Growing Up and Moving Out: Globalization of "Traditional" Industries in Taiwan

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MIT IPC Globalization Working Paper 00-004

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June 2001

No matter what the stage of development, every country worries about its place in the international division of labor. States that are early on the development path, on the one hand, seek to develop industrial sectors whose impact will be both broad and long-term. They fear that inappropriate policies will leave them cut-out of the dynamic sectors that power the global economy. States that are further along, on the other hand, worry that their leading sectors and firms will not adjust rapidly enough to the changes in the world economy. They fear being hollowed-out as companies move operations to countries where labor is less expensive and regulations more lax. Taiwan is unusual in that it confronts the challenges of both the developed and the developing world: until quite recently it was one of the classic cases of "late" development; it now confronts the questions of adjustment that are so familiar to the advanced capitalist countries. It fears both being cut-out and hollowed-out simultaneously.

Taiwan, by all accounts, is a star pupil in the class of late-developers: it has done tremendously well at promoting industrial development. By 1995, it was the world's third largest PC maker, with total PC-related annual output reaching $15.8 billion. According to some estimates, Taiwan supplies over half of the world's supply of many PC-related products.[1] To a great extent because of this phenomenal success in high-tech industries, however, "traditional" sectors such as autos and apparel in Taiwan have come under increasing pressure to relocate manufacturing facilities off-shore; labor costs on the island are rising, and for some activities it is simply not possible to find enough workers. Taiwan represents the new set of challenges for late developers: having successfully maneuvered through the obstacles of early development, it seeks to chart a course for long-term growth. Should the bread-and-butter industries of the early growth period be abandoned as the

[1] Chin Chung, "Division of Labor Across the Taiwan Strait: Macro Overview and Analysis of the Electronics Industry," in Barry Naughton (ed.), *The China Circle*, (Washington, DC: Brookings Institution Press, 1997), p. 181.

economy matures? How does a late developer ensure that large parts of the economy do not become victims of overall success?

Most studies of late development focus on the first stage of the industrial development process, when the challenge is developing a competitive industrial base. "In the language of contemporary economics," writes Robert Gilpin, "every state, rightly or wrongly, wants to be as close as possible to the innovative end of 'the product cycle' where, it is believed, the highest 'value added' is located."[2] The critical questions revolve around the most effective means of promoting the development of dynamic economic sectors. How much state involvement is appropriate? What is the proper role of the state? What social and political institutions are most conducive to growth? At this stage of the development process, industrial decline is of little concern to most policy-makers, yet it is the inevitable partner of success: as an economy develops, productive resources (labor, capital, and land) must either be transferred from declining sectors to those that are growing, or new strategies must be discovered to more effectively utilize resources that remain in traditional sectors.

In the development literature it is generally acknowledged that late developers do not face the same challenges as their predecessors in the initial stages of industrial development; is this also true as the economy matures and problems of adjustment become increasingly important? When faced with declining sectors, does a late developer have the same choices that an advanced industrialized county has, or is it in someway constrained by its late development background? The purpose of this paper is to push the study of late development to the next stage: by studying adjustment and relocation in Taiwan, we are able to look ahead to the next generation of adjustment—the challenges that developing countries will face when they begin to grow old.

The paper analyzes the process of adjustment and relocation in two industrial sectors in Taiwan, the textile/apparel and automotive sectors. Both are representative of

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[2] Robert Gilpin, *The Political Economy of International Relations*, (Princeton: Princeton University Press, 1987), p. 99.

industrial sectors that are targets of developmental efforts during early stages of growth, rise to become pillars of the local economy, and then finally encounter problems as growth begins to slow. The Taiwanese textile/apparel sector followed the classic trajectory of export-led growth. Production of natural fibers began in the 1950s with strong government support. As exports increased in the 1960s, the industry moved into man-made fibers and began to develop the complementary apparel firms. The industry peaked in the 1980s: Taiwan was the leading apparel exporter to the U.S. market for a brief period and the second leading producer (after the U.S.) of man-made fibers.[3] Beginning in the late 1980s, however, rising wages, increased government regulation (labor and environmental), and an appreciating currency began to erode Taiwan's comparative advantage in the labor-intensive parts of the sector.

The Taiwanese auto sector, by contrast, followed the classic import substitution strategy. The government sought to promote the development of local industry by imposing high tariffs on imports and localization requirements on domestic producers. In the 1950s and 60s local firms acquired technology primarily through licensing arrangements with Japanese firms, but in the 1970s and 80s many of these evolved into joint venture projects. Although the local components firms benefited greatly from the localization requirements, they too were reliant upon Japanese firms for more advanced technology. The primary constraint upon growth in the industry was market size: local demand in 1999 was only 500,000 and this was divided between 11 assembly plants. Rising labor costs, combined with the difficulty of achieving economies of scale, began to force Taiwanese auto firms to begin searching for new survival strategies. As in advanced industrial nations, in both the Taiwanese textile/apparel and auto sectors, relocation was seen as the cure for all ills.

I argue that the decision to relocate must take into account two factors. First, although the pressures driving relocation (e.g. shortage of workers for low-end

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[3] Kitty G. Dickerson, *Textiles and the Global Economy, 2nd Edition*, (Englewood Cliffs: Prentice Hall, 1995), p. 150.

manufacturing, rising wages, increased regulation, currency fluctuations) in Taiwan and advanced industrialized countries may be similar, the strengths and weaknesses of the Taiwanese firms will not be the same, and relocation strategies adjustment policies must recognize this. In particular, the innovative capacity and degree of technological independence are critical because they are a key determinants of Taiwanese firms' comparative advantage over the low-cost competitors in the regions that they are moving to and, perhaps more importantly, they will determine Taiwan industry's capacity for transforming what is left at home to higher order functions. Innovative capacity and technological independence, however, depend in part on how the Taiwanese firms originally acquired their technology (e.g. licensing, joint ventures, etc.) and from whom. How capabilities arrive affects how they leave. On the one hand, continued dependence on Japanese technology hinders the relocation efforts of Taiwanese auto assembly firms: moving offshore duplicates rather than compensates for these weaknesses. In the textile/apparel sector, on the other hand, Taiwanese firms not only are technologically independent, but are better able to utilize advanced information technology to coordinate far-flung production networks than local factories in the regions that they relocate to.

Second, relocation strategies must take into account both the nature of the global production networks that organize a sector, and the place (both current and potential) of Taiwanese firms in them. In particular, opportunities are shaped by the degree to which the production networks within a sector are divisible (both geographically and between firms) into distinct, or modular, activities and how these activities are then coordinated. The textile/apparel chain is easily divisible, and this has always been a primary reason why it is a bottom rung on the development ladder. Work can easily be given to the lowest bidder. While this inherent modularity creates an opportunity for Taiwanese firms, it also creates a danger: they can easily be cut-out. Hence, it is also important to understand what integrates the pieces of the network—the "glue" that holds the network together. In this case the "glue" consists primarily of the information technologies that are the heart of modern

retailing. This paper points to information technologies as being a potentially critical source of comparative advantage for Taiwanese firms. Production in the auto industry is usually far more integral than the textile/apparel industry. Large assembly firms have out-sourced an increasing percentage of work to large suppliers—in this sense it is modular—but then force suppliers to co-locate with their assembly plants. In many respects it is design work that ties the production network together. Because the suppliers are increasingly responsible for the design of large sub-systems of the car, a high degree of interdependence is created between the assemblers and the large suppliers: the assemblers cannot easily build a particular model in a new location without the suppliers that were involved originally; the suppliers are driven to co-locate by their need to reach production volumes to justify the expense of development. From the perspective of Taiwan, the problem is that this highly integral system revolves around the exact weakness of Taiwanese auto firms: design.

I. Theoretical Approaches to Relocation

Just as there are different approaches to development, there are different approaches to the stage that comes immediately after successful development, when the comparative advantage that has been acquired through such great effort begins to wane. One strategy, of course, is upgrading: increasing technical capabilities so as to be able to move into higher value-added activities, thereby preserving the comparative advantage of the home site. Upgrading is not always feasible, however, and when it is not, relocation becomes the primary alternative. What should be moved offshore and when?

One of the most influential models of relocation in the study of East Asian political economy has been the industry life-cycle theory. Bruce Cumings points to Japan, Korea, and Taiwan as a perfect illustration of the theory. "The cycle in given industries—textiles, steel, automobiles, light electronics—of origin, rise, apogee, and decline has not simply been marked, but often mastered in Japan; in each industrial life cycle there is also an appropriate

jumping off place, that is, a point at which it pays to let others make the product or at least provide the labor. Taiwan and Korea have historically been receptacles for declining Japanese industries."[4] In the first stage of the process, Taiwan and Korea imported Japanese products; they then began to import technology and capital goods in order to establish their own industries; and finally, having mastered a particular manufacturing process or product, they themselves began to move activities offshore. The logic is the same for both firms and leading sectors in a national economy. Both will initially export from home to meet foreign demand for a new product, but as the product matures and competition intensifies, cutting production costs becomes increasingly important. Production is gradually moved to those locations with lower labor costs.[5] The expectation is that countries on the receiving end of this investment will be able to gradually replicate the industrial structure of the "geese" flying ahead of them in the formation. Late developers should consequently have no more difficulty relocating than early developers because they have fully replicated the industrial structure of their predecessors.

Although the industry life-cycle theory captures a key dynamic driving the outward flow of investment from a mature economy, it necessarily simplifies a complicated process, and in doing so, confuses the issues facing mature late-developing countries. As Mitchell Bernard and John Ravenhill argue in their development of a regional hierarchy approach, an attempt to move beyond an industry life-cycle approach, neither Taiwan nor Korea were able to develop exact replicas of Japanese production structures. To the contrary, not only did local context (e.g. politics, history, institutional structures) affect the form of new production structures, it was also difficult to develop a single commodity in isolation. "Rather than an

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[4] Bruce Cumings, "The origins and development of the Northeast Asian political economy: industrial sectors, product cycles, and political consequences," *International Organization* 38 (Winter 1984), p. 46.

[5] The national level version of the product-cycle model, also known as the "flying geese" model, has been attributed to a Japanese economist, Akamatsu Kaname, writing in the late 1930s; the product cycle of individual products and the relationship to firm competitiveness was the focus of Raymond Vernon's work in the 1970s. Mitchell Bernard and John Ravenhill, "Beyond Product Cycles and Flying Geese: Regionalization, Hierarchy, and the Industrialization of East Asia," *World Politics* 47 (January 1995), p. 172-173.

'ahistoric' flow of a single commodity," Bernard and Ravenhill write, "contemporary production needs to be seen in terms of interrelated complexes of industrial activity involving networks of firms, and continuous innovation of a key range of inputs in a multitude of related industries."[6] The problem is twofold. First, the process of product and technological maturation that is predicted by the industry-life cycle model appears to be less and less common. "More complicated production processes, the increasing rapidity with which products are being introduced, and more complex embodied technologies that result from research and development ... have all reduced the efficacy of reverse engineering as a catch-up production strategy."[7] Second, it is not an entire production system that an advanced country such as Japan simply boxes up and ships to a low cost labor site, it is part of the system, and in most circumstances it is the labor intensive part of final assembly. The forces of innovation and the backward linkages remain behind. Rather than industries being transferred from one goose to another, it is a piece of an industry, and not all pieces are equally advantageous. The expectation is that the partial diffusion of technology will create an intraregional hierarchy of production, with the depth of the industrial foundation growing weaker at each stage. Late developers will have difficulty relocating because the “brains” of the industry are located in the countries from which they originally acquired the technology.

The commodity-chain approach in many respects follows a similar logic as the production hierarchy approach, particularly the emphasis on production networks, but extends it further: the nation-state as a unit of analysis drops out completely, and is replaced by the global commodity chain, defined as "a network of labor and production processes whose end result is a finished commodity."[8] Rather than attempting to determine

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[6] Bernard and Ravenhill, p. 184.
[7] Bernard and Ravenhill, p. 177.
[8] Richard P. Appelbaum and Gary Gereffi, "Power and Profits in the Apparel Commodity Chain," in Edna Bonacich, Lucie Cheng, Norma Chinchilla, Nora Hamilton, and Paul Ong (eds.), *Global Production: The Apparel Industry in the Pacific Rim*, (Philadelphia: Temple University Press, 1994), p. 43.

the power of different nations within a production network, this approach argues that there are different "nodes" in a commodity chain—pivotal points in the production process (i.e. supply of raw materials, production, export, marketing)—and the objective should be to understand how control of various nodes translate into power and profit. The nature of the chain becomes a key variable. Gary Gereffi identifies two distinct types: the producer-driven chain and the buyer-driven chain. While in a producer-driven chain large, integrated enterprises play the key role in controlling forward and backward linkages, in a buyer-driven chain large retailers, brand-named marketers, and trading companies control a decentralized production network often located in the developing world. The auto industry is a classic example of the former; the apparel industry is a classic example of the latter. In the apparel industry, according to Gereffi, profits and power "derive not from scale, volume, and technological advances as in producer-driven chains, but rather from unique combinations of high-value research, design, sales, marketing, and financial services that allow the buyers and branded merchandisers to act as strategic brokers in linking overseas factories with evolving product niches in their main consumer markets."[9] In other words, the key problem is not necessarily the technical dependence of late development—the expectation of the production hierarchy approach—but the dependence on markets in the developed world, and the consequent power of branded retailers. The expectation is that even though an industry might have independent technical capabilities, it will be cut out of the production network as soon as it is undercut on price by less developed locations.

II. The Taiwanese Textile and Garment Sector: Divided It Stands?

Traditionally, the textile and apparel industries have been classic bottom rungs on the industrial development ladder. Production equipment is widely available—the technical

[9] Gary Gerrefi, "The Organization of Buyer-Driven Global Commodity Chains: How U.S. Retailers Shape Overseas Production Networks," in Gary Gereffi and Miguel Korzeneniewicz, (eds.), *Commodity Chains and Global Capitalism*, (Westport, Conn.: Praeger, 1994), p. 99.

obstacles are not high—and once it is purchased, it is not difficult to reach world class production levels. In the early 1950s, in order to conserve foreign exchange and promote the development of a local industrial base, the Taiwanese government began to both restrict the importation of textile products and offer incentive and assistance to local entrepreneurs who invested in the sector. Investment increased rapidly, and it was not long before oversupply necessitated the move into export markets. Cotton spinning and weaving dominated for the first decade, but then the end of U.S. foreign aid (some of which had been in the form of raw cotton) in 1965 forced the move into the man-made fiber industry and the development of the apparel industry.[10] Open U.S. markets, experienced textile entrepreneurs who had fled communist China (and brought their production equipment with them), and good low-cost workers proved to be a winning combination in global markets. By the late 1960s, textiles were Taiwan's number one export, a position that would not be relinquished until the early 1980s.[11] This period of success not only provided firms with the financial strength that further growth would require, but also gave them critical experience working with foreign buyers.

In the 1980s, two key changes began to reshape the Taiwanese textile and garment industry: first, the cost of labor increased due to a shortage of skilled workers and the passage of a new Labor Standards Law in 1984; second, because the value of the New Taiwan dollar vis-a-vis the U.S. dollar fell from forty in 1985 to twenty-six in 1990, exports from Taiwan became correspondingly more expensive.[12] As the cost of manufacturing in Taiwan increased, textile mills began to upgrade their production facilities (in 1988, for instance, Taiwan ranked with Japan and the U.S. in introduction of advanced water-jet

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[10] Tatsufumi Yamagata, "Taiwan's Textile Industry: From Industry Promotion to Trade Friction," in R. Inoue, H. Kohama, and S. Urata (eds.), *Industrial Policy in East Asia*, Tokyo: JETRO, 1993, p. 98.

[11] San Gee and Wen-jeng Kuo, "Export success and technological capability: Textiles and electronics in Taiwan Province of China," in D. Ernst, T. Ganistasos, and L. Mytelka (eds.), *Technological Capabilities and Export Success*, London: Routledge, 1997, p. 52.

[12] Gereffi and Pan, p. 129.

looms and air-jet looms) and apparel firms began to relocate to sites with cheaper labor.[13] Taiwan's exports of apparel and accessory represented 55% of overall textile exports from 1975 to 1986, while exports of yarns and fabrics represented just over 40%. By 1992, however, exports of apparel and accessories had fallen to one-third of overall textile exports, and exports of yarns and fabrics had increased to 61%. In absolute terms, Taiwan's apparel and accessory exports peaked in 1987 (at US $5 billion), and have lagged well behind exports of yarn and fabrics since 1988.[14] By the end of the 1990s, firms involved in knitting and dyeing processes began to follow the apparel factories off-shore. Low barriers to entry in the industry, the very attribute that made it an attractive target for development in the 1950s, became a disadvantage in the 1990s. "Many customers from the United States have shifted their orders to countries with cheaper labor since the beginning of this year," explained an official of the Taiwan Textile Federation. "Southeast Asian countries can easily start up the production of woven fabrics because the level of production skills is so low. Local small and medium-sized [Taiwanese] firms that spend relatively little on R&D have [consequently] encountered severe setbacks in exports."[15]

What happens when it is no longer possible to use the home economy as an export base? The industry life-cycle approach would lead us to believe that Taiwan would be in much the same situation as a Japan or the United States.[16] In 1984, Martin Feldstein, then chairman of President Reagan's Council of Economic Advisors, explained this view in testimony before the U.S. Congress:

> The labor intensive [U.S.] apparel market cannot and should not compete with much lower cost labor elsewhere. The stuff depends on somebody sitting at a sewing machine

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[13] Gee and Kuo, p. 54.

[14] Gereffi and Pan, p. 130-131.

[15] Ben Shen, "Plants close down, move out," *Taiwan Economic News*, December 1, 2000.

[16] In fact, when Akamatsu Kaname first used the term "flying geese" in the 1930s it was in a study of the Japanese textile industry. The "Made by Hong Kong" project challenged the notion of textile / apparel being a "sunset" industry. See Suzanne Berger with David Gartner and Kevin Karty, "Textiles and Clothing in Hong Kong," in Suzanne Berger and Richard K. Lester, (eds.), *Made By Hong Kong*, (New York: Oxford University Press, 1997).

> and stitching sleeves on; it is crazy to hurt American consumers by forcing them to buy that at $4 or $5 an hour of labor. We ought to be out of that business.[17]

The very same argument can be made in the Taiwanese context: given the rising labor costs in the industry, firms should move resources out of mature industries that are prone to rising labor costs in Taiwan in order to create space for more profitable sectors. An industry life-cycle approach would expect that the decline of apparel exports from Taiwan would lead the textile and garment firms to move on to the next leading sector, and begin a new cycle. This has not happened. To the contrary, the Taiwanese firms are moving parts of the industry abroad—based on a complex set of calculations that will be explained in detail below—but retaining overall control (and often some manufacturing) in Taiwan: it is only the nationality of the workers that is different.

Independent Technology in a Modular Industry

Relocation in the textile/apparel industry is facilitated by two factors. First, the Taiwanese firms are not dependent on others for technical support. In the apparel industry the technology is not particularly complicated—the industry continues to revolve around workers sitting at a sewing machine—and in the textile industry, the Taiwanese firms have been steadily improving their production technology over the course of three decades. Because Taiwanese firms are among the world's most advanced, there are no licensing agreements or foreign partners to constrain their plans to relocate manufacturing facilities. Second, the structure of the industry is modular in that different parts of the supply chain do not have to be in close geographic proximity to each other, nor do they have to be

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[17] Cited in Frederick H. Abernathy, John T. Dunlop, Janice H. Hammond, and David Weil, *A Stitch in Time: Lean retailing and the transformation of manufacturing—Lessons from the apparel and textile industry*, (Oxford: Oxford University Press, 1999), p. 11. As late as the early 1990s, the textile/apparel industry represented the largest manufacturing employer in the United States with over 2 million workers. Dickerson, *Textiles and the Global Economy, 2nd Edition*, p. 236.

organizationally connected (either through ownership or management). Given this modularity, Taiwanese firms are able to relocate parts of the value chain that are not competitive in Taiwan without threatening their place in the overall chain: labor intensive operations move off-shore, but the Taiwanese firm remains in control over the decentralized manufacturing network. This is as true for the electronics industry (due to a similar degree of modularity) as it is for the apparel industry.

Independent capabilities in part of the overall value chain should not be confused with complete independence, however. Taiwanese firms remain highly dependent on the foreign retailers who are their primary buyers. In fact, according to the commodity chain approach, the inherent modularity of the textile/apparel sector also creates a vulnerability for Taiwanese firms. Gereffi and Pan, for instance, describe how Taiwanese firms are transformed from exporters into intermediaries in a "triangular manufacturing network": a foreign buyer places orders with a Taiwanese firm with which it has had a long-term relationship, this firm then issues the manufacturing orders with offshore factories (that it either owns or contracts), and the final goods are then shipped to the foreign buyer.[18] Although relocation buys some time for the Taiwanese firm, the brand-name retailer will ultimately have little loyalty when lower costs manufacturing sites—or the locally-owned factory down the street—raise their capabilities. "When that happens," Gereffi and Pan argue, "[Taiwanese] employers as well as workers in Taiwan's garment companies will be looking for new jobs."[19] According to this perspective, cost-cutting through relocation provides only a temporary source of comparative advantage for the Taiwanese firm.

Integral Links in a Modular Industry: The Need to be Indispensable

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[18] Gary Gereffi and Mei-lin Pan, "The Globalization of Taiwan's Garment Industry," in Edna Bonacich, Lucie Cheng, Norma Chinchilla, Nora Hamilton, and Paul Ong (eds.), *Global Production: The Apparel Industry in the Pacific Rim*, (Philadelphia: Temple University Press, 1994), p. 127.

[19] Gereffi and Pan, p. 144.

In focusing on the vulnerabilities that are created by the modular nature of the textile/apparel sector, however, the commodity chain overlooks the flip side of the coin: the industry has become increasingly modular because advances in the use of standards, information technology, and supply chain management have increased the ability of firms to coordinate far-flung production networks.[20] In other words, the supply chain may be highly modular in terms of geography and organizations, but it is becoming increasing integral in terms of the electronic interfaces that link together pieces of the supply chain.[21] While a Taiwanese firm that relocates simply to access low cost labor is indeed pursuing a fragile source of comparative advantage, the firm that has the capability to manage an increasingly sophisticated supply chain is not. The objective must be to combine relocation with upgrading: the former is necessary to lower labor costs, while the latter is required in order to maintain a degree of comparative advantage over low-costs competitors. Firms must take full advantage of geographic modularity—the characteristic that allows the Taiwanese to escape high costs at home—while seizing every opportunity to increase the "stickiness" of the links that integrate the value chain.

The primary opportunity is created by the move toward "lean" retailing. Until the mid-1980s, relations between firms within the textile and apparel sector were arm's length relationships between relatively autonomous firms. In the mid-1980s, however, technological and market changes led giant retailers such as Wal-Mart to transform the relationships between the production, distribution, and retailing parts of the commodity chain. As Abernathy, Dunlop, Hammond, and Weil (1999) describe, Wal-Mart, among others, insisted "that suppliers implement information technologies for exchanging sales data, adopt standards for product labeling, and use modern methods of material handling that assured customers a variety of products at low prices.... These new practices—which

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[20] I'm indebted to Tim Sturgeon for this point.

[21] In distinguishing between the different aspect of modularity, I follow Charles H. Fine, *Clockspeed: Winning Industy Control in the Age of Temporary Advantage*, (Reading, MA: Perseus Books, 1998), p. 136-137.

[the authors] call *lean retailing*—have compelled apparel producers to reorganize the manner in which they relate to retail customers, undertake distribution, forecast and plan production, and manage their supply relations."[22]

The impact of information technologies on certain segments of the apparel industry is profound primarily because of retailers desire to develop supply relationships based on a rapid replenishment system. Firms in many sectors hold the objective of keeping inventories low, but it is particularly important in the apparel industry because of the risk associated with fashion trends. A particular fashion item must be developed and manufactured months before the season in which it is sold, and if it does not sell, the retailer is forced to gradually decrease the price until the inventory begins to move. In 1985, the cost of markdowns in the U.S. apparel industry was estimated to be $25 billion.[23] If, on the other hand, an item does prove to be popular, the retailer wants to be able to replenish its stocks as rapidly as possible so as to take full advantage of an all too fleeting fashion trend. The objective of lean retailing is to reduce the risk of selling a perishable good by continuously adjusting the supply of products offered to consumers at retail outlets so as to match the actual level of market demand.[24] Bar codes, computer technologies, modern distribution centers, and the promulgation of standards across firms, enables lean retailers to transform the relationships between firms within the textile/apparel sector. Where there were once arms-length relationships, with suppliers being nearly interchangeable, the relationships are coming to be highly integrated by both information technologies and standards. In many respects the boundaries between firms have become blurred: sales information at the retail store is sent directly to the garment factory, the factory produces clothing ready to place on the shelves at the store, the distribution system facilitates rapid

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[22] Abernathy, Dunlop, Hammond, and Weil, p. 3.
[23] Abernathy, Dunlop, Hammond, and Weil, p. 48.
[24] Abernathy, Dunlop, Hammond, and Weil, p. 55. See also Dickerson, *Textiles and the Global Economy, 2nd Edition*, (Englewood Cliffs: Prentice Hall, 1995), p. 471-2.

delivery. The ideal is to have a system operating so smoothly that it is almost as if the factory is hidden away in a back-room of the retail store.

The increasingly high-tech nature of the textile/apparel industry creates opportunities for Taiwanese firms because the emphasis of the entire chain shifts from achieving cost reductions through savings on labor costs (a primary weakness at home) to more effective management of the chain and the consequent ability to more effectively match supply to market demand (a potential strength). Effective value chain management has the capacity to produce savings that dwarf the gains to be had by cutting labor costs by a few cents—or even dollars—an hour.[25] Taiwanese garment production will inevitably relocate to regions with lower labor costs, but the home firm, rather than becoming a middleman that is expendable in time, has the potential to become the key force behind a smoothly operating, high-tech commodity chain: small, local firms in Southeast Asia or mainland China may be able to undercut a Taiwanese firm on labor costs, but they are unlikely to be able to make the investments in electronic data interchange that make rapid response possible. In short, being able to handle electronic orders from buyers, effectively forecast, plan, track production, and manufacture apparel quickly and flexibly, are skills that provide a far more enduring form of comparative advantage for Taiwanese firms than constantly scouring the globe for the lowest cost labor.

Taiwanese textile and apparel firms have been struggling to exploit these changes, usually under intense pressure from customers. For both textile and apparel firms the challenge is to shorten the lead time from order to delivery. In the past, the manager of a textile firm commented, importers ordered fabric in large quantities—volume was king—but the movement towards rapid response has led them to pressure textile companies to reduce prices, produce in smaller batches, deliver with shorter lead times (monthly), and to develop new fabric designs on their own.[26] The calculations of apparel firms are more complex

[25] Abernathy, Dunlop, Hammond, and Weil, p. 11.

[26] Firm interview, November 16, 1999. Similarly, the manager at another textile firm said current time between order and delivery was 75-90 days, and the objective for the near future was to cut this time in half. Firm interview no. 011700.

because they must take into account labor costs, quotas, and proximity to market. Labor costs generally lead firms to mainland China and Southeast Asia. Firms that have multiple manufacturing locations—and most large firms do—keep careful comparative records of both labor costs and labor productivity in each of their factories, and the differences between locations are huge.[27] Quotas and proximity to the U.S. market for rapid replenishment, however, lead firms to Mexico, Central America, and the Caribbean basin. As another manager explained, not only is his Mexican factory within NAFTA, but he can calculate delivery time to the American buyer in terms of hours. Because the same delivery from China would take weeks, U.S. buyers were exerting strong pressure for manufacturers to establish Mexican factories.[28]

No matter what the reason for relocating, however, managing a network of widely dispersed factories effectively requires the utilization of advanced information technologies. A company with operations in Taiwan, China, and Mexico, for instance, receives orders from U.S. buyers in the New York office, and decides what factory will fill the order by calculating quality ratings for the factory (provided by the Taipei office), quota availability, costs, and delivery time. Like many companies, it retains one factory in Taiwan (used for new customers and rapid turnaround), owns several factories overseas, and has the ability to outsource to overseas contractors. Using technology purchased from the American software giant Oracle, the company is in the process of developing a Web-based order and inventory management system that will allow better communication between New York-Taipei-China-Mexico, and will allow the customers to track the progress of their orders. In

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[27] The labor costs of one firm, for instance, were reported (in US $) to be $800/month per worker in Taiwan, $100 in a coastal province of China, $30-40 in Indonesia,[27] and $50-60 in Cambodia. Productivity also varied. Using the Taiwan productivity rate as an index of 100, China was a 95, Indonesia 40-45, and Cambodia 55-60. Some described conducting careful time and motion studies on their workers in the hope of achieving further productivity gains. Firm interview no. 111899.

[28] While information technologies facilitate the division of the textile/apparel value, the need to shorten lead times encourages the integration of activities in the off-shore location. Taiwanese firms locating in off-shore locations are increasingly forced to integrate into upstream activities because: 1) they can not find local firms that meet their performance standards; and 2) using home suppliers makes rapid response impossible, and consequently defeats the purpose of being close to the customer. Many firms take on activities off-shore that they do not perform at home.

fact, the size of the company's investment in software development (currently 80 people) has led it to start selling software to other Taiwanese apparel companies.[29]

In numerous cases, buyers are forcing the Taiwanese manufacturers to develop computer links that would enable the buyer to track their orders electronically. One firm, for instance, was in the process of installing a system provided by the German software giant SAP that would allow the "live" tracking of orders. A CAD design system allows the buyers in the U.S. to send the master garment patterns to the Taiwan headquarters via the internet, where the production patterns for the various garment sizes are set, and then sent on to the offshore manufacturing facility where they are finally printed on paper using a plotter.[30] At each step in this process, the buyer has the ability to check on the progress of the order. Although the Taiwanese firms sometimes were reluctant to open up their operations to their customers in this way, many believed that in the end, the improved logistics would allow them to significantly improve their own operations. The sophistication of these technology linkages provide Taiwanese firms with an important edge over local companies in countries such as China and Cambodia. Each individual factory may be fairly traditional in terms of the technology deployed on the factory floor—and not too different from the locally owned factory next door—but the network of factories is distinctly high-tech.

Although more speculative, and perhaps wishful thinking, it is possible that political trends could also reinforce the need for stability across the different part of the apparel value chain. In particular, the focus on labor conditions among student organizations and labor organizations in the United States has forced brand-name retailers to concern themselves with the conditions in factories that previously were only the distant parts of a long

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[29] Firm interview no. 011700.

[30] Firm interview no. 111899. In a similar example, the Chia Heir Group, a leading textile manufacturer, cooperated with Computer Associates International, a provider of e-business solutions, to construct a business to business platform for the textile industry. The cooperative effort was subsidized NT $12 million (US $387,000 at US $1:NT$31) by the Industrial Development Bureau of the Ministry of Economic Affaris. Ben Shen, "CA Builds B2B Platform for Taiwan's Textile Industry," *Taiwan Economic News*, October 17, 2000.

commodity chain.[31] This trend gathered power with the reports in the early 1990s concerning working conditions in Nike factories in Vietnam. Scrutiny than began to focus on other highly visible brands such as the GAP and Kathie Lee Gifford. In effect, the brand power of these companies—the very element which the traditional commodity chain literature believes should give these companies great power within the chain—becomes a vulnerability, and the more famous the brand, the more attractive the company became for protesters. Just as the desire for lean retailing has led many retailers to move away from arms-length relationships with suppliers, fear of political controversy has also led them to sponsor the monitoring of working conditions in factories that previously would have only been distant names on a shipping crate.

It is the lengthy approval process for new factories that can create an opportunity for Taiwanese firms. In the late 1980s, the GAP had a waiting list of "tested" potential factories, and production could be shifted at any time between factories that had the requisite mix of labor, quality, and turnaround time.[32] The intense focus on labor conditions a decade later, however, has made the process that factories must go through in order to become suppliers for a brand-name retailer longer, more complicated, and more expensive for the retailer. Consequently, the cost of switching away from approved and proven suppliers has increased. The manager of one Taiwanese firm, a major supplier to the GAP, described how the GAP monitored every aspect of labor and living conditions in the factory complexes of its suppliers. Because it is not easy for the GAP to build this sort of relationship—often the approval process takes 2 to 3 years—they want to maintain long-term relationships with suppliers, and they are willing to pay well to do so.[33] If Taiwanese firms can prove that they are more reliable on providing the type of factories that the politics of the final market necessitate, they will have an advantage over less reliable suppliers, even

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[31] See, for instance, Liza Featherstone, "The New Student Movement," *The Nation*, May 15, 2000.
[32] Appelbaum and Gereffi, p. 58.
[33] Firm interview no. 111899.

when these alternatives are less expensive. On the other hand, as the pool of approved factories increases and the interfaces to IT systems become more standardized (e.g., via the Internet), switching costs could fall.

In any case, comparative advantage of Taiwanese firms could increasingly be located in managing a global network of factories for retailers who are willing to pay a premium to get the work done effectively. Not only could Taiwanese firms become less likely to be cut-out of the value chain, but they could gain an extremely useful method of smoothing variability of demand. When they own factories both at home and abroad in addition to having contract relationships with other overseas factories, they have the ability to move orders around the network, and if work begins to dry up they can cancel the contract relationships while protecting the wholly-owned factories. The global network allows them to protect the home base.[34]

III. The Taiwanese Automotive Sector: Head-to-Head Competitor or Team Player?

Although hardly a global player, the automotive industry plays an important role in the Taiwanese economy, and in contrast to the textile and apparel sector, domestic output and employment have actually grown over the past decade. Between 1989 and 1999, auto sector output increased from $4.7 to $9.1 billion U.S. and employment from 66,000 to 76,000.[35] The growth of finished vehicle production is limited by the small size of the market, so most of this growth has been to supply the international market for aftermarket

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[34] Of course, the home base is considerably smaller than it once was due to the shortage of workers and labor costs. But as the president of one of Taiwan's top apparel companies explained, they may be forced to further reduce the number of workers in Taiwan, but they would not eliminate the home factories (like some of their competitors have done). If the "mother" company dies in Taiwan, he said, so will the "child" companies abroad. Firm interview no. 111899.

[35] Teresa M. Lynch, "Leveraging Capabilities: Models of Foreign Production in the Taiwanese Automotive Industry," MIT IPC Working Paper, December 2000, p. 3. As Lynch notes, the Taiwanese auto industry accounted for 1.3% of total employment in Taiwan in 1998; the comparable percentage in the U.S. for the same year was 1.0%.

parts. In 1992, local demand for finished vehicles was 450,000 units and this was divided between 11 assembly plants. By 1999 this figure had grown to only 500,000. Although two firms, Yulon Motors and China Motor Company, had a combined market share of 47% in 1999, the production volumes of each individual plant were still too low to capture economies of scale, and this has limited their ability to become internationally competitive. In addition to the assembly firms—all of which have foreign partners—and their first tier suppliers, there are over 1,500 small supply firms, and they play a key role in the Taiwanese automotive sector. Suppliers are often family-owned businesses that either do dedicated work for one or two first tier clients, or focus on the aftermarket. Taiwanese auto firms are a major exporter of aftermarket parts.[36]

When discussing strategies of globalization in the auto sector, it is important to distinguish between the assembly firms in Taiwan and the aftermarket firms. For the assemblers in Taiwan, the primary objective was to expand their market, and the obvious strategy was to go to mainland China—not an uncommon strategy among automakers. When the first foreign auto firms established operations in China during the mid-1980s, the intent was to take advantage of high tariff walls to gain a foothold in a potentially critical future market. As auto firms have usually done in emerging markets, an older model was manufactured at first using imported components, and through the gradual development of local suppliers, the process was gradually localized according to the dictates of Chinese law for local content. Both quality problems and high costs (in part a result of operating at low volumes) effectively precluded exporting cars manufactured from China. Many manufacturers were content to carve out a regional niche—usually with the help of the protectionist policies of a local government—and because the sale price of these vehicles was set at an artificially high level, some could do so quite profitably. Shanghai

[36] In 1996, Taiwan exported US $2.5 billion of autoparts. It was the second largest exporter of autoparts in Asia (after only Japan). Francisco Veloso and Jorge Mario Soto, "Incentives, Infrastructure and Institutions: Perspectives on Industrialization and Technical Change in Late Developing Nations," *Technological Forecasting and Social Change* 66, 2001, p. 87-109.

Volkswagen, the dominant player in the market, reported total profits of over 3.5 billion renminbi (just under US $500 million) in 1996.[37] Market potential was enormous in the long-run, but in the short-term most manufacturers had to content themselves with being the beneficiaries of a protected market.[38]

It was the potential for higher volumes—even if in the distant future—and the artificially high profits of a protected market that attracted one of the largest Taiwanese auto firms to the mainland. In 1994, explained a manager at the firm, executives at his company decided that only through foreign investment would the firm be able to achieve the threshold volume of 300,000 vehicles per year that it believed was necessary to be a viable independent auto firm.[39] If China had been an open market, he commented, his firm would not be able to compete, but hopefully continued protection would allow them to get their foot in the door. Only 50/50 joint venture (JV) assembly projects are allowed in China, so the Taiwanese firm searched for a local partner that would give them 100% operational control in exchange for the investment capital. Ultimately, a coastal province in the south was chosen which had virtually no local auto industry. Aware of how much money regions such as Shanghai were making from motor vehicle production, the provincial government was eager to develop a local auto firm.

The relocation strategy utilized by the Taiwanese firm was simply to reproduce its supply network in the new location. This was necessary both to conform to Chinese domestic content regulations and to lower costs—importing a part increased the price by

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[37] *Qiche Gongye Guihua Cankao Ziliao* (Tianjin: Zhongguo Qiche Jishu Yanjiu Zhongxin, 1997), p. 80-81.

[38] Protection existed at both the international and the local level. Local protectionism created an incredibly fragmented market. In 1995, total vehicle production in China was 1.45 million, but because this volume was spread over some 122 assembly plants, the annual average volume per firm was only 12,000 vehicles. While only 15 of these firms were producing passenger cars, because total output in 1995 of passenger cars was 326,000, the average output per firm was only 21,726. Yasheng Huang, "Between Two Coordination Failures: Automotive Industrial Policy in China and Korea," Harvard Business School Working Paper, 1998, p. 3.

[39] Specifically, he commented, it was only at this level of production that the firm could afford to carry out design work on new models. Interview no. 012500.

40% (30% duty, 10% transportation).[40] The firm "persuaded" its Taiwanese supplies to co-locate with it, primarily by making future contracts in Taiwan contingent upon the supplier investing in a plant in the industrial park alongside the new China assembly plant—a common practice in the global auto industry today. Headquarters believed that it was necessary to bring their own suppliers to China not only to assure quality, but also because it would allow them to launch production of other models more quickly and easily. Managers at many of the supply firms made it clear that they were less than enthusiastic, but had little choice. Between 1997 and 1998, 30 Taiwanese component firms built wholly-owned factories in an industrial park next to the assembly plant. By 2000 these firms were supplying the JV with 80% of its parts (by value), while the remaining 20% came from 56 Chinese firms, 30 of which are Shanghai Volkswagen suppliers in Shanghai. Production began in 1996 with a few hundred cars, and by 1999 production volumes had reached 5,000 vehicles per year. The objective was to achieve volumes of 150,000 vehicles per year by 2005.

Will this relocation effort be successful? It is, of course, too early to come to any firm conclusions, but it is possible to draw out a few scenarios. There is some reason to be optimistic. In some respects, the Taiwanese firm will be doing what it has done for many years at home: taking vehicle models designed by foreign partners, adapting them to local tastes, and manufacturing them successfully at very low volumes. This experience could give the Taiwanese flexibility that larger international automakers might lack. In 1999, the total market demand for automobiles in China was 946,800 units, and according to some projections this could almost double within four years.[41] If such market projections are realized, the Taiwanese firm will only have to capture a small percentage of the market to be successful, and it should not be difficult to establish a niche that is being neglected by the

[40] Information in this paragraph is from interviews no. 012500 and no. 011900.
[41] Wang Chengtao, Chen Ming, Dennis Schuetzle, and Weiping Zhu, "An Engineering Study for the Development and Marketing of Personal Use Cars (PUCs) in China," Ford Motor Company, 1999, p. 12.

larger players—potentially a relatively low-priced vehicle that does not need frequent model changes. But there are also strong reasons for pessimism.

Dependent Technology in an Integral Industry

As Bernard and Ravenhill note in their critique of the industry life-cycle theory, it is not complete industries that are moved offshore as they mature, it is only those portions that are labor intensive or relatively lower value added. The result is a production hierarchy in which Taiwan is one step down. This is exactly what has happened in the Taiwanese auto sector: in contrast to the textile/apparel sector, Taiwanese auto firms face the severe disadvantage of technological dependence. Each of the major assemblers in Taiwan produce cars that were developed through either joint venture agreements or technical assistance contracts with foreign automakers (in most cases Japanese), and these relationships are reproduced at the supply level.[42] If the Japanese partner is Nissan, for instance, many of the suppliers will have relationships with Nissan suppliers because the technology must be compatible as the model produced in Taiwan evolves. At many of the supply firms interviewed, when the assembler required a major new component to be designed, the initial design and approval process took place in Japan, and the finished component was then sent back to the assembler in Taiwan for approval. Minor modifications could be made in Taiwan, but the components would often be sent to Japan for testing.[43] Control over basic model designs, key drive-train components, and engines effectively give the Japanese mother firm the ability to veto the export or relocation plans of the related Taiwanese firm.[44] When the Taiwanese have made efforts to develop

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[42] It is also important to point out that the Japanese partners (Nissan and Mitsubishi) are not the most competitive Japanese auto firms.

[43] Interview no. 011800.

[44] Gregory W. Noble, "Trojan Horse or Boomerang: Two-Tiered Investment in the Asian Auto Complex," Berkeley Roundtable of the International Economy, Working Paper #90, November 1996, p. 20; Teresa M. Lynch, "Leveraging Capabilities: Models of Foreign Production in the Taiwanese Automotive Industry," MIT IPC Working Paper, December 2000, p. 11.

independent technical capabilities, the Japanese partners have done everything possible to obstruct their progress.[45]

Taiwanese firms, in addition to being constrained by the need for Japanese approvals, also are hindered by their lack of cutting edge technology. In the past, when a global auto firm built an assembly operation in an emerging market, a combination of local suppliers and imported parts were used to build a model that was long out-dated in more developed markets.[46] This was the approach that was taken in China during the 1980s, and it was an environment that the Taiwanese might have done well in. They could have simply replicated their home operations in the new environment, and because the market was relatively undemanding, weaknesses on the design side would not have been a problem. Unfortunately, this is no longer the case: the Chinese domestic marketplace is changing rapidly and so has the relocation pattern of foreign firms.

First, the Chinese government has continued to leverage market access in exchange for increasingly sophisticated technology. In the auto sector this meant that new entrants—General Motors and Honda being the most prominent—had to bring their most recent models and technology. Manufacturers still had the cushion of high final sale prices relative to world markets (due to tariff barriers), but they were forced to manufacture cars at a new level of quality and technical sophistication. Second, and reinforcing this trend, the prospect of Chinese entrance to the World Trade Organization (WTO) has brought the realization that domestic manufacturers in China will soon have to be able to compete without the benefit of high tariff walls. Chinese tariffs on imported components will be reduced from the current 28% to 10% by 2005; Chinese tariffs on imported vehicles will be

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[45] This refers to the consortium of Taiwanese firms organized (and subsidized by the government) to design a common engine. According to the project director, "The Japanese did everything they could to stop us." Quoted by Noble, "Trojan Horse or Boomerang: Two-Tiered Investment in the Asian Auto Complex," p. 20.

[46] It was the need to use local suppliers and the uncertainty over future viability of the market that led auto companies to traditionally assemble older models in emerging market operations. Old equipment could easily be transferred from the home country, and it was generally easier to find local suppliers in the host country for parts that were not as technologically advanced.

reduced from the current 80-100% to 25% by 2006. Local content regulations will also be eliminated. The MNC assemblers operating in China will most likely use suppliers operating in China (whether local or foreign) when they are competitive, but if they are not, they will import. The result should be a gradual degree of convergence with international standards, both in terms of quality and price, that was not possible in a closed system.

For Taiwanese auto firms, on the one hand, this convergence presents a real problem. Taiwanese firms that relocate to the mainland usually do not have well developed design capabilities at home, let alone at their offshore facilities, and shifts to new models ultimately have to be approved in Japan.[47] In that Taiwanese auto firms cannot compete with these global players in their home market, it will be even more difficult to do so in a foreign setting. For multinational auto firms, on the other hand, convergence is not a problem. In part this is because they already possess the latest technology, but also because the primary mode of relocation has shifted substantially from the days when emerging markets were thought to be convenient warehouses for obsolete equipment and models. The most dramatic change has been the increased utilization of first tier global suppliers, those with the capability to coordinate and deploy component manufacturing where ever a new assembly plant is established.[48] Assemblers ask these global suppliers to not only provide complete modules and sub-systems, but to cooperate in the design process as well. This trend has led towards both a consolidation of the supply chain—as first tier suppliers seek both to broaden their geographic reach and to gain module and systems capability (i.e. capabilities that will allow them to provide an entire module or system rather than just a

[47] The design capabilities of Taiwanese firms vary, but the R&D divisions are invariably small in comparison to their Japanese counterparts upon whom they must heavily lean. At one components firms, which was a JV with a Japanese company, The R&D section consisted of 23 people, and was directed by a Japanese manager. In Japan, the partner had a 900 person design group. Interview no. 011800.

[48] Sturgeon and Florida, "The World that Changed the Machine: Globalization and Jobs in the Automotive Industry," Final Report to the Alfred P. Sloan Foundation, May 5, 1999, p. 6.

particular component)—and an increasingly integral supply chain.[49] Not only do suppliers want to maximize their customer base so as to maximize production volumes, but assemblers force them to co-locate whenever a new assembly plant is established (particularly in that only that supplier will have the design capability for a given component).

This new model of relocation gives the MNCs distinct advantages. First, assuming that the global suppliers co-locate with them, the MNCs can increase the quality of production at offshore sites more quickly than in the past. Rather than go through the laborious process of developing local suppliers, they simply have to wait for the global suppliers to begin production, and they are then assured of quality and service at a consistent level. In that a primary criteria for becoming a global supplier is to have a design center close to the design facilities of the assembler, it is also easier to rapidly develop new models. The supplier becomes involved at the earliest stages of the design process, and this highly cooperative relationship can both speed up the design process and facilitate the customization that may be necessary to make a particular model more appropriate for an overseas market. Finally, in contrast to the past, when offshore manufacturing sites often struggled to meet the standards of the home company, assemblers currently are able to develop their most advanced plants abroad—often in the developing world. Without the restrictions of unionized labor, old-line management, and aging plant and equipment these operations provide opportunities to experiment with new and innovative production techniques.

In short, when Taiwanese auto firms relocate beyond the protected home market, the industry's technological dependence severely limits their ability to compete with the world's top auto firms. In the short term the Taiwanese may be able to take advantage of protected markets in China to increase their production volumes, but as barriers to trade within China decrease, these gains will vanish: if relocation does not create any new comparative

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[49] Sturgeon and Florida, p. 68. "In the long run," write Sturgeon and Florida, "it may well be suppliers, not automakers, that generate the vast majority of the industry's future foreign direct investment (FDI)—and associated economic and social benefits (e.g. employment)." Sturgeon and Florida, p. 2.

advantage, there is no reason to believe Taiwanese firms will be able to compete any more effectively offshore than they do at home.[50]

Modular Opportunities in an Integral Industry: Looking for that Niche

Rather than trying to compete head-to-head with the major global auto companies, an alternative strategy would be to integrate into the global production networks. The Taiwanese textile/apparel and electronics sectors provide evidence that a certain degree of dependence does not necessarily preclude successful relocation. Firms in these sectors are not competitive in all aspects of the value chain. Western firms dominate the retail business, and continue to exert strong leverage as buyers. Given the inherent modularity of the value chains in these sectors, however, Taiwanese firms have been able to pick the activities in which they have a comparative advantage (while avoiding those in which they do not) and ruthlessly exploit these advantages. When firms in these sectors relocate, they do so as part of a global logic. They may only do a few activities, but what they do is done well. The challenge for these firms is to increase the integral links that connect them to buyers so as to avoid being cut-out of the supply chain.

In the auto industry, it would not be easy for a Taiwanese firm to become a global supplier. Although auto manufacturing is increasingly modular—in that assemblers outsource large sub-systems of the car—the first tier suppliers are almost as sophisticated as the assemblers in terms of resources and design capability, and Taiwanese firms simply would not have the technical capabilities. They might, however, be able to achieve more modest goals. Could Taiwanese auto firms take the team player approach of the textile/garment sector? One strategy would be to integrate more closely into the regional

[50] This pessimism might be unwarranted if the Taiwanese can develop a market niche in low-end models (which the Fujian project is trying to do). Up to this point, most foreign auto maker have produced luxury cars which are out of reach of the vast majority of the population, thus creating an opportunity for a high-quality, yet inexpensive car. The window of opportunity seems to be closing, however, as many JVs are now preparing low-end models.

production networks of the foreign firm with which they are either owned or partnered. Rather than reproduce facilities in an offshore location, they would work in concert with factories that are in the network of the foreign partner through means of a "regional complementarity" scheme. ASEAN, for instance, has had formal "complementarity" schemes since 1983, all based on the idea that the only way to generate and exploit firm and industry level economies of scale is to institute programs of resource-pooling and market-sharing among member states.[51] Given the small size of member countries, complementarity schemes are developed that allow components manufactured in one country to supply assemblers in any other member state at favorable terms of trade as long as inter-ASEAN trade among the trading companies remains balanced overall. These schemes can also be informal in nature, involving trading between the various facilities of one company. An engine manufactured by a plant in Thailand, for instance, might be traded for a transmission manufactured at a plant in Indonesia. Both plants achieve higher economies of scale than if they were producing for the local market alone. Japanese firms have been the most active participants in complementarity schemes in Asia, but American participation has been increasing.[52]

A second approach would be to tie into the lower tiers of supply networks. While a Taiwanese firm would rarely have the design capability to be a first tier supplier, many could become important players in lower tiers. Indeed, this is an alternative relocation strategy that many Taiwanese auto firms are employing with some success.[53] In China, local protectionism led to closed supply networks in the past, but increasing competitive pressure is beginning to force these networks open. The strategy of several Taiwanese firms has

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[51] This discussion of complementarity schemes draws on Tim Sturgeon, Appendix to November research notes.

[52] Not only are there abundant opportunities for complementarity schemes, but the Taiwan operations can in many respects be a model for the region. The "high complexity, low volume" production methods of Taiwan, where 4 or 5 different models can be built on the same assembly line, are more appropriate for small markets than the American methods.

[53] On the divergent strategies of Taiwanese auto firms, see Teresa M. Lynch, “Leveraging Capabilities: Models of Foreign Production in the Taiwanese Automotive Industry,” MIT IPC Working Paper, December 2000.

been to establish competitive manufacturing operations in China based initially on exports, and position themselves to acquire new business as first tier suppliers are forced to lower their costs. Alliances with foreign firms are sometimes utilized as well: one supplier has established a joint venture with Johnson Controls, a US-based global supplier, in order to gain access to the General Motors purchasing network both in China and globally.[54] In contrast to assembly firms that simply duplicate their Taiwan operations in the offshore locations, smaller supply firms are also using relocation as a means of both compensating for weaknesses in the home location. One company, for instance, opened a factory in Wuxi primarily in order to access engineering talent. In Taiwan, it is not only difficult to find engineers willing to work in manufacturing—as one manager commented, "it is hard work and most would rather be in the information technology industry"—but they are far more expensive than on the mainland. In Wuxi, the quality of engineers is comparable to Taiwan, and the total cost is one quarter. One half of the design work performed by the Wuxi plant is done for the home Taiwan plant, hence relocation not only creates new market opportunities, but also lowers costs for the home operations and allows its engineers to focus more exclusively on higher end design work.[55]

IV. Conclusion

The auto, textile, and apparel sectors are "traditional" in the sense that the primary advances are well established. In the auto industry, mass production techniques gave American firms an enduring comparative advantage beginning in the 1920s and 30s; "lean" production gave Japanese firms a similar advantage beginning in the 1970s. In the apparel sector, the heart of the production process still involves a person at a sewing machine. The absence of dramatic change in final assembly processes, however, should not be confused

[54] Firm interview no. 071100b.
[55] Firm interview no. 071100a.

with the absence of change. As I have argued in this paper, there continues to be change, but primarily in the global organization of manufacturing industries. To think of the manufacturing processes as traditional is to risk obscuring both the opportunities and the dangers that firms from late developing economies face as they seek to relocate manufacturing facilities off-shore.

First, moving manufacturing operations offshore in order to lower costs is not a long term solution to declining competitiveness at home. Given rising labor costs and labor shortages at home, Taiwanese firms certainly must seek to lower the cost of labor, but an exclusive focus on the price of labor provides only a temporary advantage[56], and may be detrimental in the long term.[57] In part, this is because there will always be producers with lower costs pressuring the Taiwanese firms: as Gereffi and Pan argue, the role of a middle-man in a triangular manufacturing system is an unstable one. Unless a firm is prepared to relocate as soon as labor costs in a given location begin to rise, it will repeatedly find itself vulnerable to price pressure from below. Even more importantly, however, an exclusive focus on labor costs may leave Taiwanese firms ill-equipped to deal with what may prove to be the more dangerous competition: firms that have an expertise in utilizing the information technology necessary to effectively manage the individual components of a modular supply network. If this is the case, the challenge will not be from low cost producers in Southeast Asia and China, but firms in Hong Kong, the United States and Europe;[58] firms that according to the traditional industry-life cycle logic should have nothing to do with

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[56] This is a point that was made by the "Made by Hong Kong" study team as well. See Suzanne Berger with David Gartner and Kevin Karty, "Textiles and Clothing in Hong Kong," in Suzanne Berger and Richard K. Lester, (eds.), *Made By Hong Kong*, (New York: Oxford University Press, 1997).

[57] In this respect, it is interesting to note that China, with its seemingly unlimited supply of cheap labor may obscure the need for Taiwanese firms to focus on other factors. In interviews with Taiwanese firms in Mexico, it became apparent that the reference point of China made it difficult for Taiwanese managers to adjust to the problems of a Mexican workforce. Rather than focus on the advantages of being in Mexico—the possibility of rapid response—and attempt to find new ways of managing Mexican workers, some managers were simply in despair (one going so far as to claim the only solution was to fly in Chinese workers).

[58] I owe this point to Tim Sturgeon.

manufacturing operations. Meeting this challenge requires relocation combined with upgrading. Firms must take advantage of the modular nature of the textile/apparel value chain in order to lower costs, but they must also seek to increase the "stickiness" of the connections between the pieces of the chain by focusing on electronic linkages and standards.

Second, the contrast between the Taiwanese textile/apparel and automotive sectors illustrates the importance of controlling the core technologies of an industry. Unlike textile/apparel firms, Taiwanese auto firms are often dependent on Japanese partners for technology, and this dependence limits their ability to compete in the markets to which they would like to relocate. While the textile and apparel firms have the ability to relocate parts of their operations so as to reinforce the strength of the parts that remain in Taiwan, the auto firms that relocate duplicate the weaknesses of the home firm because they are still ultimately dependent on the Japanese. Why the contrast? One answer might be that the technical hurdles were higher in autos than in textiles/apparel. While this is true, it would hardly explain why Taiwanese firms have become so dominant in the high-tech industries. What distinguishes both the textile/apparel and the high-tech sectors is their increasingly modular nature: Taiwanese firms are able to specialize on a narrow piece of the overall value chain and establish their dominance. In the auto industry, by contrast, the integral nature of the design process makes this much more difficult; a firm is either an assembler that must control design for a complete model or a global supplier that has to cooperate on design with the assembler and supply it world-wide. Without a domestic market large enough to justify extensive R&D expenditures, the Taiwanese auto firms were forced to rely on the Japanese.

How can a developing country gain control over the core technologies of manufacturing industries? Countries with large domestic markets, of course, have leverage that can be exerted over foreign investors, and countries such as China have not hesitated to do so. Countries with less leverage, however, must be more strategic. This might translate

into being less ambitious—choosing industries that have lower technical hurdles—but it does not have to. The alternative is to seek a small niche initially, and then gradually expand from an area of strength, much like Taiwan did in the electronics and textile/apparel sectors. As codifiable design process, product and component standardization, and increasingly sophisticated electronic interchanges encourage value chain modularity, barriers to entry will decrease for firms in developing countries provided they can meet the standards of the lead firms.[59] It becomes possible to concentrate resources in the most suitable niche.

In effect, the organizational changes that result from new information technologies and standards subvert the classic "big push" logic of late development. Industrialization, according to this logic, must proceed simultaneously among multiple fronts because of the inherent complementarities and indivisibilities of economic processes.[60] The capital intensity of the process became the justification for an active state role; the presence of early developers was the justification for infant industry protection. In a world where economic processes are global in scope and increasingly divisible, however, it is both more difficult to match the resources of a global network (e.g. in the auto industry) and more possible to become a part of a network. But the same features that create opportunities for developing countries to become integrated into global networks—the increasing use of information technologies and standards—also make it easier for them to be replaced. The objective is to take advantage of modularity, but then proceed to reinforce the "stickiness" of linkages within the chain. The policy prescriptions of a "little niche" world are very different than a "big push" world: rather than pursue grandiose industrial policies, government agencies should provide market advice (i.e. sponsoring trade fairs, facilitating relations with buyers, etc.) and work to develop and disseminate new technologies and production techniques

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[59] See Timothy J. Sturgeon and Ji-Ren Lee, "Industry Co-Evolution and the Rise of a Shared Supply-base for Electronics Manufacturing," paper presented at the Nelson and Winter Conference, June 12-15, 2001.

[60] For the classic version of this argument, see Alexander Gerschenkron, *Economic Backwardness in Historical Perspective*, (Cambridge: Harvard University Press, 1966), p. 11.

within and between sectors. It is a more modest approach, but one which will hopefully lead to a durable comparative advantage.