Wintelism and Production Networks in the Electronics Industry

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Contents.

Summary.

This paper deals with two interrelated elements of globalization: Wintelism and cross national production networks which have been underexposed in discussions about globalization.

Wintelism refers to the shift in competition away from final assembly and vertical control of markets by final assemblers toward a struggle over de factor product standards generating market power anywhere in the value chain. In electronics Intel and Microsoft are leveraging their control over PCs to alter the terms of competition by emphasizing the microprocessor resp. the operating system as de facto market standards. The creative use of intellectual property rights and associated licensing strategies define defensible market positions more than manufacturing cost as the basis of competitive advantage.

Cross national production networks refer to the dis-integration of the industry's value chain into constituent functions which can be contracted out to independent producers wherever located in the global economy.

These networks have emerged most clearly in Asia and have been used by American and Japanese firms. The development of USA direct investment in electronics in Asia over the past three decades will be examined and compared with Japanese investment in Asia. A production network typology will be used to analyse the positions of US, Japanese and Overseas Chinese electronic firms.

The final question to be discussed is whether the production networks that have emerged in East Asia can become a significant feature of the integration of Central /Eastern Europe. The optic of such networks provides an alternative perspective on the East European economic transition.

The basic conclusion is that Wintelism and networking were the principal means by which the US electronics industry recovered from its mid-1980's crisis in competition with Japanese firms and will likely influence a broader range of sectors. However, there is nothing automatic about the benefits of participating in international production networks. Periodically there are important reversals in the distribution of such benefits.

The China Circle will witness one of the great market battles in memory as US, Japanese and indigenous production networks vie for 21st century advantage.

1. Characteristics of globalization.

A whole series of dramatic changes in the international economy has taken place for which globalism has become the emblem. Globalism refers to a complex story of global markets, national development strategies, regional dynamics and competing corporate strategies.

Firstly, the global era is characterized by the growth of the intensity of interconnection between countries in terms of trade and investment as a percentage of GDP. It must be noticed that this is nothing more than a return to the intensities of 1914. The fact of expanding market interconnections in the form of investment, financial networks and trade is not itself in question: at issue is the character of those ties, the pattern they form and their significance. The character of the economic connections among countries and firms in 1914 and 1996 is quite different.

Secondly, the present global era has multiple centers each with a distinct capacity for innovation and development, so that a dominant style is lacking and a multiplicity of distinctive corporate and national strategies compete to capture advantage in volatile markets.

A third feature of globalism is that the international market dynamics in most high-tech industries has to be analyzed as a competition between firms operating out of largely a national home base in the sense that it is the national market in which the majority of a firm's assets, employment and sales reside and from which corporate control is exercised. Only a very few high-tech MNEs are globally footloose. Firms strategies are systematically shaped by the logic of competition in the home market base. The national market logic dominates international market strategies. The global leadership of US firms was rebuilt partly on a domestic foundation. Therefore, national foundations of distinctive economic growth trajectories and corporate strategies are enduring and remain the basis of global competition.

However, fourthly, these national systems are evolving in a world economy that increasingly has a regional structure, with three emerging regional groupings: North America, Europe and Asia, each with their distinctive market dynamics.

Globalization must be distinguished from the code words of earlier eras, internationalization, referring to firms selling abroad by trade and multinationalization, referring to MNEs producing abroad in a variety of locations. The British era was one of trade, while the American era has been one of foreign direct investment.

Globalism has to do with the arrival of the Asian challenge. The pace of Asian growth and the exports that have accompanied and facilitated it have brought the region from the periphery to the core of the world economy. If projections to the year 2000 are correct, Asia's share of world income will soon surpass that of North America. There is no single Asian miracle and its development is certainly not one story. These countries did not develop at the same time, but in an historical sequence. The region's development must be segmented into four historical tiers, each tier representing a different range of

market options and state tasks:

1) The case of Japan and its 19th century industrialization.
The Meiji Restoration of 1868 established a set of institutions and policies based on domestic innovation, the generation of indigenous technological know-how and autonomous industrialization by capturing and dominating large portions of the value-added and technology chain by national producers by limiting foreign imports and capital inflows but at the same time promoting domestic competition and facilitating technological transfer through licensing agreements.

2) The case of Taiwan and Korea, based on low wages and learning rather than indigenous innovation, linked to aggressive export policies in an open international environment, supported by industry subsidies from the government to the winners as measured by export success. Today it is no longer possible to follow a development trajectory that combines second generation technology with low domestic factor prices and low subsidized capital that compensates for the less modern machinery.

3) The Southeast Asian countries Thailand and Malaysia constitute a third tier based on cross-national production networks. These countries do not have a history of domestic manufacturing that developed indigenously in Japan and that was created through learning in South Korea and Taiwan. The Southeast Asian countries are more dependent on MNEs for their industrial development and have inserted themselves into regionally based cross-national production networks. A strategy of autonomous learning based on second generation technology was difficult to realize and therefore they developed complementary relationships with MNEs. Japanese MNEs came for the local market and to export to third countries; the Americans came for the local market and to re-export back home. US electronics firms gradually deepened the technological capacity and autonomy of their Asian affiliates which produced more sophisticated components and complex subsystems so that an alternative supply base has been created which avoided dependence on Japanese competitors for critical components and technology.

4) China and later India will establish a fourth tier that is a blend of regional divisions of labor and domestic autonomous development. This reduces dependence on the availability of European and American markets.

This paper concerns two interrelated elements of globalism: “Wintelism” and cross-national production networks, which have been underexposed in globalization discussions. Wintelism refers to the shift in competition away from final assembly and vertical control of markets by final assemblers toward a struggle over de facto product standards generating market power anywhere in the value-chain. In electronics Intel and Microsoft are leveraging their control over PCs to alter the terms of competition by emphasizing, with nearly identical systems, components or software that have become de facto market standards, i.e., Intel for the microprocessor and Microsoft for the operating system. The shift to Wintelism was accelerated on the one hand by the increasing cost and complexity of continuing innovation which made it increasingly difficult for any company, even IBM, to maintain ownership and control over all relevant technologies and on the other hand by the increasingly strident demands from major industrial users for increasing interoperability of complex systems purchased from multiple vendors. In concert with clone-makers, Intel

and Microsoft wrested control of the PC from IBM and developed strategies to set and control the evolution of de facto standards.

Wintelism is the code word that best describes the dominant industrial and business practice of the new era. The competition over value-added and market control has shifted away from assembly to the rapid evolution of components and subsystems, systems architectures and product design defended with intellectual property and to proprietary market created, not government established, standards. The creative use of intellectual property rights and associated licensing strategies define defensible market positions more than manufacturing cost as the basis of competitive advantage. Manufacturing does not vanish in significance, it shifts the location of production. It remains true that one cannot control what one cannot produce. But the ways of implementing production systems are now different, with more standard elements of products being handed off to sub-contractors. There remains a core production skill which is required to defend position today and facilitate continuing product and process innovation.

Cross-national production networks are another distinctive element of the new competition and refers to the dis-integration of the industry's value chain into constituent functions which can be contracted-out to independent producers wherever located in the global economy. Firms break down the value chain into discrete functions and locate them wherever they can be carried out most effectively and where they are needed to facilitate the penetration of important growth markets.[1] In OEM (Original Equipment Manufacturing) arrangements the customer provides detailed technical “blueprints” to allow the contractor to produce according to specifications. If a firm seeks to move up to the higher value-added segment of the OEM market, i.e. wants to be upgraded to ODM (Original Design Manufacture) status, he provides a detailed product design based on the fairly loosely defined requirements of the customer.[2] In order to cope with the increasingly demanding requirements of global competition, companies are forced to integrate their erstwhile stand-alone operations in individual host countries into increasingly complex international production networks. Such networks are relationships among firms that organize, across national borders, research and development activities, procurement, distribution, production definition and design, manufacturing and support services in a given industry. These intricate divisions of labor have become possible because quite heterogeneous mixes of technology capacity and wage costs have been woven together. It is precisely the variety of production circumstances that provides the network its flexibility. The East Asian story has been based on regional heterogeneity and characterized by the explosion of cross-national networks.

International production networks are more than governance structures for economizing on transaction costs. Of equal importance are the search for clusters of specialized capabilities and access to contested growth markets. To compete in electronics a firm must be able to internalize on a global scale, specialized assets and capabilities, including technological knowledge, organizational competence, finance, production experience, supplier and customer networks and market intelligence. However, as no firm can generate all these different capabilities internally, this necessitates a shift from individual to increasingly collective forms of competition such as networks. Competition is shaped by strategic games with cooperation

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[1] In electronics the value chain consists of six stages:
1. R&D (especially product and component development, proto-typing, and initial process engineering).
2. Engineering (especially product customization and detailed process engineering).
3. Component manufacturing and sub-assemblies.
4. Procurement (International Procurement Offices (IPO's), consignment assembly, OEM/ODM arrangements, and turnkey production arrangements.

[2] 5. Final assembly and testing.
6. Sales & marketing (including the establishment of distribution channels and customer support).

on basic support services (such as R&D and standards) and intermediate inputs often going hand in hand with intense competition at the final production stage.

In production networking firms move to a variable cost position vis-à-vis their manufacturing operations. This means that more of the company's manufacturing assets will be held by outside companies, so that the firm will be using the assets of specialized outside suppliers allowing to change the volume of production on very short notice and with less cost. This reduces manufacturing overhead and inventory carrying costs and positions a firm to concentrate more intensively on marketing and design. The central competitive problems within industries influence what a firm must control in the network, so that the optimal management of networks varies across sectors and over time as the competitive problems shift. But the basic industrial foundations do not shift quickly and are thus to continue over long periods to contribute to national differences in network management.

Some estimates suggest that contract manufacturing and cross-national production networks represent 10-20% of total product-level electronics manufacturing and 40-50% of highly volatile electronics industry segments, such as PCs and modems.

Wintelism and networks come together in the virtual corporation, which is a temporary network of independent companies - suppliers, customers, even erstwhile rivals - linked by information technology to share skills, costs, and access to another's markets. It will mix and match what it does best with the best of other companies. The virtual corporation avoids the inefficiencies and costs of vertical integration and seizes advantage of the best efforts of world-class partners to bring his product to market faster.

Still most companies put undue emphasis on owning, managing and controlling every activity. But there is just not enough time in the day to manage everything anymore. Partnering will assume great importance. Alliances are critical to the future. Technologies are changing so fast that nobody can do it all alone anymore. When talking about virtual corporations today, the talk is about alliances and outsourcing. The virtual corporation describes an enterprise that can marshal more resources than it currently has on its own, using collaborations both inside and outside its boundaries. It will have neither central office nor organization chart. It will have no hierarchy, no vertical integration. The evolving corporate model will be fluid and flexible and once the opportunity is met, the venture will, more often than not, disband. One of the drawbacks of the virtual corporation is that it spells the loss of control over some operations. Companies must build a high level of trust in each other.

Traditionally, two types of competitive strategies could be distinguished in the electronics industry.

On the one hand, for consumer electronics and electronic components, competition used to center primarily on cost reduction and judicious pricing. Non-price competition was largely restricted to a few high value-added market niches.

On the other hand, in the computer industry, the focus of competition has been on product differentiation, based on proprietary computer designs and market segmentation.

Today, this distinction no longer holds. In almost every sector of the industry, firms have to cope with much more complex requirements, where price and non-price forms of competition are closely intertwined. The distinction between homogeneous and differentiated products has decreased. Most electronic products have become high-tech commodities,

which combine the characteristics of mass production implying large investment thresholds to reap economies of scale with extremely short product cycles implying rapid depreciation and periodic trajectory-disrupting innovations. As a result, cost competition must be combined with product differentiation and speed-to-market.

Of great importance is the increasing uncertainty that results from periodic trajectory-disrupting innovations. Established leadership positions can no longer be taken for granted and the target of competition becomes fuzzy and can change at any time. E.g., competition in the computer industry was characterized by a basic paradox: despite IBM's early leadership and the oligopolistic nature of competition there have always been possibilities of latecomers to enter the battlefield by means of product differentiation and market segmentation strategies. IBM's decline since the mid-1970’s is representative of a broad development - the pervasive destabilization of established market structures. This has happened as a result of the continuous down-sizing of computer systems, which has made them increasingly interchangeable, and some progress towards open, non-proprietary computer systems. The distinction between the different segments of this industry has become blurred and nobody's established customer and supply base is immune to raiders from outside. For each participant the scope of competition becomes much broader and requires an increasingly complex set of capabilities.

Traditionally, a firm shifts to international production to penetrate protected markets through tariff-hopping investments and to exploit international cost differentials, primarily for labor. However, today a number of equally important factors are at work, including the exploitation of uncertainty through improved operational flexibility, a compression of speed-to-market through reduced product development and product life cycles, learning and the acquisition of specialized external capabilities and a shift to market penetration strategies from established to new and emerging markets.

Normally a firm is reluctant to engage in international production. On the one hand it fears that geographic dispersion will weaken existing governance structures with the result that control over strategic resources and capabilities will erode. On the other hand it fears that distance will magnify the impact of unexpected disruptions in its value chain and will thus lead to substantial coordination costs.

By concentrating production within a region a firm can benefit from the advantages that material inputs, ideas, and finance can move more quickly back and forth across different stages of the value added chain. A region guarantees proximity which facilitates close, fasts and cost-effective interaction between different stages of the value chain. Therefore, there is a trade-off between the advantages of proximity (and co-location) and the advantages of geographic dispersion.

The puzzle to be solved is why, despite the fundamental advantages of keeping production at home and at close proximity in the region, electronics firms have almost invariably moved to international production once they reach a certain size.

There are three possible solutions to this puzzle.

First, proximity matters and works best at home, but there are other more important concerns that force firms to shift to international production and to disregard the advantages from co-location.

Second, some forms of proximity may be less constraining than others to a

redeployment of production overseas, so that these proximity effects may be reproduced at some foreign locations.

Third, the link between close cooperation and co-location may be somewhat looser than is normally assumed. There are alternative and more indirect ways to achieve close cooperation that do not necessarily require physical co-location. Key support functions may be migrated so that an increasing variety of value-chain functions may be co-located abroad.

Proximity can mean a variety of things, depending on which stages of the value chain are involved. There are five forms of proximity requirements, and each has different effects on the scope for international production.

1. Proximity to engineering support.

This type of proximity concerns the distance between manufacturing sites and engineering support activities, such as preventive maintenance and testing. It is crucial for a firm's capacity to quickly ramp up and ramp down the relevant production lines as well as for a quick progression along the learning curve. Engineering of support activities tends to follow the redeployment of production at a relatively early stage, i.e. once production moves beyond screwdriver assembly. Although testing has been the most resistant to overseas redeployment, due to the very high cost of testing equipment, today, most of the engineering support services are available in East Asia and some of them at a distinctively lower marginal cost than in the US. Therefore, this type of proximity thus does not unduly constrain relocation.

2.Proximity to suppliers.

Proximity to suppliers affects the cost and complexity of logistics, but it also affects speed-to-market, delivery times, and the scope for just-in-time inventory management. Distance from suppliers can magnify the impact of unexpected disruptions with devastating effects especially where product cycles have been cut. In principle there are no major constraints to a progressive geographic dispersion of a variety of supply sources and some suppliers are now located in East Asia.

3.Proximity between prototyping and volume manufacturing.

This type of proximity is essential for a quick solution to the teething problems that accompany the ramping-up of any new production facility. As Singapore has developed an excellent infrastructure for a variety of value chain activities, including product design, there are now fewer constraints to a redeployment of prototyping. Therefore, it makes sense that sooner of later prototyping may be moved to where mass production is.

4. Proximity to customers.

Often it may be necessary to collect feedback on customer requirements. Over the last few years, there has been a quite substantial migration of computer design capabilities to East Asia. The fact that overseas production now frequently occurs quite soon after the launch of new products implies that engineers in Asian subsidiaries have been plugged into the companies' design debates on a regular basis. The result is that design information is now shared much more freely between the parent company and its overseas affiliates. The transfer of design capabilities has already moved to independent third parties, originally to OEM's and now to ODM's. American computer companies have accepted this partial

leakage of design capabilities in order to sustain and improve their access to the East Asian supply base and the region's increasingly important growth markets.

5. Proximity between process and product development.

Production processes must constantly be adjusted to accommodate the unique specifications of a new design. Design adaptations are necessary to improve yields and accelerate time-to-market. It is plausible that the links between new products and new processes are strongest if both functions are co-located.

However, substantial barriers still exist to the internationalization of R&D so that R&D has been substantially less mobile than other value chain functions. Of all possible international locations for R&D, most locations in East Asia still lack fundamental prerequisites. It takes a broad educational system, plus first-class research institutions, in order to develop such capabilities.

But over time there is likely to be increasing pressure to relocate some aspects of R&D to East Asia for three reasons:

1. Some countries are pursuing aggressive entry strategies into the aerospace industry which require the strengthening of a domestic R&D infrastructure.
2. The region is experiencing a rapid armaments race which is generating spin-off effects on local R&D.
3. Singapore, Korea and Taiwan are currently engaged in systematic attempts to improve the effectiveness of private and public R&D management.

If this happens, the process will take on a momentum of its own. While R&D is less prone to relocation than manufacturing, it is certainly not immobile and can be moved abroad. The question is not whether this will happen, but when and which locations will have accumulated sufficient design and R&D capabilities to qualify for such co-location.

In order to reap the benefits of the present set of requirements posed by international production, electronics firms have responded by a shift from partial to systemic forms of globalization.

Partial globalization is characterized by a loose patchwork of stand-alone affiliates, joint ventures and suppliers that are scattered around the globe and that co-exist without much interaction. The firm cannot reap the full benefits of international specialization. Low productivity production for a particular market can in fact be highly profitable if the market is highly protected. However, this logic ceases to work once competition begins to cut across national borders and becomes global. Partial globalization has shown a constant tension between centralized and decentralized governance structures and they fail to establish a two-way flow of information across all network nodes to respond quickly and flexibly to unexpected disruptions and changes in markets and technology.

Systemic globalization implies that a company attempts to network its operations and inter-firm relationships worldwide. It is systemic as the firm generates closer, faster, and more cost-effective interactions between different nodes of these international production networks. This enables the firm to internalize resources and capabilities without excessive centralization. International production networks result from an attempt to combine the scale economies of centralization with the flexibility of decentralization and the vast opportunities for learning and time compression.

An international production network combines a lead firm, its subsidiaries, affiliates

and joint ventures, its suppliers and subcontractors, its distribution channels as well as its R&D alliances and a variety of cooperative agreements, such as standards consortia. The lead company derives its strength from the intellectual property and know-how associated with setting, maintaining and continuously upgrading a de facto market standard. This requires perpetual improvements in product features, functionality, performance, cost and quality. The lead firm outsources not only manufacturing, but also a variety of high-end support services. The result is that an increasing share of the value-added shifts across the boundaries of the firm as well as across national borders. Competitive success thus critically depends on a capacity to orchestrate and coordinate such complex international production networks and to integrate them into the firms organization.

Small and medium sized enterprises (SMEs) have become important carriers of globalization and help to fill in the interstices of international production that large MNEs are unable to detect and deal with. As suppliers, subcontractors, and matchmakers for market penetration, SMEs act as a convenient buffer against uncertainty and provide cheap, flexible and quick sources of supply for a variety of production inputs. Coordinating inter-firm production networks has become a crucial concern for strategic management. Governance within any particular network describes how control and coordination is exercised and by whom. In order to cope with the increasingly complex competitive requirements decentralization of control needs to be complemented with some centralization of coordination functions.

One of the hallmarks of the electronics industry after World War II has been the fast pace of geographic dispersion, with IBM as one of the early pioneers. American investments in Europe were driven primarily by the desire to be present in the potentially huge future European market. IBM gave rise to a new model of international production for American electronics firms. In the 1960's IBM began to shift the labor-intensive assembly of computer components to low-cost offshore locations in Asia. Much of the offshore sourcing consisted of screw-driver assembly with very little local value added and almost no local linkages.

The strategic rationale for redeploying production to East Asia was very different from the one that prevailed in Europe. Market access in East Asia was of practically no concern. The real goal was sourcing for the lowest-cost export platform location. Consumer electronics firms focused on licensing, franchising and other contract manufacturing arrangements that gave rise to the now famous OEM contracts which did not require equity control. However, American semiconductor firms proceeded differently by establishing their own affiliates insisting on equity control in order to minimize the risk of technology leakage and which focused on very simple screw-driver assembly with Motorola as a pioneer.

Over the last decade, outsourcing has become an important practice in the electronics industry since firms focus more closely on core activities and competencies and purchase various intermediate goods and services from other firms. The spread of OEM and ODM arrangements enables these firms to concentrate on what they do best. Today it is normal that the supply chain of say a computer firm spans different time zones and continents. Microprocessors are sourced from the US, memory devices from Japan and Korea, motherboards from Taiwan, hard disk drives from Singapore, monitors from Korea,

Taiwan and Japan, keyboards and power switch from China and finally assembly is usually dispersed to major growth markets in the US, Europe and Asia. However, the complexity of the logistics becomes mind-boggling with very high coordination costs (exceeding often the cost of internal value generation) as many of these suppliers ship their products from widely dispersed overseas affiliates.

Outsourcing is no longer confined to parts and components but involves as well a variety of high value-added support services, including product customization, product design, and production technology.

During the early 1980's, the appreciation of the US dollar and the resultant increase in the cost of capital have been an important motivation for outsourcing. Outsourcing was seen as an effective instrument for accelerating the turnover of capital. By outsourcing, firms expect to reduce the high fixed capital cost burden and risks that would result from any expansion of in-house production facilities.

Secondly, outsourcing has potentially huge scale economies because the average size of each contract is likely to increase and each supplier offers more favorable unit prices and delivery schedules.

Outsourcing has also a strategic motivation. In order to survive the extremely intense competition that is characteristic for the electronics industry, global competitors are forced to concentrate on product development while at the same time remaining a low-cost producer. In order to meet these goals, firms tend to focus on R&D, the production of some key components and some limited involvement in the highly automated final assembly of higher value-added products. By outsourcing most of the other activities, these firms may reduce the burden of high fixed costs and risks resulting from in-house production. Outsourcing also allows firms to adjust flexibly to excessive demand fluctuations.

Wintelism and production networking have already altered the terms of competition in electronics and will likely influence a broader range of sectors.

In the auto industry, competition is a battle among the assemblers who design and integrate the final product and that competition has been dominated by high-volume mass production, often labeled Fordist. By the mid-1970's, flexible or lean production provided Japanese firms on the basis of Toyota's innovation to create flexibility with volume the capacity to enter and alter markets in North America and Europe.

Until the early 1980's, essentially all electronics product-markets were dominated by large-scale producers such as IBM, Siemens, Matsushita, NEC and Toshiba, which produced fully proprietary systems whose key product standards were either fully open, in which the technical information is in the public domain as was the case with products like TVs and radios, or fully closed in which case the technical information is owned as intellectual property such as in telecommunications and computers.

With both closed and open systems vertical control over technologies and manufacturing was the key to market success. Competition centered on growing an installed base of customers who could be locked-in to a firm's product line. Lock-in was possible because

the cost of switching between closed systems could be very high.

The origins of Wintelism are fundamentally rooted in the USA. American policy, especially antitrust, prevented both AT&T and IBM from monopolizing the technology to dominate all of electronics and in fact helped to set an industry-wide pattern of technology cross-licensing. Through licensing and labor mobility both AT&T and IBM became technology pumps, widely spreading to start-up and established producers and users the basic technological innovations on which the chip industry was built.

Therefore, policy helped to foster the emergence of merchant firms whose primary activity was selling components to producers of final products, and whose marketing strategy was inherently one of diffusion of the new technology. Very likely, the unique merchant industry structure could not have emerged except under cover of the US antitrust policy umbrella.

After having spun off from larger companies or from universities, merchant startups produce the components and subsystems which embed advanced research. They are making technology broadly available in the market that might once have been available only through internal corporate development companies. The decomposition of competition into the constituent elements of a product or a system eases the task of smaller firms. The small firm does not have to mimic the technology development structure of the large firm of two decades ago.

Because the basic role of merchant producers was to diffuse technology as widely as possible, they fostered the coming-into-being of other specialized producers throughout the electronics value-chain who could take advantage of it. They pioneered and instigated the gradual process of vertical dis-integration throughout the American electronics industry. Final assemblers needed no longer to be vertically integrated into component production on the AT&T/IBM model. Instead, they could focus on system definition and assembly. Therefore, as specialization in one part of the value chain breeds specialization in other parts, through the 1960’s and 70’s, specialized producers emerged in the entire value chain.

This whole process was accelerated by the competitive entry of Japanese producers who helped to eliminate traditional vertically-integrated players from the US market.

In the struggle to break loose from IBM's dominance and to react to the Japanese ascent, new strategies emerged with the PC as the pioneering product on the foundation of networkable, microprocessor-based systems. In the new systems the interface specifications which permit interoperability with the operating system or system hardware, are owned as intellectual property but made available to others who produce complementary or competing components, systems or software products. Hence the systems are “open-but-owned” so that the technical standards are licensed and restricted, in order to build installed-base and lock-in customers, rather than published.

In Wintelism, market power has shifted from the assemblers such as Compaq, Gateway, IBM, or Toshiba, to key producers of components (e.g. Intel), operating systems (e.g. Microsoft), applications (e.g. SAP, Adobe), interfaces (e.g. Netscape), languages (Sun

with Java) and to pure product definition companies like Cisco Systems and 3 COM. They all own key technical specifications that have been accepted as de-facto standards creating a universe of licensees who produce to the standard and add value to its use. Applications software firms like Word Perfect, PC assemblers like Compaq, peripherals producers like Canon, or content providers like Grolliers, all produce to Microsoft's Windows operating system standard. Each standard owner maintains a growing installed base of customers who use the products that conform to the standards. Switching will not occur unless truly radical and compensatory improvements in price-performance-functionality is offered and unless it is even more costly to stay put.

Summarizing, Wintelism has moved competition away from assembly to the rapid evolution of the constituent elements of the system being assembled, that is, to the system architecture, its components and subsystems, its operating system, languages and applications and to the creation and evolution of restricted de facto standards. System products have moved away from stand-alone proprietary systems toward open-but-owned systems that are meant to be interconnected into digital information networks.

In practice, the core functionality of final systems is often owned and controlled by the independent companies who supply or define the constituent elements. They, rather than the final assemblers, often control both the pace of technical advance and the availability of critical system elements so that product rents accrue to them rather than to assemblers. Competition is as much about standards as it is about production. This appears from the desire of Sun to widely license its Java language to other assemblers, or of Oracle to define and widely disseminate the architecture for a network computer tailored for Internet functionality, and these actions really represent efforts to supplant the market dominance of standards and architecture controlled by Microsoft and Intel.

For Wintelist firms, ownership and manipulation of their de facto standards are barriers to entry considerably more effective than the barriers of scale and vertical control over technology and production in the past. But production and scale do not vanish from the story; they are still significant. Relevant production know-how still facilitates product and process development.

The organizational counterpart of Wintelism is cross-national production networks and contract production services. These networks comprise a clever division of labor on which different value-chain functions are carried on across national boundaries by different firms under the coordination either of a lead MNC for its own production or of a production service company which manages the production value chain for clients. In networks, companies need no longer control production through ownership or direct management of each piece of the value-chain.

In such networks of non-equity, non-arms-length, cross-border and inter-firm relationships, significant value is added outside the lead firm and entire business functions may be outsourced. E.g., in order to create a PC a firm might use specialist producers of computer displays in Japan, assembly services in Taiwan, software from Bangelore, and process development in Singapore. For the USA, networks in Asia are to be considered as an alternative supply base, an alternative to reliance on Japanese competitors for underlying component technologies and manufacturing capabilities.

Such networks have evolved to exploit an ever more intricate division of labor based on increasing local technical specialization and have emerged most clearly in Asia, but are not confined to Asia. They are not principally about lower wages or access to markets and natural resources. They are about the linkages among diverse and heterogeneous economies with very different technical and economic capabilities at very different stages of development.

Such arrangements existed already since the 1970's prior to their adoption in the electronics industry, especially for brand name companies in industries like garments, footwear, furniture and toys. But this phenomenon was only of marginal interest. Now it becomes of real significance because it touches the core elements of the industrial economy and the most rapidly expanding sectors, especially in the manufacturing service sectors with firms like SCI Systems and Solectron which provide turnkey production networks. Formerly vertically integrated assemblers like IBM, Hewlett-Packard, and Apple have moved to the new network model. Some of the most successful systems companies own no internal manufacturing at all.

The implications are that while Wintelism creates a whole range of market opportunities in sectors that were previously dominated by giant assemblers playing in controlled oligopolistic markets, the new networks possibilities provide small producers with a cost-effective strategy to exploit the new market opportunities. In short, an infrastructure for the implementation of global production strategies without FDI has been put in place.

Wintelism and networks have implications for all firms, large and small. Wintelism and networks together separate product development from production and radically minimize the capital requirements and the range of in-house production skills needed for volume production and mass market strategies. They also provide a merchant, open-market source for many of the critical elements of systems, making them available for distinctive final product development. This has opened new business opportunities for firms operating at much smaller scale than traditional vertically integrated assemblers.

For some small firms, having the skill to develop sophisticated products for niche markets, it is possible to aim at larger volume markets by applying niche market product development skills to volume markets and contracting-out volume manufacturing. Therefore, the niche market may be used as a prototype for volume entry.

However, an era of small and flexible firms is not emerging. Rather, over time, scale remains a significant imperative in different parts of the value chain, notably in production, product development, the dynamics of standardization, and distribution. E.g., so long as chip design firms remain small, they can contract-out for capacity, but as demand for their products becomes sizeable, it gets increasingly difficult to find adequate production capacity so that they themselves have to invest in or buy-into large scale production facilities.

Similarly, standards do not rest simply on the domination by a single producer. Very often, they require a painstaking knitting-together of a large-scale standards coalition composed of other producers and suppliers who add value around the standard.

Finally, in many market segments, maintaining competitive advantage over time rests in large-scale investments in distribution and marketing rather than in technology development. Thus, Wintelism and networks shift the location in the value chain of scale investment from production to distribution, but not its necessity. In sum, while Wintelism and networks fragment or dis-integrate the value chain, they do not imply that we are headed to an era of small scale specialty firms becoming dominant within each market segment. The advantages of scale are redistributed, but not eliminated.

As networks mean that supply and quality can be assured as much by external contract as by internal ownership, the question is under what circumstances does outsourcing undermine the capacity of a firm to control the direction of product development, market response, and industry evolution?

Under what circumstances must a firm manage the outsourcing internally as an alternative to internal production and when can a firm safely outsource the outsourcing by using a manufacturing service firm to manage the external relationships. It remains true that firms cannot control what they cannot produce, but the meanings of production and control must be reconsidered .

There is no single answer here. Answers turn on the unique characteristics of both the product-market and the contract production services in question, such as the structure and openness of potential contract production markets, or the degree to which production know-how influences not just the cost of today's products but the design of tomorrow's products as well.

Wintelism and networks have mattered mightily to the outcomes of competition in the electronics industry and were the principal means by which the US electronics industry recovered from its mid-1980’s crisis in competition with Japanese firms. Wintelism and networks are likely to be broad features of the international economy that reach well beyond electronics. These new approaches well diffuse more widely to other industries, e.g., through next channels.

1. Microelectronics is transforming products and processes in a wide range of sectors. Firms that effectively cope with the new technologies will be the winners. As microelectronics pervades the consumer durable professional goods and capital equipment sectors, Wintelism and networks will become increasingly viable strategic alternatives.

2. Wintelism and networks are likely to be imitated and to be spread into models of best practice to be diffused widely beyond the firms or sectors of their origin and likely widely beyond Asia as MNCs bring the new approaches to other markets and sectors.

2. US and Japanese Leadership.

From the early 1970’s until the mid-1980’s, Japanese producers were ascendant in electronics and took over consumer electronics, gained leading world market shares in semiconductor chips, materials and equipment, and looked entirely capable of repeating the feat in computers, office systems (e.g., copiers, faxes), and customer telecommunications equipment.

However, by 1994, US producers of silicon chips and semiconductor materials and equipment were again flourishing, having regained the dominant world position. US industry leaders are now so certain of continued success that many dismiss the Japanese giants as competitive dinosaurs, ill-adapted to the raucous, fast, changeable, idea-intensive electronics markets of the future. The recent success of US-owned firms has rested in significant part on the growing technical sophistication and competitive strength of Asian-based producers in the China circle, (encompassing China, Hong Kong, and Taiwan), Singapore and Korea.

As the Asian market develops in both technical sophistication and size over the next decades, the mantle of electronics leadership could well pass from US and Japanese firms to indigenous Asian producers, especially those centered in the China circle.

Several competitive shifts lie behind recent Japanese troubles and American re-ascendance. Chief among these were the bursting of the domestic Japanese asset bubble, the attendant, lengthy recession in the Japanese economy, and multiple endaka (dramatic yen appreciation).

Japan's electronics success was driven to a considerable degree by rapid growth in the sheltered domestic market, which allowed to reach scale economies, the launch of several generations of consumer and office systems, premium prices to subsidize price competition on foreign markets, cheap capital for continuous reinvestment and quality-conscious consumers who rewarded corporate strategies built on incremental product revisions.

Cheap capital ended when the asset bubble bursted, provoking Japan's longest post-war recession so that firm strategies premised on rapid growth were no longer supported and the willingness of retailers blindly to support the producer-controlled pricing structure ended.

Combined with successive appreciations the economic problems made Japanese firms increasingly vulnerable to price competition both at home and abroad.

Moreover, capital and technology were turned-over more slowly in production, moderating the ability of Japanese firms to compete through aggressive manufacturing innovation and the incremental product revisions it generated.

The end result was increased specialization among Japanese electronics firms in areas of core advantage and a thorough-going industry rationalization, as is evident in the surge of off-shore production investment into East Asia and China.

By the end of the 1970's, US electronics firms were almost completely dependent on Japanese competitors for supply of the underlying component technologies necessary to produce consumer electronics products. In most cases, thorough-going technology dependence was a first step toward market exit. Indeed by 1980 most major US firms had exited the consumer segment of the market.

The loss of consumer electronics' high-volume demand eroded the US supply base for the other segments of the electronics industry and threatened them with an equally

competitively constraining architecture of supply. [3]

As US producers of industrial electronics were in danger of becoming dependent on their Japanese competitors for essential technologies the only alternative was to make the supply architecture more open and competitive. In conjunction with government policies and local private investors in Asia, US firms gradually turned their Asian production networks into a flexible supply base alternative to Japanese firms.

This transformation occurred in three stages:

1) From the late 1960's to late 1970's US firms established their presence through FDI. Most US firms sought not market access but cheap production locations and established local assembly affiliates. Because their Asian affiliates were integrated into a production operation serving advanced country markets, US firms upgraded their Asian investments in line with the pace of development of the US lead market. This led to greater technology transfer and increasing technological capabilities for locals.

2) From 1980 to 1985 their Asian affiliates developed extensive local relationships in the shadow of the dollar appreciation and began to source more parts and components locally. An elaborate and deepened technical division of labor between US firms and Asian-based operations began to appear bound together in production networks serving US firms' advanced country markets. A new supply base was being created in Asia under the control of US and local, but not Japanese capital.

Asian governments provided a panoply of fiscal and tax incentives, invested heavily in modern infrastructure, generic technology development and the technical up-skilling of the work force, engaged in selective strategic trade interventions and provided market intelligence and product development roadmaps. By the end of the 1980's the result was burgeoning indigenous electronics production concentrated in the PC and PC-related markets throughout the region with nerve-centers in Taiwan and Singapore and with most of it, outside of Korea, under the control of Overseas Chinese capital.

3) From the late 1980's to early 1990's the technical capabilities of the regional production networks were significantly upgraded and local affiliates were assigned global product responsibilities. The production networks extended to more and more capable local Asian producers who became increasingly skilled suppliers of components, subassemblies and entire systems. Even design was contracted-out.

As a result, an intricate network sub-contracting structure of affiliated and family enterprises has been formed which comprised a local production and supply base. In response to steep rises in factor input costs and exacerbated by currency appreciation, these emerging production networks became more and more regionalized. US firms effectively exploited increased technical specialization in Asia.

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[3] The supply base is the local capability to supply the component machinery, materials and control technologies and the associated know-how, that producers use to develop and manufacture products. The architecture of supply is the structure of the markets and other organized interactions (e.g., joint development) through which the underlying technologies reach producers.

Summarizing, for the resurgence of US market and technical leadership two competitive shifts were of paramount importance.

1. A market shift: new electronics product markets have begun to converge on a common technological foundation of networkable, open, microprocessor-based systems, and are characterized by competitions to set de-facto market standards. Open systems imply that interface specifications permit interoperability with the operating system or system hardware which are published or licensed and made available to independent designers of systems or software who can produce complementary or competing products.

Over the last half decade, the domestic US market has been the principle launch market for such new products on which standards competitions have been fought. By setting and controlling the standards US firms have achieved dominant positions on world markets as US choices became global standards.

2. An organizational shift: US firms moved away from traditional integration to network forms of organization, specifically, Asian-based production networks centered in the China Circle and Singapore.

This had three significant consequences for US firms:

a) US firms were relieved from the constraining threat of competitive dependence on Japanese firms as Asian production networks offered an alternative supply base.

b) The networks lowered production costs and turnaround times while keeping pace with rapid technological progress.

c) The networks spawned Asian-based direct competitors to Japanese firms.

All this contrasts sharply with the development pattern of Japanese investments in the region over the same period. Japanese production networks in Asia developed through three different periods with fundamentally different strategic rationales for engaging in Asian production networks.

1). From the late 1960's most Japanese investments into Asia has been aimed at serving nascent local markets behind tariff walls. Japanese investment was often turnkey, with knock-down kits exported from Japan for local final assembly and sale in the local affiliate’s domestic market. Until the early 1980’s there was the period of domestic market orientation. In this period Japanese production networks have started out with a loose, locally embedded structure. The penetration of heavily protected Asian markets required joint ventures with local partners, which provided access to distribution channels and facilitated relations with the government. Local content was substantial, but often this came at the expense of cost efficiency and quality.

As long as markets keep growing, this loose network organization is considered to be a great strength as it enables firms to remain reasonable flexible. Once demand growth can no longer be taken for granted, the costs of excessive decentralization and decision autonomy become important.

Japanese firms upgraded the technological capacities of their Asian investments at the slower pace necessary to serve lagging local markets. Whatever the Asian affiliates needed could be easily supplied from Japan. Less technology was transferred and even that remained locked up within the Japanese firm’s more limited circle of relations.

2) In the second phase from 1980-1985, the pattern of Japanese investment led to a dual production structure under the control of Japanese firms premised on traditional product cycles. Sophisticated products were produced at home with sophisticated processes to serve advanced country markets, while lower-end products were produced with simple processes in regional affiliates to serve local Asian markets. The Japanese production networks remained relatively closed, even as the US networks became more open and entwined with indigenous producers, and more specialized.

After 1986 the shift to export platform production gathered momentum which led to the establishment of highly centralized governance structures and very limited local roots. Japanese firms insisted on 100% affiliates or at least majority joint ventures. Governance structures became highly centralized and outsiders had limited opportunities to enter these production networks. In this period American companies relied more on decentralization which gave rise to a certain degree of local embeddedness. Under the impact of the Yen appreciation Japanese producers of consumers electronics were quickly losing market share in the US and Europe. A quick response was to establish huge export platform plants in low-cost production sites in Southeast Asia. Local content remained limited and most components and materials were imported from Japan.

There are two reasons why Japanese electronics firms choose to rely on centralized control.

First, as time is of great importance for developing a firm's capacity to manage international production and firms did not have time to follow the gradual approach, the response was to try to transplant key features of the Japanese production system with as little change as possible. Production ramp-up had to occur quickly, and cost and quality had to be tightly controlled, so that tight centralized management control was a perfectly rational choice.

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 activities abroad, it is faced with complex coordination problems and the risk of disruptions caused by suppliers, demand fluctuations and production problems. By centralizing, firms try to reduce the likelihood of such disruptions. 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.

However, this tight control of their Asian affiliates and the little scope for autonomous decisions came at a very heavy cost. It prevented Japanese firms from harnessing the resources and capabilities that have accumulated in East Asia; it slowed 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.

3) Up through the end of 1993, Japanese firms still controlled their Asian affiliates' major decision-making and sourcing activities from Japan. More low-end process/product technology had been off-shored. Local Asian content had risen toward 60 percent, but core technological inputs were exclusively sourced from Japan. In short, Japanese firms

intensified rather than rationalized their dual production structure and failed to benefit from increasing, cheaper, and faster technical capabilities in the rest of Asia.

However, since 1991 with the bursting of the bubble economy the pendulum is swinging back again toward decentralization and local embeddedness. We are witnessing a shift to more open and locally embedded Japanese production networks. Lower labor costs do matter, but of equal importance are:

1) a regionalization of procurement;
2) the penetration of Asia's contested growth markets;
3) attempts to harness the regions improved capabilities and;
4) a shift to more decentralized governance structures.

Ad 1) The Yen appreciation has acted as a powerful catalyst for the regionalization of procurement. It has eroded the cost competitiveness of the Japanese production base and has drastically increased the price of components and capital equipment that Japanese affiliates in Asia import from Japan. Now parent companies in Japan increase their imports from Asia, both for final products and components, and the share of higher-end, technologically more complex products has increased considerably. Japanese firms are systematically increasing their reliance on international procurement. They are building more flexible and open international networks between parts suppliers and assemblers. The tight linkages that traditionally have bound together Japanese electronics firms and their domestic suppliers are losing much of their earlier vigor. Those suppliers that produce relatively complex and higher value-added components have substantially increased their investment in East Asia and they are much less inclined to stick to their traditional clients. The higher-level Japanese component suppliers that have set up shops in East Asia are now under increasing pressure to involve local supplier firms for lower-end subcontracting and contract manufacturing activities. In addition Japanese affiliates in Asia have also increased their direct purchases from both Taiwanese and Korean suppliers. However, this has not prevented a further rapid growth of component imports from Japan. 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.

Ad 2) With respect to penetrating Asian growth markets, 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. Now most electronics markets have shifted from sellers to buyers markets, Japanese overseas investment in East Asia is driven by market share expansion within the region, especially in China in order to get a floor into this potentially huge growth market, not only for homogenous products but also for differentiated products. This 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. Due to the razor-thin profit margins that characterize most standard consumer products their production has to be located at low-cost sites and close to their main growth markets, primarily in Asia.

Until the late 1980’s, most of the Asian production networks of Japanese electronics firms covered only a limited variety of products. In most cases, the focus has been on the final assembly of low-end household appliances requiring fairly conventional mass production techniques. Over the last few years, substantial changes have occurred in this

traditional product mix which enforced Japanese electronics firms to open up their Asian production networks.

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. 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 localize component sourcing, key management functions and R&D.

This is especially true for telecommunications equipment where Asia is now the most important growth market. Foreign firms are required 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 simply is too costly and time-consuming to provide them from abroad.

A dramatic pressure for opening-up regional production networks resulted from a blistering price war in Japan during the fall of 1992 started by US firms such as Compaq and Dell on language machines for roughly half the price of NEC machines. Most of these machines were actually produced at locations in the China Circle.

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 Japanese firms were forced to shift fairly ad hoc and without much preparation, a growing share of their production abroad, especially to lower-cost locations in East Asia. However, confronted with an increasingly pervasive price war, Japanese computer firms have cast aside most of their earlier inhibitions to forge close ties with Asian suppliers and now they replicate the production networks that American computer companies have established in the region.

So far very little over-lapping and rivalry had occurred between American and Japanese sourcing strategies. The Americans focused on PC-related products, while the Japanese focused on consumer electronics and appliances. Now this is rapidly changing, as Japanese firms are shifting a variety of PC-related products to East Asia. For the first time, American and Japanese firms will have to compete for the same potential supply sources in East Asia.

Ad 3) Access to the regions improved capabilities is now considered to be an essential prerequisite for successful upgrading of Japans 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.

Simple cost considerations, i.e., cheap labor, are no longer the only factor that attracts electronics firms to this region. Since the mid 1980’s, substantial improvements have occurred in the locational advantages of East Asia, e.g., in infrastructure, education,

financial liberalization. Leading electronics firms, both in the US and Japan, are now eager to capture some of the externalities generated in these centers of expertise. East Asia has become a leading supply base for an increasing variety of information products. The region shows two complementary strengths:

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. This holds especially for Korean chaebol like Samsung.

2) A capacity for quick response to changes in market requirements and technology through flexible specialization in manufacturing and procurement. This applies for medium-sized Taiwanese computer firms.

Until recently, most of these products were based on imported design, with the focus on manufacturing excellence and sophisticated supply chain management. Now this is beginning to change: production and procurement capabilities are supplemented by design and market development strategies.

The Japanese are outsourcing now a variety of capabilities that either have become too expensive in Japan or that only very few firms can afford to retain. However, 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.

The current shift from proprietary components to standard components that can be sourced at lower cost from local or regional suppliers has forced Japanese firms to upgrade their regional and local support services. This is the main driving force for relocating R&D activities to East Asia. By so doing Japanese electronics firms can tap into existing pools of lower-cost human resources. As Asia is characterized by very heterogeneous demand patterns and highly segmented product markets, Japanese firms had to adapt their Asian production networks to the idiosyncrasies of each of these markets. Product customization requires an on the spot capacity for continuous re-design (adaptive engineering).

The largest share of Japanese electronics R&D activities in East Asia falls under two categories: software engineering to develop Chinese language programs to improve market access in China for Japanese computer manufacturers and circuit design dedicated to ASICs for consumer devices or telecommunications equipment. Both are essentially support services required to enter or expand the region’s domestic markets.

Ad 4) Japanese production networks started out with a loose, locally embedded structure during the period of domestic-oriented production. When the focus shifted to export platform production, a highly centralized governance structure had been established with very limited local roots. During the 1990’s a new stage developed with the pendulum swinging back again toward decentralization and local embeddedness. However, in contrast to the earlier period of domestic market orientation, the present tendency toward decentralization shows three important differences.

1) Japanese electronics firms are now moving more elements of their value chain to Asia, including some high value-added support services.

2) The mix of products that they produce and source within the region has been substantially broadened and includes higher-end consumer products, a variety of informa-

tion products as well as components and subassemblies.

3) Corporate headquarters find 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.

Japanese firms find 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 individual Asian affiliates take over a number of coordination functions that used to be the sole privilege of the parent company. A certain degree of decentralization of governance structures is necessary in order to unleash the learning and innovation potential of affiliates and suppliers.

Japanese firms are now searching out within the region and are qualifying non-Japanese suppliers and contract manufacturers for an increasing number of their products, subassemblies and components. This has led to an 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:

1) Responsibility for procurement can no longer be retained in Japan; it increasingly migrates to regional headquarters or individual Asian affiliates in order to speed up decision-making, because time-to-market has become the most important determinant of success.

2) 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. Most of these investments are now locally funded, i.e. they do not involve a transfer of capital from Japan. 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.

Summarizing, the ascent of Japanese international production networks has been constrained by the heritage of a closed production system. Originally their international production activities, starting with investments in Asia in the 1960’s, were concerned with by-passing import restrictions. From the mid-1970’s the focus shifted to the American and European market. The catalytic effect of the Yen appreciation around 1986 led to the expansion of Japanese production networks in East Asia. Over time, the focus has shifted from Northeast Asia (Korea, Taiwan and Hong Kong) to the ASEAN region (primarily Singapore, Malaysia and Thailand) and since 1992 from the ASEAN region to China, Indonesia, the Philippines and Vietnam. In a very short time the Japanese electronics firms have thus substantially extended the geographic coverage of their production activities. As the “China fever” raged through the Japanese industry during the early 1990’s much of the overseas investment has moved into China.

Japanese firms are now under considerable pressure to rationalize their existing Asian production networks and to cut costs wherever possible and at every stage of the value chain. They are forced 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 have a vested interest in interacting with local companies and in increasing their Asian value-added.

However, American electronics firms did not sit idle and deepened their links with suppliers through an increasing variety of inter-firm supplier networks. Both American and Japanese firms have concentrated, by and large, in the very same countries. However, one important feature of Japanese electronics firms is that they are still laggards in international production compared to their American and European counterparts. The Japanese electronics firms have for quite some time tried to reap the maximum advantages from certain basic features of their domestic production system which they thought would be difficult to reproduce abroad. The result is that today their overseas production ratios are, in general, much lower than their American and European counterparts.

So far there has been very little overlapping and rivalry between American and Japanese production networks in Asia. American firms focused on PC-related products while Japanese firms focused on consumer electronics and appliances. This is now rapidly changing. As Japanese firms shift a variety of PC -related products to East Asia, they may now try to tap into the same set of regional supplier networks and capability clusters that have so far catered primarily to the needs of American firms. This implies that for the first time American and Japanese firms will have to compete for the same supply sources in East Asia. During the 1980's, the preemptive development of these East Asian supplier networks greatly helped American computer companies consolidate their market leadership. It remains to be seen whether American computer firms will be able to retain control over these precious supplier networks now that Japanese PC vendors are also beginning to target them.

In the electronics industry roughly the following pattern becomes visible. Singapore and Hong Kong compete for a position as regional headquarters together with major support functions like procurement, testing, training, engineering services and some product design; South Korea and Taiwan compete for OEM contracts and as suppliers of precision components; Malaysia, Thailand and the Philippines are preferred locations for the volume production, especially of mid-level and some higher-end products. Chinas main attraction is its potential huge domestic market for a wide range of electronics products and now it competes as a new export platform production base for low-end assembly and simple components manufacturing.

3. Network typology.

Two broad dimensions structure the comparison of the national variations in the networks in the electronics industry in Asia.

* Horizontal versus vertical networks, in which the question is whether firm relationships are structured among networks of peers who cooperate to form long-term relationships, or whether there is one principal firm dominating tiers of suppliers who in turn may dominate their own suppliers.

* Open versus closed networks. Here the question is whether networks are easy penetrable by outsiders, with shifting transactions based on exchange relations, or whether

they are closed to outsiders, based on tight, not-easily-penetrable long-term relationships rather than exchange relations.

Next table presents the variety of Asian networks on the basis of the vertical-/horizontal and open/closed distinctions.

	Vertically-integrated	Horizontally-integrated
Open	US networks	Taiwanese networks
Closed	Japanese/Korean networks	Overseas Chinese networks

Precisely because the Americans were weaker in production than their Japanese competitors and in fact competed on product definition, they have been open to outside participation and innovation in the production subsystems, non-critical components and assembly of the final product systems.

The US networks tend to be open to outsiders, fast and flexible in decision-making and implementation, structured through formal, legal relationships and capable of changing contour as needs change. Their activities are centered in the NICs, especially Singapore, but increasingly reach into the rest of Asia and China.

By contrast, the Japanese networks tend to be relatively closed to outsiders, more cautious to make and implement decisions which are generated from Japan, and structured on stable, long-term business and keiretsu relationships, mostly centered from Japan.

The US networks rely on an open, competitive supply architecture in which Japanese, US, Taiwanese, Singapore, Korean and other Asian firms compete on cost, quality and time-to-market and provide significant value-added.

By contrast, the Japanese networks rely on a largely domestic and affiliated supply base with little value-added by other Asian producers.

The US networks produce increasingly sophisticated industrial electronics like hard disk drives, PCs , InkJet Printers and telecommunications products.

The Japanese networks still mostly produce consumer audio-visual electronics and appliances.

The US networks exploit a complementary division of labor in which US firms specialize in soft competencies (definition, architecture, design-standards) and Asian firms specialize in hard competencies (components, manufacturing and design/development thereof).

By contrast, the Japanese networks exploit a division of labor with significant redundancies in which domestic Japanese firms produce high-end products using sophisticated processes, and off-shore affiliations produce low-end products.

The US networks exploit increasing technical specialization throughout the production process in which the Asian contribution is maximized; the Japanese networks

exploit a value-added specialization between products in which the Asian contribution is minimized.

This clear-cut distinction between closed Japanese and open American production networks in Asia has existed only for a relatively short period roughly from 1986 until around 1992. Both before and after this period, Japanese production networks in Asia were fairly open and locally embedded.

One should not underestimate the capacity of Japanese firms for rapid learning and organizational adjustment. They have clearly understood the constraints that result from closed, Japan-centered 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 regions capabilities and contested growth markets. Japanese electronics firms now have a good chance to recapture terrain that they lost during the 1980's.

At this very moment, Japanese production networks have become more open and more locally embedded so that Japanese firms are more willing to interact with local companies. The Asian production networks of Japanese electronics firms 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. Originally focused on subcontracting and OEM arrangements, such interactions now cover more complex value chain stages, including engineering and product development.

4. The Role of China and the Emerging Overseas Chinese (OC) Networks.

So far Japanese firms have concentrated almost exclusively on two market segments: consumer electronics (including household appliances) and electronic components. For consumer electronics they compete primarily with Korean chaebol, for components their main competitors are American, Korean and Taiwanese firms. However, Japanese firms have failed to play a significant role in China's rapidly growing markets for industrial electronics, with the exception of telecommunications equipment. This is true in particular for the computer-related products industry, which is dominated by American companies and by Taiwanese firms. Integrating China with American and Japanese networks is characterized by fundamental differences. For American networks, the focus is on computer-related products and telecommunications equipment, while for Japanese networks the focus has been on consumer products.

As a result of the huge Chinese untapped market potential, all of the leading Japanese and Korean TV-set makers have aggressively invested in domestic market-oriented production facilities. The recent massive wave of investment projects into China has 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. As local supplier industries

are still very weak, such as e.g. in TV picture tubes, 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. Moreover, labor costs have drastically increased, now approaching Thai wage levels, while productivity continues to lag behind Thai productivity levels.

Another problem results from unexpected limits to the growth of the domestic Chinese market. Roughly one-fifth of the 13 million TV sets that are sold per year in China are smuggled across the borders, may 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 foreign investors in China have to radically change their strategic focus. Instead of aiming primarily at the domestic Chinese market, an increasing share of production will now have to go into exports. One key feature of the Asian production networks is the coexistence of production oriented towards the domestic market and towards recent export bases. The same type of products is often produced at very different productivity and quality levels. Low productivity production for the domestic market can be highly profitable as long as the domestic market remains highly protected. But this is no longer the case, as domestic consumer electronics markets are now gradually being opened to international competition. The new wave of investment in China has generated substantial surplus capacities in the region. Sustaining a dual production structure is very costly. Therefore, given the heavy sunk investments involved, companies may be no longer in a position to postpone decisions on where to consolidate their individual regional supply base for particular components.

So far China competed primarily with Indonesia, India and Vietnam as a new export platform production base for low-end assembly and simple component manufacturing. Now China may 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 possible diversion of investment to China, the Malaysian government as well as other ASEAN governments are willing to accelerate trade liberalization to create a large market that can draw foreign investment and compete on a more level playing field with China. This has further increased pressure on Japanese firms to rationalize their Asian production networks, i.e. to improve their regional specialization.

The emerging Overseas Chinese (OC) networks, besides China covering Hong Kong and Taiwan, appear to combine features of both the Japanese and US approaches, with distinctive characteristics of their own. Like the Japanese, OC networks are difficult to penetrate. Much like the US, OC networks are fast and flexible. OC networks can design and execute in less time than it takes the Japanese giants just to make a go-ahead decision. The rapid design capabilities join with the hyper-competition among subcontractors in the network to implement the new designs as fast as possible.

The OC networks seem especially focused on intricate division of production tasks that can be farmed-out all the way down to family job shops and home-workers. Individual units within the network operate at small scale with minimal capital investment requirements and link on the informal bases of guanxi, that is friendship ties. The flexibility that results makes it possible to increase or decrease production scale on short notice, or to enter and exit niche product-market segments at minimal cost and with minimal fixed investments.

OC networks tend to be centered in the China Circle and increasingly focused on Mainland China. Like the Americans, the OC networks seek to exploit a highly competitive supply base. Much like the Japanese, they retain in the home base high value-added products and off-shore to cheaper production locations with lower value-added products assembled with simpler processes. OC networks also leverage increasing technical specialization through local relationships where possible and they are increasingly China-centered, rather than using a NIC base as the regional center.

Summarizing, the current position of US networks is no more a guarantee of future success than was Japan's in the early 1980's. Much depends on how Japanese firms respond to their current competitive dilemmas and on how OC firms leverage opportunities in the China circle. There is evidence of nascent Japanese adjustment which shows increasing openness and increased reliance on OC, Chinese and Korean suppliers. However, there also is anecdotal evidence that Japanese networks are snapping back toward the more traditional, closed model as the yen depreciates and as Japanese firms absorb know-how from the partners they took on in Asia. In any case there is no conclusive evidence that the Japanese strategy has changed, that they appear intent upon exploiting increased specialization in the rest of Asia, and that there is convergence of the Japanese and US models. The China Circle will witness one of the great market battles in memory as US, Japanese and indigenous production networks vie for 21st century advantage.

5. Opportunities and Challenges for Taiwan.

Over the last decade Taiwan has established itself as a world-class supply source for a variety of electronic hardware products: computer monitors, motherboards, switching power supplies, mouse devices, keyboards, scanners and a variety of add-on cards. This indicates Taiwanese computer firms have been able to develop significant design capabilities.

Progress has also been made in the field of components. Taiwan has hundreds of passive component makers that have established a strong position relative to their erstwhile leading Japanese and US competitors in higher value-added IC devices, chip sets, static RAM memories, mask ROMs and EPROMs. Small-and medium-sized enterprises have been the main carriers of this rapid development. The appreciation of the NT$ in the mid-1980's as well as the rise in the cost of land and labor has led to a rapid expansion of overseas production by Taiwanese computer companies. They were able to bypass the traditional size-related barriers to international production because they have participated early on in a variety of subcontracting, contract manufacturing and OEM relationships with

leading foreign computer companies. Since 1987, Taiwanese firms became major OEM suppliers for American computer companies and over the last few years, linkages with Japanese production networks have intensified.

However, Taiwan's electronics industry is still based on a weak foundation. For most of the key components Taiwan continues to rely heavily on imports, primarily from Japan and the price of these imports have rapidly increased over the last two years. This is the root cause for Taiwan's exploding electronics trade deficit with Japan.

It remains to be seen whether the expanding bilateral trade links in Taiwan's trade with Japan will be sustainable. There is no doubt that Japanese PC vendors perceive OEM purchases as an intermediate solution: it enables them quickly to discontinue lower value-added production activities at home and it enables them to gain time until they have been able to set up their own supply base 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 Taiwanese contract manufacturers. This obviously is a response to the gradual depreciation of the Yen which has started in 1995.

This shows that nothing is automatic about the benefits of participating in international production networks. Periodically there are important reversals in the distribution of such benefits. There are undoubtedly substantial short-term benefits for Japanese PC makers to relocate production back home. But whether this is a long-term solution remains open to doubt, because Taiwanese OEM suppliers have shown incredible speed to respond to changes in markets and technology. Japanese vertically integrated electronics giants are not famous for such flexibility.

6. Cross National Production Networks in Europe.

The Europeans do not appear to be a significant player in this story. They defined Asia as a primary investment priority and the emerging European networks reflect the political imperative of jumping over trade restrictions and they have the form of American companies of two decades ago.

The European Information and Communication Technology (ICT) industry has not been all too fast with restructuring to face the new challenges. The European Commission states that Europe did not keep pace with the trend of outsourcing, the development of a network of competing suppliers of components, i.e., transnational production networks, which is characteristic for the American and Japanese producers and their Asian supplier networks. The chances offered by the economies of Central and Eastern Europe and their possible integration into the EU have to be seized both by industry and government in order to allow industrial restructuring. Industrial cooperation on world markets is essential not only because of its involvement with the creation of standards and the presence on world markets, but also because it requires access to key technologies and components to avoid too great dependence.

The experience of Asia may provide clues about the transition of Central and

Eastern Europe and the reintegration of the European Economy. The Central and East European countries are small and middle sized countries, in a position similar to the third tier of Asian development, which will not be able to pursue autonomous national development strategies, but rather will need to insert themselves into a regional division of labor and into cross national production networks.

The Post-war European construction served to create an ever more homogeneous economic space to pursue the scale economies captured in the large single market, one that sought to compress the range of national differences along a range of dimensions so that over the medium term all EU countries will converge toward the same degree of integration and the same development level through budgetary transfers and that they will implement the same policies.

On the one hand, European security objectives have a visible economic cost as has been shown by the German case where unification proved enormously expensive. The difficulty for Europe is what economic price to pay for security purposes. Supporting the development of allies through open markets and assistance may produce development gains over the years as markets expand, but in the immediate present it creates budget pressures and adds to domestic adjustment. There is no clear policy solution to the economic problems, so that the question of costs, both the direct budget costs and the indirect of costs of accelerated adjustment, becomes central. If the Eastern countries represent a source of migrants or products that accelerates the pressures of structural adjustment in the West, then the economic/security trade off is accentuated.

On the other hand it is not unimaginable that the division of labor possible with the heterogeneity provided by Eastern Europe helps maintain production in Europe that might otherwise have exited, brings back production, or permits new production to expand in Europe.

Therefore, it is quite possible that the amplification of the economic-security tensions also represents a heterogeneity of production functions between Eastern and Western Europe that offer a solution.

The question is whether Eastern production entities become rivals to or complements for existing Western producers.

If Eastern producers are market rivals to the Western companies, then a full set of managerial, labor, and technological resources will be required for them to compete.

If Eastern entities develop into complements that supplement Western firms then Europe’s competitiveness as a region is augmented and the price of adjustment is certainly mitigated. As complements the resource packages they require will be more limited.

In sum, the role of Western producers versus Central/Eastern European firms, as rivals or as complements, will set the market linkages and influence Western political choices that will redefine the development options for decision makers in Eastern and Central Europe.

Resource endowments, political decisions, or social networks of influence and control constrain outcomes, but do not provide an explanation of the strategies and motivations of the firms. It is a matter of the type of market linkages, such as trade, investment and cross-national production arrangements, and the character of the resulting exchanges that Western firms and Eastern firms create among themselves that determine

how resources will be allocated to most efficient use and whether auto or electronic components be produced and shipped west. The nature of the linkages that emerges between East and West will shape the competitive dynamics and industrial development in Central/Eastern Europe. The transition and industrial reorganization must be understood as a regional story and this also illuminates European regional competitiveness more generally. Cross-national production networks among heterogeneous countries may make Europe a more flexible, agile, and effective competitor as a whole.

A core question is whether cross-national production networks of the sort that have emerged in East Asia could become a significant feature of the integration of Central/Eastern Europe. Eastern Europe may play multiple roles: rival to Western producers, market, location for FDI, and complement in network production. For our purposes the distinction between rival and complement are salient. Rivalry is evident in sensitive sectors such as steel, cement, chemicals, leather products and shoes, and agriculture, where the EU has taken restrictive measures. Central/Eastern firms emerge as complements in network production in sectors such as electronics, metalworking and automobile parts. Complementarity opens the door for tightly woven production networks.

Data on intra-industry trade indicate that production networking is occurring and has grown very quickly, more rapidly than the rapid expansion of trade between the CEEC and the EU as a whole.

On the one hand, the Central/Eastern European countries may not in themselves be large enough to alter the way in which European business as a whole is organized and to affect its competitive position in world markets.

On the other hand, European companies have been slow to exploit the possibilities of cross-national production networks and these have been principally used to rationalize production in the face of trade restrictions.

With respect to the question of the form of the cross-national production networks it may be repeated that the networks reflect the characteristics of the home country firm organizing the network. The influence of Western MNEs will be amplified because:

1) Eastern firms don't have the technical and management skills to compete with world class firms;

2) They don't have the financial resources to modernize aged production facilities or to engage in massive R&D projects;

3) Many firms in potential sectors are relatively small to obtain cheap credit, government subsidies or tax holidays.

Therefore, Central/Eastern European network development will be strongly influenced by Western European corporate decisions. However, European firms were so scarcely presented in Asia that it is hard to project from their behavior in Asia their likely strategies in Eastern Europe.

With respect to the character of the European networks, open networks may never come into existence. Rather the new European networks that emerge may be closed networks resembling the Japanese networks in Asia created by the investment of European firms. This may be reinforced by the lack of an indigenous production network in the East due to the existence of burdened overhanging inter-enterprise debts.

There is evidence that European companies that have moved production to Asia will consider European locations. CEEC trade advances seem to have come at the expense of Asian producers. If production that would otherwise move to Asia stay in Europe and if production presently in Asia moves back to Europe, the gains could be substantial for Europe as a whole because there are a whole range of components and sub-assemblies that might be produced in Europe.

7. Conclusions.

Recent changes in the organization of production and product development are altering the terms of competition in the global electronics industry: Wintelism and cross national production networks. Wintelism is the code word for the shift in competition away from final assembly and vertical control of markets by final assemblers to a struggle over setting and evolving de facto product standards in the market, with market power lodged anywhere in the value-chain. The constituent system elements - from components and subsystems through operating and applications software - become separate and critical competitive markets.

Electronics firms have established increasingly complex international production networks with the result that an increasing share of the value-added has become externalized. Competitive success critically depends on a capacity to orchestrate complex international production networks and to integrate them into the firms organization. The need to reduce costs is important but also the penetration of contested growth markets as well as an improved access to clusters of specialized capabilities to complement the firms's core competencies. Intense price competition needs to be combined with product differentiation. Of equal importance is speed-to-market, i.e. the firm's ability to build capabilities quicker and at less cost than its competitors. No firm, not even a dominant market leader, can internally generate all the different capabilities that are necessary to cope with these conflicting competitive requirements. This requires a shift from individual to increasingly collective forms of competition in the form of networks.

Electronics firms are breaking down the value chain into discrete functions and locating these functions wherever they can be carried out most effectively, where they are needed to facilitate the penetration of important growth markets and where this enables the firms to generate closer, faster and more cost-effective interaction between different value chain stages across different locations. This has accelerated the pace of geographic dispersion and increased the complexity of the value chain activities that are moved overseas.

The spread of international production networks can have important positive welfare implications by facilitating the formation of local capabilities in an increasing variety of locations. American and Japanese electronics firms now have a vested interest in the development of a regional supply base in Asia. The main focus is on the formation of regional clusters of specialized capabilities.

The shift from partial to systemic specialization has led to a creeping migration of higher value-added support activities that are essential for competitive success. Such leakages occur across the boundaries of the firm, but knowledge also moves to those

foreign countries that have developed a critical mass of specialized capabilities. Sophisticated regulations on intellectual property rights can slow down this knowledge migration, but they cannot completely stop it. The forces of globalization are too powerful; once manufacturing moves abroad, there are almost irresistible pressures to relocate an increasing variety of higher value-added support services.

The current success of American electronics firms owes much to the establishment of export platform production networks in Asia. They improved their specialization by relying on a combination of 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;
3. A systematic rationalization of the international production networks from partial to systemic globalization.

This has set in motion a virtuous circle. By redeploying lower-end stage of the value chain to Asia, American electronics firms were able to concentrate on what they do best, i.e., on product design, the definition of global brand names, architectural standards, and the control of distribution channels. A focus on such higher stages of the value chain has generated high profit margins and increased the disposable funds for R&D and investment. This has enabled American firms to remain market leaders through aggressive product development and the creation of new and more sophisticated entry barriers. Relocation back home is no longer an option. Then the spread of international production networks needs to be complemented with a continuous upgrading of the domestic supply base.

Wintelism and networks were the principal means by which the US electronics industry recovered from its- mid-1980's crisis in competition with Japanese firms. Both phenomena are likely to be broad features of the international economy that reach well beyond electronics.

The current US position is no more a guarantee of future success than was Japan's in the early 1980's. Much depends on how Japanese firms respond to their current competition dilemmas and on how OC firms leverage opportunities in the China Circle. Although there is evidence that Japanese networks show increasing openness, there is also evidence that they are returning to the more traditional closed model as the yen depreciates. There is no conclusive evidence that there is convergence of the Japanese and American network models.

There is nothing automatic about the benefits of participating in international production networks. Periodically there are important reversals in the distribution of such benefits.

The optic of cross-national production networks provides an alternative perspective on the East European economic transition.

The China Circle will witness one of the great market battles in memory as US, Japanese and indigenous production networks vie for 21st century advantage.

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