased further to almost 15% in 1993. See Ernst and Guerrieri, 1997.

geographically-concentrated centers of expertise either through linkages with domestically-owned firms or by establishing a local subsidiary.

East Asia today has become a leading supply base for an increasing variety of information products, i.e. products that are used for computing, communicating and multi-media purposes. In value terms, roughly 75-80% of the worldwide production of hard disk drives is produced in East Asia (exclusive of Japan). The share is 75% for PC motherboards and computer monitors, and 70% for fax machines and scanners. Over the last two years, Taiwan has emerged as the leading producer of laptop PCs, with a 1995 share, in value terms, of close to 40%. Samsung has become the world leader in DRAMs, with both LG and Hyundai following closely behind. Firms from Korea and Taiwan are currently investing more than \$30 billion in new chip-making facilities.⁶⁹

These three examples reflect two distinct, yet complementary strengths of this region: 1) a capacity to ramp up at an incredible speed the production of highly capital-intensive and complex mass production lines like monitors, disk drives and computer memories; and 2) a capacity for quick response to changes in market requirements and technology through flexible specialization in manufacturing and procurement. While Korean chaebol like Samsung represent most closely the first strength, medium-sized Taiwanese computer companies like Acer are typical for the second strength.⁷⁰

Until recently, most of these products were based on imported design. The focus has been on manufacturing excellence and on sophisticated supply chain management, while product and market development remained weak. This is now beginning to change: production and procurement capabilities are increasingly being supplemented by design and market development capabilities. Today, 70% of the PCs supplied by Taiwanese computer firms as part of so-called OEM contracts, are designed by the Taiwanese firm. Design, in this, context, means the capacity to make quick changes in the configuration of motherboards in order to be able to integrate the latest microprocessor generation. While this is a very demanding requirement, one should not lose sight of the fact that this is something quite different from the capacity of a firm to define architectural standards and thus to create new markets.⁷¹

⁶⁹ The current oversupply of computer memories, especially DRAMs, has forced some of these companies to slow-down the implementation of these investment projects.

⁷⁰ For a detailed analysis of the sophisticated mass production capabilities of Korean chaebol, see Ernst, 1994c and 1997a. An assessment of the strengths and weaknesses of the Taiwanese electronics industry can be found in: Ernst, 1997 b.

⁷¹ In the PC industry, for instance, the capacity to define architectural standards is monopolized by a handful of companies, with Intel (for micro-processors) and Microsoft (for operating systems) being the undisputed leaders.

Another important development is the spread of “turnkey manufacturing” arrangements in the PC industry. Compaq, in a recent contract with Taiwan's Mitac International, has out-sourced all stages of the value chain except marketing for which it retains sole responsibility.⁷² Mitac in turn will be responsible for the design and development of new products, as well as for manufacturing, transport and after-sales services at its manufacturing facilities in Taiwan, China, Britain, Australia and the U.S. Compaq expects to save up to 15% in overall life-cycle costs. Mitac's greatest attraction for Compaq are its plants and sales subsidiaries that are located in most of the world's key computer markets.

3.2. A broader capability transfer

Japanese electronics firms are now experimenting with new approaches to innovation management. This has far-reaching implications for the organization of their Asian production networks: it may help to improve the capacity of Japanese firms to mobilize and harness the region's capabilities.

These experiments are driven by the need to outsource a variety of capabilities that either have become too expensive in Japan or that only very few firms can afford to retain. This reflects the efforts of Japanese electronics firms to emulate successful strategies of American electronics firms: to improve their specialization, and hence to strengthen their core competencies through an increasing reliance on outsourcing.⁷³

There is a rich literature on the comparative strengths of innovation management by Japanese firms:⁷⁴ a capacity to reduce the development cycle for new products and thus to accelerate speed-to-market, as long as these products remain within a given technology paradigm. A continuous

⁷² Information provided by MIC/III, October 27, 1995

⁷³ In a study for the Sloan Foundation project on the globalization in the electronics industry, I show that American electronics firms were able to improve their specialization by relying on a combination of the following three strategies: 1) an early redeployment of final assembly and testing activities to a few locations in East Asia; 2) the outsourcing of an increasing variety of value chain activities to Asian contractors, first in Japan, then in Korea and Taiwan, and now also in China and other Asian countries; and 3) a systematic rationalization of the international production networks that have emerged as a result of these activities. This has set in motion a virtuous circle: By redeploying lower-end stages of the value chain to Asia, American electronics companies were able to concentrate on what they do best, i.e. on product design and the definition of global brand names and architectural standards, and on the control of distribution channels. A focus on such higher stages of the value chain has generated high profit margins. In turn, this has enabled American companies to stay ahead through aggressive new product development strategies. See Ernst, 1996b.

⁷⁴ Important contributions include: Imai 1988; Mowery and Rosenberg, 1990 ; Kenney and Florida, 1993; Clark and Fujimoto, 1991; Nonaka and Takeuchi, 1995; Branscomb and Kodama, 1993

refinement of product design and process engineering have been hallmarks of the Japanese approach to innovation management.

However, more recent research which has been conducted mostly by Japanese researchers and is much less well known in the West, has highlighted some important weaknesses of the international innovation management strategies of Japanese electronics firms.⁷⁵ Compared to their American and European counterparts, Japanese firms are still at a relatively early stage of R&D internationalization, and so far have very limited experience in organizing international R&D networks.

One of the pioneers of such outsourcing strategies for innovation has been Canon, the highly successful computer printer, copier and camera company.⁷⁶ Over the past decade, this company has devolved significantly more management control to foreign subsidiaries, hired a greater proportion of foreign staff and management, and absorbed more ideas from abroad than is the Japanese norm. The first step in that direction took place in 1990 when Canon set up five overseas R&D centres, now employing 15% of its R&D staff. In 1996, Canon gave its US research unit global responsibility for software, established a French global telecommunications research unit, and an automated language translation centre in the UK. Today, half of Canon's global workforce works abroad, up from 30% a decade ago. Of the 40,000 outside Japan, only 900 are Japanese.

The main driving force for relocating R&D activities to East Asia is the current shift from proprietary components to standard components that can be sourced at lower cost from local or regional suppliers. In order to achieve this goal, Japanese electronics firms are all forced to upgrade their regional and local support services.

A second important objective for Japanese electronics firms to expand their R&D activities in Asia is to tap into existing pools of lower-cost human resources. Most countries of the region in fact pursue quite aggressive policies to increase the supply of engineers and scientists. The following areas are of particular importance: software engineering; certain basic assembly technologies; some areas of circuit design; and certain areas of system engineering and integration. As the Export-Import Bank of Japan emphasizes, Japanese electronics firms are under tremendous pressure "...to

⁷⁵ The following account is based on Abe, 1992, and interviews in the Japanese electronics industry, November 1993 and June 1995.

⁷⁶ Dawkins, William, "Time to pull back the screen. Japanese multinationals may follow Canon's example and shift power overseas", *Financial Times*, 11/18/96

reconstruct their advantages internationally ...[through] internalization of human resources of host countries within each company group.”⁷⁷

This is not going to be easy. Japanese affiliates in Asia find it difficult to retain trained foreign personnel not only because of the “glass ceiling” that normally prevents foreigners from reaching top management positions, but also because of the relatively slow pace of upward mobility for managers and engineers.⁷⁸

As a result of the closed production networks which they had established during the 1980s, they are facing much greater difficulties, compared especially to American companies, in recruiting top local engineers. After some unsuccessful attempts to headhunt engineers by paying higher salaries, they have now developed a peculiar recruitment approach that builds on some inherent strengths of the Japanese production system.⁷⁹ They now hire most of these local engineers internally. Based on a careful selection process, each affiliate develops a pool of highly motivated “technicians”, which they then train over a period of 5 to 7 years to become (possibly unlicensed) engineers. This accounts for the relatively low turnover at the engineering level - the new engineering skills are firm-specific. This peculiar recruitment approach obviously builds on existing strengths of the domestic Japanese production system. At the same time, it allows the Japanese firms to overcome two problems; 1) most host countries limit the immigration of Japanese engineers; 2) there is an implicit understanding among Japanese firms that bidding up salaries to attract engineers should be avoided.

Third, Japanese firms now also attach much greater importance to market intelligence and product customization. They are increasingly conscious of the fact that Asia is characterized by very heterogeneous demand patterns and highly segmented product markets. At the same time, the variety of production sites has kept increasing, with the result that Japanese firms have now to adapt their Asian production networks to the idiosyncrasies of each of these markets. As a result, local affiliates need to have a capacity for continuous product customization: they need to establish on the spot a capacity for continuous re-design (adaptive engineering). Adaptive engineering and

⁷⁷ Tejima, 1996, reporting on the most recent annual questionnaire survey of the Export-Import Bank of Japan.

⁷⁸ On the last aspect, see the work of Dennis Tachiki on the peculiar dynamics of human capital formation in Japanese foreign affiliates. See Tachiki, 1994

⁷⁹ Most of my interview partners in Japanese electronics firms emphasize that they cannot merely replicate the US model of international production. This supports our argument that changes in the organization are path-dependent, in the sense that they are shaped by peculiar features of the domestic production system. For Japanese firms this implies that they have to come up with an organizational response that is based on and amplifies the strengths of their domestic production system. One prominent example is the distinctively different approach of Japanese electronics firms to human capital formation in Asia.

some development activities become increasingly decentralized and take place in engineering departments of Asian manufacturing affiliates.

Table 1 summarizes some empirical evidence for R&D activities of Japanese electronics firms in East Asia. I distinguish five categories:

(I) Adaptive engineering, i.e. engineering activities that go beyond basic manufacturing support services and include the incremental adaptation and improvement of products and processes.⁸⁰

(II) Circuit design

(III) Software engineering (that ranges from simple program reconversion to fairly sophisticated projects))

(IV) Product development, most of it for the local market, and a few projects for the regional market.

(V) Generic technology development, i.e. major innovations with a huge potential for productivity enhancement and the creation of new product markets.

The table shows that out of a total of 45 projects, only one falls under the category V, i.e. the audiovisual information research center of Matsushita in Singapore, established in 1990, that focuses on the development of compression technology for image transmission required for videophones and multimedia. Eleven projects are reported to involve product development.⁸¹

The largest share of Japanese electronics R&D activities in East Asia falls under two categories: software engineering (with 15 cases) and circuit design (with 11 cases). The essential point to stress is that in most cases both are essentially support services required to enter or expand the region's domestic markets. For software engineering for instance, the development of Chinese language programs plays an important role, with the objective to improve the market position in China for Japanese computer manufacturers. And most of the circuit design activities are dedicated to ASICs (application-specific integrated circuits) that are required for consumer devices or telecommunications equipment sold in the domestic or regional markets. Both Singapore and Hong Kong have recently emerged as regional IC design centres for consumer devices. Japanese firms are now concentrating their limited resources at home on higher value-added products related to computing, multi-media and networking applications, and thus are eager to redeploy design and engineering functions linked to AV equipment and home appliances. Take the example of Sharp's IC design centre in Singapore that currently consists of ten people.⁸² Apart from after-sales support services, its main function right now is the programming of microcontrollers

⁸⁰ Basic manufacturing support services are defined to include activities like calibration and testing, die and tool services, (preventive) maintenance and repair, and quality control.

⁸¹ Category IV is problematic: it may also contain some relatively simple tasks belonging to category I. More in-depth interviews are required to solve this problem.

⁸² Based on interviews at Sharp headquarters, in June 1995.

embedded in home appliances. Over the next years, Sharp intends to use this centre in order to outsource design work from Japan on a much larger scale: till 1998, the company was planning to increase the centre's staff to 30 people.

4. A shift towards decentralized governance structures

We have seen that Japanese production networks have started out with a loose, locally embedded structure during the period of domestic-oriented production. This dramatically changed, once the focus shifted to export platform production, which has led to the establishment of highly centralized governance structures and very limited local roots. A new stage is reached in this zig-zag movement during the early 1990s. The pendulum now swings back again toward decentralization and local embeddedness.

In contrast to the earlier period of domestic market orientation, there are however three important differences: First, Japanese electronics firms are now moving more elements of their value chain to Asia, including some high value-added support services, like product design and development. Second, the mix of products that they produce and source within the region has been substantially broadened, and now includes higher-end consumer goods, a variety of information products (required for computing and communication), as well as components and subassemblies. Third, corporate headquarters finds it increasingly difficult to cope, from a distance, with the task of reconciling the conflicting requirements between export platform production and domestic and regional market penetration.

This has substantially increased the complexity of their Asian production networks. Japanese firms are finding it much more difficult today to control and coordinate these manifold activities as part of a closed regional production network. This has led to a gradual shift to more decentralized governance structures, where regional headquarters and/or individual Asian affiliates take over a number of coordination functions that used to be the sole privilege of the parent company. Each of the individual nodes of Japanese Asian production networks now have to contribute to the lead company's resources and capabilities. A certain degree of decentralization of governance structures is necessary in order to unleash the learning and innovation potential of affiliates and suppliers.

One obvious example is the rapid regionalization of procurement that we have discussed before. We have seen that Japanese electronics firms are less reluctant now to search out within the region and to qualify non-Japanese suppliers and contract manufacturers for an increasing number of their products, subassemblies and components. This has led to a rapid expansion of OEM purchases,

subcontracting and contract manufacturing arrangements. As a result, companies from within the region, especially from the China circle, now play a critical role as members of Japanese production networks. This has important implications: responsibility for procurement can no longer be retained in Japan; it increasingly migrates to regional headquarters or individual Asian affiliates. The most important reason is to speed up decision-making. For most of the products produced in Asia, time-to-market has become the most important determinant of success. Japanese affiliates in Asia thus simply cannot wait the roughly nine months that are normally required to get approval on procurement from headquarters.

Let me add a second example that may also indicate a shift to more decentralized governance structures. I am referring to the localization of investment funding. To the degree that Japanese affiliates are now much less dependent on their parent companies for investment funds, they may also gain more decision autonomy. This is not to deny that a greater reliance on local reinvestment initially is driven by short-term financial considerations: a higher profitability of the local affiliate makes it rational to use such profits for local re-investment. Yet, once this process gets going, it may as well have the important side effect of strengthening, step by step, the decision autonomy of the local affiliate.

Localization of investment funds has two aspects: First, Japanese affiliates in Asia have begun, at long last, to tap into the region's thriving equity markets and list on local stock exchanges. Various interview partners have emphasized that Japanese electronics firms are now much more inclined to local LSE listings, but it is difficult to find hard evidence. I thus use the increase of local reinvestment to document the localization of investment funds.

Until the early 1990s, most of the funds required for the expansion of Japanese regional production activities in East Asia have consisted of remittances from the parent company in Japan. Reinvestments of overseas affiliates and equity links with local investors have played a very minor role.⁸³ This pattern is now beginning to change, especially in ASEAN countries which have received the bulk of Japanese investment during the 1980s. Most of these investments are now locally funded, i.e. they do not involve a transfer of capital from Japan. Between 1989 and 1992, the ratio of reinvestments of Japanese affiliates to Japan's total FDI increased from 35% to 60% for ASEAN affiliates, and from 54% to 80% for NIE affiliates. This is way above the ratios that were reported for affiliates in the U.S. and Europe, that increased from 15% (1989) to 24%

⁸³ During the peak of the recession, when most Japanese electronics firms faced a serious profit squeeze, Japanese parent companies actually used sophisticated transfer-pricing techniques to transfer back home any profits made in Asia. Interview with Japanese venture capital firm, November 1993

(1992), and from 10% to 17% respectively.⁸⁴ This was made possible by the high profitability of Japanese affiliates in Asia: in FY 1992, the ratio of “ordinary profit to sales” of Japanese overseas manufacturing affiliates was 5.1% in ASEAN, and 5.6% in Asian NIEs. This is in sharp contrast with the situation in the US and Europe where these ratios were minus 0.2% and minus 2.5% respectively.

The increasing importance of locally funded reinvestment has been documented for Malaysia and Thailand in a JETRO survey conducted in October 1993. This survey covered 19 subsidiaries in Thailand and five in Malaysia, most of them from the electronics industry.⁸⁵ When asked how they have raised their funds for their recent investments, the great majority in both countries responded that locally funded reinvestment had played an important role. This was the case for 13 out of the 19 companies in Thailand and for four out of the five companies in Malaysia. In Thailand for instance, eight companies reported that the local subsidiaries had borne the full burden, and five that it had been split fifty-fifty between the Japanese parent and the local subsidiary.

Recent data confirm this trend: During the fiscal year of 1993 for instance, Japanese manufacturing affiliates in Asia have reinvested \$5.45 billion - more than the \$4.37 billion in North America and the \$1.48 billion in Europe.⁸⁶ The share of reinvestment in total Japanese investment in Asia now has reached 60%, with the result that reinvestment by affiliates now exceeds direct investment.

⁸⁴ MITI, 1994b

⁸⁵ In Thailand for instance, 11 out of the 19 firms covered were from the electronics industry (eight in home appliances, two in computers and peripheral equipment and one in components). A brief summary of this survey can be found in JETRO, 1994a, p.21

⁸⁶ JETRO, 1996, p.19

III. Implications for the China Circle

In the reorganization of their Asian production networks, Japanese electronics firms have been struggling with four objectives that I have described in *part II*: a regionalization of procurement; penetrating Asia's contested growth markets; attempts to harness the region's improved capabilities; and a shift to more decentralized governance structures. We have seen that, in order to cope with these conflicting requirements, Japanese firms had to develop a regional strategy that moves beyond the idiosyncracies of individual countries.

Japanese firms are now under considerable pressure to rationalize their existing Asian production networks, and to cut cost wherever possible, and at every stage of the value chain.⁸⁷ They are forced to make a serious effort to improve the specialization among individual Asian affiliates, and between them and their local suppliers. As their Asian production networks have become more complex and locally embedded, Japanese firms now have a vested interest to interact with local companies and to increase their Asian value-added.

One further level of complexity needs to be added: regional strategies need to be consistent with the firm's global strategy. In order to address this issue, some Japanese electronics firms have now established global information networks that link overseas affiliates and the parent company and that cover crucial stages of the value chain, such as product design, production, procurement and inventory control.⁸⁸ The purpose is to ensure that any affiliate in East Asia has the same access to this information, not only as its sister affiliates in the U.S., but also as its parent company.

All of this has important implications for the China circle: Japanese and China Circle networks are likely to interact more closely in the future and this may considerably change the dynamics of competition in the electronics industry. A systematic analysis of these interactions is beyond the scope of this chapter whose main purpose is to correct some popular misconceptions about Japanese Asian production networks. Our analysis of the different incarnations of these networks has already provided various examples of linkages with the China circle.

⁸⁷ In an earlier study, published in November 1994 (Ernst, 1994b), I have argued that, due to drastic changes in the domestic production system, Japanese electronics firms will no longer be able to postpone systematic efforts to consolidate and rationalize their existing international production networks, especially with regard to procurement, sales and distribution channels, and the acquisition of human resources. While this prediction originally has been met with considerable skepticism, it is now confirmed by a number of more recent studies. Examples include Dobson 1995, Stopford 1995, and Tejima, 1996.

⁸⁸ Companies like Canon, Sony, Sharp, NEC and Fujitsu have acted as pace setters, with other companies now following suit.

In what follows, I will come back again to some of these examples, in order to address two specific questions: What do we know about the role of China in the emerging regional supply base of Japanese electronics firms? And what opportunities and challenges are likely to emerge for Taiwanese firms?

1. The role of China

A regional specialization is now beginning to emerge for Japanese networks in East Asia. In the electronics industry, we can distinguish roughly the following pattern: Singapore and Hong Kong compete for a position as regional headquarters (together with major support functions like procurement, testing, training, engineering services and and some product design); South Korea and Taiwan compete for OEM contracts (including some design activities) and as suppliers of precision components; while Malaysia and Thailand, and now also the Philippines are preferred locations for the volume production, especially of mid-level and some higher-end products.

China's role is of critical importance. Much depends on how Japanese networks are going to integrate this huge, quasi-continental economy that is now also becoming a major geo-political force. China's main attraction, overwhelmingly, is its potentially huge domestic market for a wide range of electronics products. At the same time, it also now competes as a new export platform production base for low-end assembly and simple components manufacturing.

1.1. Market access

Let us first look at the issue of market access and how it has shaped China's integration into Japanese production networks. Japanese firms so far have concentrated almost exclusively on two market segments: consumer electronics (including household appliances) and electronic components. While for consumer electronics, they compete primarily with Korean chaebol, for components their main competitors are American, Korean and Taiwanese firms.

Japanese firms however have failed to play any significant role in China's rapidly growing markets for industrial electronics, with the exception of telecommunications equipment.⁸⁹ This is true in particular for computer-related products which is dominated by American companies and by Taiwanese firms.⁹⁰ It is important to note that most of the computers sold with an American label were produced as OEM products in the China Circle, primarily in Taiwan, but also in Singapore.

Fundamental differences thus exist in the logic of integration of China with American and Japanese production networks. For American networks, the focus clearly is on computer-related products and on telecommunications equipment, while for Japanese networks the focus overwhelmingly has been on consumer products.

Let us take a closer look at China's integration into Japanese production networks for consumer electronics. China's market potential for these products is mind-boggling. 70% of China's population of 1.2 billion people, i.e. 840 million people, live in the countryside. Of these 840 million people, only 10% own a color TV set, compared to almost 90% of the Chinese urban population. Market penetration is substantially lower for more sophisticated consumer goods: VCRs e.g. have spread to only 3% of the Chinese population.

As a result of this huge untapped market potential, all the leading Japanese and Korean TV setmakers have aggressively invested in domestic market-oriented production facilities. Competition has intensified to such a point that pervasive price wars have drastically reduced the profit margins for most of these affiliates. The massive wave of recent investment projects that went to China in consumer electronics, has also given rise to a serious long-term problem: it may actually slow down progress to an improved regional specialization of Japanese Asian production networks. In some cases, these investments have actually led to quite substantial surplus capacities within the region, both for final assembly lines and component manufacturing.

⁸⁹ Both NEC and Fujitsu are involved in some smaller projects, but lack well behind the market leaders from the US (AT&T and Motorola) and Europe (Ericsson, Alcatel and Siemens).

⁹⁰ In 1994, the share of American computer companies of China's brand name desktop market was 42%, with Compaq (15%) as the dominant market leader. For notebook PCs, the share of American companies was 30%, while Taiwan's Twinhead was the largest non-American brand vendor with 5.5%. Toshiba, which worldwide is among the market leader in laptop computers, had managed to acquire no more than a miserable 1% market share, even behind Philips 2% share. Market share figures are courtesy of Taiwan's MIC/III.

Take the case of the Matsushita group which, since 1992, has aggressively expanded its China presence and now has 19 affiliates in this country.⁹¹ So far, Matsushita's Chinese affiliates play a secondary role for its Asian production network: the production value of its China affiliates accounts for less than 5% of Matsushita's total international production. The largest chunk by far is still generated in ASEAN, where an estimated 60% of Matsushita's total international production value worth \$ 6 billion originates. The goal now is to raise China's share to roughly 20 to 25% of Matsushita's international production value by the year 2000.

This obviously has given rise to major structural adjustment problems. Matsushita's joint venture in Beijing for TV picture tubes nicely illustrates these problems:⁹² This project is widely considered to be a major test case for Japanese FDI in China and it has received a quite privileged treatment. Nevertheless, serious problems have emerged. As local supplier industries are still very weak, 15% of the components used (all of them key components) have to be imported from Japan. Due to the Yen appreciation, the price for these components has rapidly increased, leading to a severe profit squeeze. In addition, labor costs have drastically increased, approaching now Thai wage levels, while productivity continues to lag behind Thai productivity levels. Probably the most serious problem however results from unexpected limits to the growth of the domestic market. Roughly one fifth of the 13 million TV sets that are sold per year in China, are smuggled across the borders, many of them ironically produced by Japanese affiliates in Southeast Asia. Furthermore, demand for lower-end TV sets is already reaching saturation: almost 90% of China's urban households are now estimated to have such TV sets.

The result is that Matsushita now has to radically change its strategic focus. Instead of aiming primarily at the domestic market, which was the original motivation, an increasing share of production will now have to go into exports. This is likely to generate quite serious problems of over-capacity. This comes on top of structural adjustment problems that still cry out for appropriate solutions and that result from the earlier wave of investments in ASEAN during the 1980s. Take again the example of Matsushita. One key feature of the Asian production network of this company is the coexistence of "mini-Matsus" oriented towards the domestic market and of more recent export bases in the same countries. This is now causing serious conflicts of interest that need to be reconciled. The same type of products is often produced at both facilities, but at very different productivity and quality levels. Both types of facilities have also generated quite different types of sourcing arrangements. In principle, as Salter (1960) has shown, plants of very different vintages can co-exist competitively, as long as they are producing different qualities for

⁹¹ Author's interview at Matsushita headquarters, November 1995

⁹² Based on Sender, Henny, "Be Prepared. China is a Minefield for Even the Sturdiest Firms", *Far Eastern Economic Review*, April 27, 1995

different market segments at different prices. Low productivity production for the domestic market can in fact be highly profitable, as long as the domestic market remains highly protected. This however is no longer the case, as domestic consumer electronics markets are now gradually being opened up to international competition.⁹³

In addition to the first wave of Japanese investment in East Asia between 1986 and 1990, the new wave of investment in China has generated substantial surplus capacities in the region. Sustaining such a “dual production structure” is a very costly proposition. Overcoming it, on the other hand, may not be easy, due to the heavy “sunk investments” involved. Companies like Matsushita thus can no longer postpone decisions on where to consolidate their individual regional supply base for particular components, like for instance TV picture tubes.

1.2. China's role as an export platform production base

This brings me to the second aspect of China's integration into Japanese Asian production networks. China so far competes primarily with Indonesia, India and now also Vietnam as a new export platform production base for low-end assembly and simple component manufacturing.⁹⁴ This however is now beginning to change. China may now emerge as an alternative site to Malaysia and Thailand, as Japanese firms are aggressively searching for ways to overcome the dual production structure and the accumulated surplus capacities in Asia.

One possible approach is to close down production lines in Malaysia and Thailand and to redeploy them progressively to the much larger Chinese market. In response to this threat of a possible investment diversion to China, the Malaysian government as well as other ASEAN governments are now willing to accelerate trade liberalization through AFTA, primarily with the objective “... to create a market of 350 million people that can draw foreign investment and compete on a more level playing field with China.”⁹⁵

⁹³ Consumer electronics is one of the areas where tariff reduction has achieved considerable progress in the context of AFTA, the regional free trade zone of ASEAN countries.

⁹⁴ All of these four countries have recently received a major inflow of investment and subcontracting arrangements by Japanese electronics companies, with China being by far the most important recipient. Vietnam now also has succeeded to enter the Japanese production network: Fujitsu, in early 1996, has established a printed circuit board assembly plant in Vietnam which could pave the way for further Japanese investments.

⁹⁵ *Far Eastern Economic Review*, cover story on ASEAN, August 11, 1994, p.32

All of this implies that formidable barriers remain to be removed before the potential for regional specialization can be fully realized for Japanese Asian production networks. The massive wave of recent investments of Japanese consumer electronics firms into China has undoubtedly created serious structural adjustment problems that may not be easy to solve in the short run. This has further increased the pressure on Japanese firms to rationalize their Asian production networks, i.e. to improve their regional specialization.

It is important to note however that Japanese firms can certainly not dictate unilaterally the necessary changes; they now need to find a delicate balance between the requirements of the China market and the requirements of the ASEAN market. Again this indicates why pressures to open up and decentralize Asian production networks are likely to remain a permanent challenge for Japanese electronics firms.

2. New opportunities and challenges for Taiwan

2.1. Taiwan's achievements

Over the last decade, Taiwan has established itself as a world-class supply source for a variety of electronic hardware products: it is the world's largest supplier of computer monitors, motherboards, switching power supplies, mouse devices, keyboards, scanners and a variety of add-on cards. Since 1994, Taiwan also has become the world's largest manufacturer of notebook PCs. Most of these computers are sold to American and Japanese computer companies which then resell these machines under their own logo. What matters however is that 70% of the computers that are sold under such OEM arrangements have been designed by Taiwanese companies.⁹⁶ This clearly indicates that Taiwanese computer firms have been able to develop significant design capabilities.

Progress has also been impressive in the field of components. Taiwan today has hundreds of passive component makers that have established a strong position relative to their erstwhile leading Japanese and US competitors. And although Taiwan's semiconductor industry at present accounts for hardly more than 3% of the world market, some of its firms have developed a strong position for a number of higher value-added IC devices, like chip sets, static RAM memories,

⁹⁶ Information provided by MIC/III.

mask ROMs, and EPROMs. In addition, Taiwan today has one of the world's leading silicon foundry companies, TSMC, that is able to produce leading-edge ICs for major international semiconductor firms, with very short production cycles, and with the most sophisticated process technologies and production equipment.

These are impressive achievements for any country. They are even more impressive for a small island, about one-third the size of New York State. With a population of about 21 million people, roughly half the size of South Korea, Taiwan could initially provide very little in terms of a large and sophisticated domestic market, and in terms of specialized capabilities and support industries, let alone the science and technology (S&T) infrastructure that is necessary for developing a broad set of electronics products. Taiwan's PC industry thus, from the outset, crucially depended on international markets and access to foreign technology.

This brings us to a second important feature of Taiwan's computer industry: small-and-medium-sized enterprises (SMEs) have been the main carriers of its rapid development. Taiwan today is home to more than 4000 firms that produce a broad mix of PC-related products and electronic components. With but a few exceptions like the Tatung group, almost all of these companies started out as small companies, often with just a handful of employees. This is a reflection of the overall industry structure of this country: In 1993, SMEs accounted for 96% of the total number of companies and 69% of the total number of employees. The most noteworthy feature however is that SMEs were responsible for 55% of Taiwan's manufactured exports.⁹⁷

In the computer industry, SMEs have acted as highly successful carriers of international market share expansion, first through exports and now also increasingly through international production. Since the appreciation of the NT\$ in the mid-1980s, Taiwan's cost of land and labor began to outstrip by far the much lower costs in Southeast Asia and China. This has led to an extremely rapid expansion of overseas production by Taiwanese computer companies, well before they were able to consolidate and upgrade their domestic production activities.⁹⁸

⁹⁷ Chen, Tain-Jy et al, 1995

⁹⁸ Between 1992 and 1994, the overseas production of Taiwanese computer firms more than tripled, from around \$ 970 million to more than \$ 3 billion. And, in value terms, the ratio of overseas production out of Taiwan's total PC production has increased from 10.4% in 1992, to 14.9% in 1993, 20.6% in 1994, and 27.2% in 1995. For 1996, the OPR is estimated to increase to 29.5%. Throughout this short period, annual growth in overseas production value was consistently over 70%, which implies that overseas production today plays a critical role for the success and failure of Taiwan's PC industry. Ernst, 1997b.

This rapid expansion of overseas production runs counter to some well established beliefs about what a company needs in order to survive in the international arena, beliefs that are based on international trade and investment theories. A statement that small size disqualifies a company as a carrier of internationalization is widely regarded as self-evident. Small firms have limited resources and capabilities and thus are unlikely to possess substantial proprietary assets. They also have a limited capacity to influence and shape markets, market structure and technological change. Small size thus can act as a powerful barrier to internationalization.

Elsewhere I have shown that Taiwanese were able to bypass these size-related barriers to international production primarily because they have participated early on in a variety of subcontracting, contract manufacturing and OEM relationships with leading foreign computer companies.⁹⁹ These linkages first emerged in consumer electronics with international production networks established by Philips and a number of Japanese companies (especially Matsushita, Toshiba and Sanyo). Since 1987, Taiwanese firms became major OEM suppliers for American computer companies. Over the last few years, linkages with Japanese production networks have again intensified, this time primarily for computer-related products and components. This clearly reflects some of the fundamental changes in these networks that have been analyzed in this chapter.

2.2. How will the growing interaction with Japanese production networks affect Taiwan's electronics industry?

Despite all its achievements, it is fair to say that 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.¹⁰⁰

⁹⁹ Three additional factors were of equal importance: 1) A highly motivated workforce with a level of education that, in most other countries, is beyond the reach of SMEs. 2) A highly flexible, hierarchical domestic supply base of loosely connected speciality producers that have enabled Taiwanese computer vendors to react incredibly fast to changes in market requirements and technology. And 3) the role of government policies that initially facilitated market entry of SMEs and that now provide some of the externalities that are essential to upgrade this industry. Ernst, 1997b.

¹⁰⁰ These and the following figures are courtesy of MIC/III, May/June 1995

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 SEAsia. The result is that in 1994, 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 display panels, a key component for Taiwan's 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 two years, prices for these devices have rapidly increased, with the result that, in value terms, these imports are likely to have further increased.

This heavy dependence on component imports from Japan has been the root cause for Taiwan's exploding electronics trade deficit with Japan. In 1993, Taiwan's trade deficit in components (\$2.5 billion) was responsible for almost 72% of Taiwan's total electronics trade deficit with Japan.¹⁰¹ Obviously, this is a critical barrier to a further upgrading of Taiwan's electronics industry.

What will be the impact of Taiwan's growing interaction with Japan's Asian production networks? Two important developments have recently shaped these relationships: As shown in *part II*, Japanese computer companies have drastically increased their OEM purchases from Taiwanese firms since 1994. A second important development is that Taiwan is now also emerging as a critical supply base for a variety of electronics components. Take for instance semiconductors. In April 1994, a large Japanese purchasing mission to Taiwan, the first of its kind, ordered \$ 60 million of semiconductor products. One year later, in April 1995, a second much larger Japanese purchasing mission ordered more than double that amount, i.e. almost \$ 130 million.¹⁰²

¹⁰¹ Ernst and Guerrieri, 1997

¹⁰² Taiwan Semiconductor Manufacturing Corp. (TSMC), the world's leading silicon foundry, was able to capture an order volume of \$20 million, primarily as a supplier to NEC and Fujitsu. While TSMC's exports to Japan in 1994 made up only 0.5% of its annual sales, this share has increased to 2% in 1995, out of an estimated \$ 1 billion in total sales. Other Taiwanese firms that were able to benefit include leading IC producers like Vanguard International Semiconductor Corp., UMC, Hualon Microelectronics, Macronix International, Winbond Electronics, and Mosel-Vitellic, but also a number of much smaller companies like Tamarack Microelectronics, Everlight Electronics Co, Hi Sincerety Microelectronics Corp., Kingbright Electronics Co Ltd., and Mospec Semiconductor Corp.

It is interesting to note that expanding bilateral trade links now have powerful vested interests in both countries. The April 1995 purchasing mission brought together 20 of the most powerful Japanese electronics firms and the 16 leading Taiwanese producers of PCBs, semiconductors and other components.¹⁰³ These trade links can now rely on effective institutional arrangements in both countries. In Japan, the main driving force has been the User's Committee of Foreign Semiconductors (UCOM) of the powerful Electronics Industry Association of Japan (EIAJ). Ironically, UCOM had originally been established under pressure from the US government, which was hoping that it could help to increase drastically the Japanese market share of American IC producers. On the Taiwanese side, the main driving force is the Sino-Japanese Economic and Trade Foundation, a private organization founded for the purpose of reducing Taiwan's bilateral trade deficit with Japan which, however, has strong backing from the Taiwanese government.

As a result of both developments, Taiwan has experienced a dramatic growth of Japanese computer-related imports. From less than NT\$ 3.9 billion in 1990, these imports have increased to more than NT\$ 21 billion in 1994.¹⁰⁴ Two products predominate in 1993: components with 34% and EDP with almost 33%. Together they account for more than two third of Japanese imports from Taiwan. Especially impressive is the rise reported of these imports in the last two years: Taiwanese exports to Japan have increased by 347% for PC's, 169% for components, 122% for terminals, and 110% for monitors.¹⁰⁵ Equally impressive are the reductions in Taiwan's imports from Japan during the same period: -36% for components and -35% for other peripherals.

It remains to be seen whether this improvement in Taiwan's trade links with Japan will be sustainable. There is no doubt that Japanese PC vendors perceive OEM purchases as an intermediate solution: it enables them to quickly discontinue lower value-added production activities at home. It also enables them to gain time, till they have been able to set up their own supply base for some of these products in China and Southeast Asia. This implies that such rapid growth of OEM contracts is unlikely to last. Some Japanese PC makers have now started to move some production in-house, taking it away from Intel Corp. and Taiwan contract manufacturers.¹⁰⁶

¹⁰³ The Japanese delegation was headed by the Vice Chairman of the Matsushita group, and included a broad spectrum of semiconductor producers, users and producers of other components, like NEC, Toshiba, Hitachi, Fujitsu, Mitsubishi, Matsushita, Oki, and Sony, Sharp, Alps, Anritsu, Ricoh, Victor, Minolta, Sanyo, Seiko Epson, Yamaha and Yokogawa.

¹⁰⁴ These and the following trade figures are taken from Ernst and Guerrieri, 1997

¹⁰⁵ Figures provided by MIC/III

¹⁰⁶ EBN Online, 7-1-96, "Japanese PC Makers Move Production In-House"

For instance, Fujitsu, Hitachi, and Toshiba are ramping up PC output in their own Japanese plants, cutting back or eliminating their relabeled OEM purchases from offshore contract companies. Both Fujitsu Ltd. and Hitachi Ltd. were using Acer Inc. of Taiwan to make PCs that they sold in Japan under their own labels. This obviously is a response to the gradual depreciation of the Yen which has started in 1995. The move back to Japan is driven by a perception that it is now again possible to use integrated circuits and components from their domestic sister divisions.

This example indicates that nothing is automatic about the benefits from participating in international production networks. Periodically, there may be important reversals in the distribution of such benefits. The question is how long Japanese PC producers will be able to sustain this relocation of production back home. There are obviously substantial short-term benefits for their component divisions. But whether relocation back home provides a long-term solution, remains open to doubt. For instance, it is unlikely to facilitate the expansion of international market share. After all, one of the great advantages of Taiwanese OEM suppliers has been the incredible speed with which they are able to respond to changes in markets and technology. Japanese vertically integrated electronics giants are not famous for such flexibility.

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Danish **R**esearch **U**nit for **I**ndustrial **D**ynamics

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