

HIGH-TECH AND LABOUR IN THE ASIAN NICS

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The Industrial Evolution of the Asian NICs

The role of South Korea, Taiwan, Hong Kong and Singapore in the international division of labour has changed dramatically in the past decade. In the 1970s, these four economies, commonly referred to as the Asian NICs or newly-industrialising countries, exported a narrow range of labour-intensive manufactured goods to industrial countries. Since the late 1970s, rapid technological upgrading, induced mainly by market pressures and, in the case of South Korea, Taiwan and Singapore, strongly supported by activist government policies, has transformed these countries into competitive exporters of a wide range of manufactured products including semiconductors, computers, machine tools, audio and video equipment, and automobiles. They have made this transformation while continuing to dominate export markets for low-technology products such as garments, footwear, toys and household appliances.

In recent years, economic success has created new challenges for the Asian NICs. Domestically, all four are running short of unskilled labour, making it difficult for them to remain competitive in low-technology industries. Internationally, they are under pressure, especially from the United States, their largest trading partner (with whom their combined trade surpluses matched that of Japan in 1987), to quicken the rise in their appreciating currencies, and have already lost their eligibility for GSP access to the U.S. market. South Korea and Taiwan are also being pressured to open up their protected home markets faster and wider. All these problems of success are causing a restructuring of manufacturing industries. Many local and foreign firms in the NICs are relocating their

labour-intensive operations to more labour-abundant countries in neighboring Southeast Asia, while automating their operations and shifting into higher-value product lines in the NICs themselves. A few indigenous firms have located production in developed country markets to avoid trade barriers and improve market access and service to customers, while some have even invested in small U.S. high-tech firms to obtain a window on new technologies.

In all the NICs except Hong Kong, where the colonial government still follows a self-proclaimed policy of positive non-interventionism, the state exercises a significant influence on the industrial restructuring process. In South Korea, an activist government is facilitating the entry of Korean conglomerates (**chaebol**) into new technology-intensive industries with concessional credit and other assistance. In Taiwan, the government has identified a number of "strategic" industries, including telecommunications, computers, optoelectronics, and biotechnology, which are entitled to preferential loans and special support. Singapore, too, has drawn up a list of priority industries which include industrial electronics, precision tools, medical instruments, aircraft components and software engineering, which will be given generous investment and training incentives. Though their lists of desired industries differ somewhat, government initiatives in these three NICs reflect a shared belief that the industries they are promoting should possess high-tech characteristics, that is, they should employ large numbers of research workers and engineers, and make high value-added products using cutting-edge technologies. For these countries, successful entry into high-tech industries would alleviate labour shortages, create better-paying jobs to

meet the rising expectations of their working populations, and lead to the development of exports less vulnerable to foreign trade protection.

High-tech and Labour Markets

There is no widely accepted definition of a high-tech industry. Often, the term high-tech is used not to refer to an industry, but to the application of a technology, which may be in an industry that is clearly low-tech; an example would be the use of computerised numerically-controlled devices in the machine tool and textile industries. Though high-tech industries do not constitute a distinct industrial group or employ a specific technology, they share some characteristics. They typically have fluid and dynamic structures, and in the early stages, are characterised by a large number of small innovative firms (Lim and Pang, 1985, pp. 35-37). As they mature, the weak firms are driven out, leaving a few large, specialised ones to dominate the industry. High-tech firms commit a sizeable proportion of their resources to research, development and design activities. They are high-risk, high-return ventures, with a high failure rate. Technology changes rapidly in these industries, product life-cycles are extremely short, and market demand is unstable.

High-tech industries are established first in the developed countries where they are conceived, but production is shifted quickly to lower-cost countries because of intense competitive pressures. The Asian NICs have been the main beneficiaries of this rapid internationalisation process, because of their supply of relatively low-cost and efficient unskilled and skilled labor, lower material costs, reliable suppliers and adequate

infrastructure.

Compared to low-tech and old-tech industries, high-tech industries typically require a narrower pyramid of skills, with proportionately more technicians, scientists and engineers, and relatively fewer unskilled operators. However, because these industries usually experience explosive growth in market demand, their demand for unskilled labour in absolute terms increases over time, though the relative labour content of their products may fall rapidly. Because of rapid technological change and the rising proportion of small series and customised production, automation is often difficult and/or uneconomic. Unskilled but disciplined and easily trainable labour is then crucial because it permits firms to respond flexibly and quickly to market changes. Where automation is feasible or economic, it usually makes the visual, manual, and decision-making skills of the operator less important, while raising the demand for maintenance skills and machine tenders. Firms also constantly seek to simplify manual tasks as a way of hastening retraining and minimising defects.

High-tech industries are thus characterised by competitive and fluid labour markets. Labour turnover is higher than in old-tech industries because the workforce, both skilled and unskilled, is younger, and product demand is less stable. In the United States, two additional features characterise the management style and labour-management relations in high-tech firms. First, these firms are usually not unionised, partly because they are relatively new, and employ in their blue-collar workforce a high proportion of women and ethnic minorities, groups that are harder to organise. Second, their management style is characterised by openness.

flexibility and informality. There is little emphasis on seniority and individual initiative is admired and rewarded.

High-tech and Labour Markets in the Asian NICs

High-tech industries form only a small segment of the industrial structure of the Asian NICs. But their direct and indirect contribution to the economic transformation of these countries is increasing rapidly. Of the many high-tech industries that the NICs are now promoting, none is more global in its operations or more important to the countries' industrial restructuring than electronics, a broad industry grouping that includes semiconductors, computers and peripherals, consumer electronics, industrial electronics, and telecommunications components and products.

In the past two decades, market pressures and technological changes have transformed the international electronics industry (e.g. Scott, 1986, pp. 29-33). The industry has become more diversified in terms of both products and participants, and its operations have become integrated on a global basis, with different parts of a final product being made in different countries according to their respective comparative advantage. Since the late 1970s the Asian NICs have moved rapidly away from manual assembly to machine production, from low value-added, labour-intensive products to higher value-added and skill-intensive products, and from consumer electronics and component manufacture to industrial electronics including computers, computer peripherals, telecommunications, biomedical and avionics equipment. This shift, which occurred partly in response to rising domestic wage costs and was facilitated by a growing pool of skilled

and professional manpower, has been accompanied by the rapid growth of related service and software industries. In the last few years, electronics firms in the NICs, especially those from South Korea, Taiwan, and Singapore, have begun to undertake more research and development work. South Korea, Taiwan and Singapore are also committing state resources to assist new firms engaged in the design and manufacture of customised computer chips (**FEER**, 7/1/88, 14/1/88; **AMSJW**, 18/1/88; **ST** 18/11/87).

In the 1960s and 1970s, the electronics industry in all four NICs created many new jobs, particularly for young women workers entering the labour force for the first time. Direct and indirect employment generation in this industry contributed greatly to the achievement of full employment in these countries. In the 1980s, the trend in the industry is towards mechanisation, automation, and relocation of more labour-intensive operations to lower-wage countries. This has reduced the labour content of many electronics products, but not the total demand for labour because of the phenomenal expansion in the world market for electronics products. Consequently, the electronics industry in all four countries still faces labour shortages, which have become more severe because of the rapidly falling supply of new labour market entrants, and strongly competing demand for labour from other fast-growing industries including commerce, and financial and business services.

Because their history, geography and development goals are different, the four NICs have evolved different labour market institutions and processes. Their industrial structures, including the composition and ownership of their electronics industry, are also different. Thus the

effects on their respective labour markets of a fast-changing electronics industry are dissimilar in many respects, as are their government policy responses to these changes.

In South Korea, until mid-1987 when the government acceded to opposition pressures for democratic reforms and direct presidential elections, state controls, which the government believed were crucial to its export drive, limited independent labour action. The electronics industry, together with other export-oriented industries, enjoyed industrial peace, and because labour organisations were weak, could pay wage increases that did not match productivity gains (Kim, 1987, p. 7), although industry wages were above the manufacturing and national averages (Bai, 1987, p. 17). Since mid-1987, however, the government has allowed employers and workers to settle their differences independently instead of intervening to ensure labour peace. Wages have risen rapidly, slowing the demand for unskilled labour, and accelerating the restructuring of Korean industries. With a much larger population, a much bigger pool of agricultural labour for its industries to tap, and much lower wages than the other three NICs, Korean industries have been the slowest of the four countries' to go offshore. But with strong government support and a sizeable pool of scientists and engineers -- many of them trained in U.S. institutions-- Korean firms have been aggressive in developing a competitive edge in a growing number of industries including high value-added consumer electronics, automobiles, and semiconductors.

In contrast to South Korea where the electronics industry is dominated by government-favoured home-grown conglomerates, Taiwan has an electronics

industry that is populated by large numbers of small, indigenously-owned firms as well as many large U.S.-owned multinationals. Its labour market is freer because of less direct government intervention, and more fluid and competitive because of the large number of small and flexible firms. As in South Korea, labour organisations are weak, but the labour market has favoured workers in recent years because of growing labour shortages (EAER, January 1988, p. 7).

Taiwan, responding to worldwide demand and with much less government support than that enjoyed by the Korean **chaebol**, has successfully established a computer hardware industry. In 1981, it exported only US\$104 million worth of personal computers, terminals, disk drives, printers, monitors and parts. In 1986, its exports of these items amounted to US\$2 billion, a twenty-fold increase in five years (Schive and Hsueh, 1987, p. 134). The export surge was led by both Taiwanese firms and U.S. firms that had moved their production to take advantage of Taiwan's lower costs, disciplined labour, and tax incentives. Of the Taiwanese firms, some -- like Multitech, a large computer manufacturer which employs many research workers -- were founded by academics; some evolved from firms that marketed foreign products; and a few large ones were founded with financial support from the government which enabled them to acquire technology through licensing from foreign firms. A key factor in the success of the computer industry in Taiwan is the country's growing pool of scientific and engineering manpower. This has made it possible for Taiwanese as well as foreign-owned firms in Taiwan to absorb and adapt new technologies rapidly. More recently, Taiwanese firms have begun to move away from making copies of foreign computers and parts using standard technologies to

developing and designing new high-tech products including customised chips and image scanners (**FEER**, 23/1/88). For some, a presence in the U.S. itself, including co-production with U.S. firms (for example, Multitech now subcontracts production of some of its computers to Texas Instruments), has shortened their imitation lag for new products and technologies (**BW** 8/6/87, 11/188).

Unlike South Korea and Taiwan, Hong Kong practises a free trade policy. Its colonial government does not have an industrial policy of providing tax and other incentives for desired industries. The labour market is free, with wages changing rapidly in response to market conditions. The electronics industry contains many under-capitalised, small, local entrepreneurial firms as well as a growing number of large Japanese and U.S. multinationals. In response to rising wages and labour shortages, Hong Kong entrepreneurs have improved their production efficiency, introduced new higher value-added product lines, and relocated labour-intensive operations in China's special economic zones. Unlike Singapore, Hong Kong has not depended on the importation of foreign labour to ease its domestic labour shortage. Compared with the other three NICs, the electronics industry in Hong Kong has fewer firms that are involved in manufacturing computers and peripherals. Its demand for engineering and technical skills has not grown as rapidly as in the other three countries.

Unlike South Korea and Taiwan, Singapore's high-tech industry is dominated by foreign firms, ranging from large European, Japanese and American multinationals with plants in many countries to much smaller firms (in terms of total corporate assets) with only one or a few overseas

plants, the Singapore plant typically being the only or largest of these. While the former, larger, firms are mostly in consumer electronics and components, the latter, smaller, firms which make up an increasing proportion of Singapore's electronics industry are mostly engaged in capital-intensive, high-value production requiring a much higher ratio of technical personnel.

Unlike Hong Kong but like South Korea and Taiwan, Singapore has an activist state (Lim, 1983, pp. 754-756), whose involvement in the labour market is greater than in the product or capital markets (Pang and Lim, 1987, pp. 20-21; Lim, 1987a, pp. 3-14). To maintain the competitiveness of labour-intensive industries following the attainment of full employment in the early 1970s, the government allowed employers to import foreign workers from Malaysia and other neighbouring countries, and established a tripartite National Wages Council (NWC) in 1972 to ensure "orderly wage increases". The NWC did its work so well that by 1979 the government acknowledged that its annual wage guidelines had resulted in the underpricing and overutilisation of labour. A three-year "wage correction" policy then introduced to "restore wages to market levels" succeeded in raising wage costs by nearly 20% a year between 1979 and 1981 (Lee, 1987, pp. 195-196; Pang, 1986, pp. 25-30).

The government also restructured the industrial relations system to decentralise wage bargaining and foster a closer identification of workers with the economic interests of employers (Lim and Pang, 1984, p. 28). House unions were formed to encourage labour-management cooperation and joint consultation at the enterprise level. Labour legislation was amended

to give employers greater flexibility in scheduling labour, a measure designed to benefit emerging high-tech industries which needed to operate 24 hours a day to maximise returns on their large capital investments. For example, employers were allowed to introduce 12-hour shifts so long as total weekly hours worked did not exceed the statutory maximum of 48 hours (Lim, 1987b, pp. 13-14).

The wage correction policy was followed by three years of market-driven large wage increases which slowed employment growth and spurred productivity growth, but by less than wages increased. Unit labour costs thus rose sharply in 1980-84, eroding Singapore's international competitiveness in many industries and its attractiveness as an investment location (MTI, 1986, pp. 41-42). High wage costs were a major cause of Singapore's 1985 recession, and their reduction through a wage restraint policy, together with other cost-cutting measures and favourable external factors (MTI, 1986, pp. 4-5), helped revive the economy in 1986 (Lim, 1987b, pp.14-17, 29-36).

The Singapore labour market is much more heterogenous, including ethnically, than those of the other NICs, and also highly segmented. Foreign labour (which cannot move freely from one employer to another without government approval) is concentrated in low-tech industry, mostly local firms where in 1985 wages accounted for about 22% of total costs. In large foreign firms the proportion is about 15% and in high-tech firms, such as those making computer peripherals, it is less than 2%. For high-tech firms therefore, wage **costs** (which in Singapore are less than a quarter of those in the U.S.) are less important than the **availability** of

labour (Lim, 1987b, pp. 49-50).

As in the other NICs, the government in Singapore seeks to alleviate the shortage of both skilled and unskilled labor by expanding education and training at home and abroad, and providing tax incentives and some capital assistance to encourage firms to automate. But only Singapore also exhorts married women to enter and remain in the labour force, encourages employers to offer them flexible working hours and in-plant child-care facilities, and has introduced generous tax and other incentives to encourage women, especially the highly-educated, to have larger families. This controversial policy is aimed at increasing not only the size of the population, but also its quality and hence the future supply of skilled labour. In the meantime, high-tech companies in Singapore, whose output growth is limited by the acute labor shortage, have embarked on aggressive recruitment campaigns, and at least one has in desperation turned to employing 14-16-year-old girls (allowed by law in "light" operations).

Though important, the availability of suitable skilled and unskilled labour is not the most critical factor influencing high-tech firms from industrial countries to locate production in the Asian NICs, or permitting the rapid entry of local firms into high-tech industries. If it were, the NICs, with their growing shortages of unskilled labour in particular, would have spawned and attracted far fewer high-tech firms than they did in the 1980s. The successful establishment of both local and foreign high-tech firms in these countries is rather the result of a combination of factors, including increasing supplies of experienced skilled labour, good infrastructure and local supporting industries, easy access via modern

transportation and communications to important sources and markets (including local and Asian regional sources and markets), and proximity to other country locations which have cheap and abundant labour and can provide cheap inputs, and in some cases additional labour, for the NICs' high-tech industries. These countries thus offer considerable locational advantages to high-tech industry, especially as regional inter- and intra-industry linkages and economies of agglomeration continue to develop (Lim, 1987b, pp. 38-39).

Both foreign and local high-tech firms in the NICs have adjusted to rising market wages by relocating labour-intensive operations to neighboring low-wage countries (e.g. Thailand, Malaysia, the Philippines, China) while upgrading into more capital- and skill-intensive product lines and processes, including research and design activities, in the NICs themselves, where total costs are still highly competitive with the industrial countries. The expansion of high-tech firms with their ability to offer better wages than older low-tech firms has increased competition in the NICs' local labour markets. In South Korea and Taiwan, high-tech industry has attracted both unskilled and technical labour from other firms in the electronics industry and from other sectors in the economy. Perhaps more important, it has created employment and entrepreneurial opportunities for many Korean and Taiwanese nationals who have been trained or employed in high-tech industry in the United States. In Hong Kong, high-tech industry has drawn its workforce from new labour market entrants and older electronics firms, but not from the booming garment industry which has an older workforce.

In Singapore, unlike the other three NICs, the labour market effects of high-tech industry are much more complex because of the government's extensive labour market interventions and the absolutely much smaller pool of local labour. Although allowed to, many high-tech firms do not recruit foreign workers because of their uncertain supply and quality. At the same time, the government's prevailing wage restraint policy prevents them from raising wages sufficiently to attract all the local workers that they need, which in any case might price other firms, including their own local suppliers, out of the labour market, thereby disrupting their local input supplies and raising total input costs.

The Impact of High-tech on Labour in the Asian NICs

The pattern of employment in high-tech industry in the Asian NICs conforms to the bimodal distribution predicted for high-tech industry in general, that is, there is a simultaneously strong demand for mostly male scientists, engineers and technicians, and for unskilled or semi-skilled female production operators who are primarily machine-tenders. Over time the ratio of skilled to unskilled workers has been increasing.

There is obviously a large wage gap between these two classes of workers, but it may be narrowing or prevented from widening as the supply of scientists, engineers and technicians increases and that of unskilled female workers declines, both in absolute terms and relative to demand. In comparative terms, at least in Singapore and Hong Kong, highly-skilled employees in high-tech industry usually earn less than professional and managerial workers in other sectors of the economy, especially in financial

and business services, in part because the high-tech employees are younger and have less experience and seniority. On the other hand, low-skilled female operatives in high-tech industry typically earn wages well above local individual subsistence (e.g. Lim, 1987c, pp. 13-16), and more than similar workers in low-tech manufacturing industry and other (farm and commerce) sectors of the economy, especially in other female-intensive occupations such as garments, domestic service and commercial service (e.g. ILO/UNCTC, 1985, pp. 39-44). In part this reflects the higher productivity and profitability, and lower labor content, of high-tech firms, enabling them to pay higher wages without jeopardising their competitiveness.

Employment in high-tech industry may be more insecure than in older established industries because of rapid technological change and consequently greater industry volatility and firm turnover. But this effect is yet to be empirically proven, and may be countered by high-tech industry's rapid secular growth path, its capacity to absorb wage increases, and lesser vulnerability to protectionism than older, low-tech export industries like garments, footwear and consumer electronics. High-tech industry is also much less likely to be "footloose" than older, low-tech industries which are heavily dependent on cheap labour and country quotas in importing countries. In particular, the importance of firm-specific training and the "human capital" invested in an experienced and skilled workforce discourages firms from frequently relocating skill-intensive activities. Because of labour shortages in the NICs, relocation of labour-intensive operations and upgrading into more capital-intensive activities has usually not resulted in the shedding of

redundant unskilled labour, but rather in its retraining or diminution by attrition rather than layoffs. In the few cases where restructuring has resulted in labour shedding (e.g. GEUSA in Singapore), laid-off workers have been rapidly reabsorbed into expanding neighboring industries. In absolute terms, high-tech industry has increased the demand for unskilled as well as skilled labour, and the deskilling nature of some technical change ensures that this demand will probably always exist.

High-tech industry has clearly increased the skills and technological capacity of the local labour force in the NICs. Unskilled workers, for example, have progressed from simple manual operations to the tending of sophisticated computerised machinery and equipment, for which literacy and numeracy are more important. More skilled jobs have been created, and scientific and technical personnel trained. In Taiwan, Hong Kong and Singapore, experienced scientific or managerial personnel employed in foreign-owned high-tech firms have often left to establish their own successful high-tech companies, for example, in the computer industry. High-tech has thus generated a new group of local entrepreneurs.

The impact of high-tech industry on labour organisation and labour's bargaining position in the NICs is more complex than its clearly positive contributions to employment, income and skill generation. On the one hand, high-tech industry is dominated by newer, smaller firms with a higher ratio of skilled and professional labour, all of which make union organisation more difficult -- compared, for example, with long-established low-tech industries with large, stable blue-collar workforces (Lim, 1987a, pp. 38-40). On the other hand, higher skills and labour productivity, and the

labour shortage which has accompanied high-tech expansion, have increased labour's bargaining power, since disruption of the production process is extremely costly and substitution of production facilities very difficult given the high capital and training costs involved and unavailability of alternative labour supplies. Government controls to ensure compliant labour organisation are thus undermined by market forces. The rising educational levels which accompany high-tech expansion and are in part motivated by it also contribute to increased popular demands for more democratic freedoms, including labour rights, which have recently improved in South Korea and Taiwan. And the international nature of high-tech industry increases international awareness of and concern about local labour rights and organisation, which has become a factor in trade policy. (For example, in early 1987 South Korea and Taiwan had their U.S. GSP privileges curtailed in part because of unsatisfactory progress on improving labour rights.)

The female-intensive nature of many high-tech production processes creates a disproportionate number of jobs for women, who are often discriminated against in other segments of the labour market. Thus high-tech, together with the much more numerous low-tech export industries, has contributed to the high and rising rates of female labour force participation in the four Asian NICs. This has been accompanied and facilitated by higher female educational attainment (as encouraged by the changing pattern of labour demand), a later age of marriage, and much lower birth rates -- all factors conducive to an improved social and economic position for women, who also appear to derive some non-economic benefits from their employment (Lim, 1987c, pp. 16-17). The existence of labour

shortages in all the NICs also weakens employers' ability to discriminate against women at all skill levels in the labour market. However the sexual division of labour in high-tech industry will not disappear unless more women avail themselves of scientific and technical education at the higher skill levels, something which for cultural reasons is occurring only slowly despite -- at least in Singapore -- considerable government encouragement. At lower levels of the workforce, an equally tight labour market for unskilled male labour precludes significant numbers of men joining high-tech industry as production operators.

Legitimate concerns have been raised in many countries about potential health hazards in high-tech industry, particularly for women of reproductive age who are exposed to toxic chemicals and other materials, or work with radiation-emitting equipment and even computer video terminals (e.g. Lin, 1986a, 1986b; Siegel and Markoff, 1986, 162-164). This subject remains to be seriously researched, in the industrial countries as well as the NICs, but a few points may be noted here. First, health and safety conditions in high-tech workplaces tend to be superior to those in older, low-tech industries, largely because of the physical sensitivity of equipment and products and the high costs of disruption of continuous machine production. High-tech employers, especially multinationals, have both the wherewithal (high profit margins) and the motivation (heavy investment in expensive machinery and trained workers, and an economic preference for low labour turnover) to ensure a safe working environment. The nature of the technology and constant automation -- particularly of difficult and dangerous manual processes -- do mean that physical/mechanical hazards are likely to be few relative to, for example,

noisy, dusty textile factories and overcrowded garment shops where most unskilled female operatives are employed. Indeed, because of superior conditions as well as often higher wages, high-tech firms, especially multinationals, are preferred employers among unskilled female workers. In Singapore, for example, new (non-union) computer companies have managed to attract experienced blue-collar labour away from older (usually unionised) consumer electronics firms.

Government policy is an important input into the health and safety of high-tech workplaces. Among the NICs, the Singapore government is probably the most vigilant about industrial health and safety (e.g. Lim, 1987a, pp. 43-44), and the Hong Kong government the least. In all the NICs, tight labour markets where workers have many job alternatives give employers an incentive to create safe and comfortable workplaces and fair work rules in order to attract the labour that they need. To the extent that women's labour market characteristics result in their having a shorter average work-life, high labour turnover in female-intensive high-tech firms may also have the effect of minimising workers' exposure to and hence risk from potential occupational health hazards (such as long-term exposure to radiation or toxic chemicals).

The need of many high-tech firms to operate round-the-clock means that workers often have to work rotating 8-hour shifts, with consequent disruption of their biological and social schedules. However this problem is not peculiar to high-tech firms, since many low-tech industries, hotel, hospital and other service workers, also work shifts. In Singapore, the unpopularity of rotating shift work has led most high-tech companies to

institute permanent shifts instead. But in the tight labour market it is virtually impossible to get workers for the third (night) shift, despite the higher wages offered and attempts by the government to extend the provision of various social services (e.g. public transportation) to facilitate night-shift work.

Finally, concerns have been voiced in the literature about the supposedly coercive labour process in high-tech industry (e.g. Lin, 1984, 1986b). However, the empirical observations on which such concerns are based are usually drawn from lower-tech sectors of the electronics industry (not all of which is high-tech), where typically thousands of female operatives are employed in regimented assembly-line production. The new high-tech firms of the 1980s are often quite different in their organisation and management of labour, in the NICs as in the industrial countries. For example, individual work-stations often replace assembly lines, and more flexibility is allowed where the operator essentially monitors the production of several machines rather than performs manual operations herself. The technology, the smaller size of capital-intensive firms, the more "informal" management style favoured especially by American high-tech companies, and the NICs' tight labour markets permitting worker mobility, all provide employers with the opportunity and the incentive to be more "relaxed" in their management of labour. Our own factory visits to high-tech companies in Singapore over a dozen years confirm this impressionistically.

In general, the impact of high-tech on labour in the NICs appears to have been largely positive, in both local and foreign firms. As we have

suggested, this is the result not only of the technical and economic requirements of high-tech industry, but also, and very importantly, of the economic environment in the NICs, particularly their tight labour markets, and rising skill and educational levels.

The Asian NICs and the International Division of Labour

The rapid establishment in the Asian NICs of competitive high-tech industries, by mostly foreign firms in Singapore and mostly local firms in South Korea and Taiwan, confounds the predictions of existing theories of the international division of labour in a number of ways.

First, the state has played a crucial role in enabling South Korea, Taiwan and Singapore to "leapfrog" industrial technologies, from the labor-intensive to the high-tech in less than one generation. This, together with the strategic actions of individual firms responding to state policies and market pressures, has changed the international division of labor in high-tech industry in ways not predicted by mainstream neoclassical trade theory, which focusses on relative resource endowment as the primary determinant of comparative advantage and country specialisation.

The location of high-tech industry in the NICs in its growth and even new phases also contradicts the product life-cycle theory prediction (Vernon, 1966) that only firms in mature or declining industries will move offshore to developing countries, to cut costs. On the contrary, in high-tech industry, heavy development expenditures, short product cycles

and keen competitive pressures make cost minimisation necessary very early in the product life, including the stages of research, design and pilot production (Lim, 1987b).

The ability of the Asian NICs to narrow the income and technological gap between themselves and the industrial countries, and to pose a major competitive threat to these countries in high-tech industry, also confounds the pessimistic predictions of dependency theorists who see the development of "peripheral" or developing countries as being stunted by participation in a world capitalist system dominated by "core" or industrial countries (e.g. Barrett and Chin, 1987, pp.23-24). On the contrary, the Asian NICs have used participation in the world economy to advance their industrial development, including the development of successful indigenous as well as foreign-owned high-tech firms.

The impact of this development in the Asian NICs has also not been as negative as predicted by new-wave dependency theorists (e.g. Evans, 1978; Gereffi, 1983) who argue that the "dependent development" which results from participation in the world economy widens income disparities, requires political and labour repression, and increases the insecurity of production and employment in developing country. Contrary to pessimistic predictions of negative consequences (e.g. Siegel and Markoff, 1985), the evolution of an internationalised high-tech industry in the NICs in the 1980s has been accompanied by rapidly rising incomes without worsening disparities, by diminishing political and labour repression as development has progressed, and by the security of full employment.

Today, the Asian NICs are simultaneously competitive in many different

stages of high-tech industry, from skill-intensive research and design activities to both capital-intensive and unskilled-labour-intensive production. Their ability to sustain and prolong extraordinarily high economic growth rates is partly due to increasing concentration in high-growth high-tech industries, while low-tech products and processes are relocated offshore. High-quality labour is an important ingredient in the NICs' international competitiveness, but it is only one variable among the many which they have managed to package successfully to attract and nurture high-tech industry in competition with the industrial countries. Labour in the NICs has generally benefitted from the advent of high-tech in the form of more, better and better-paid jobs, and greater bargaining power in the marketplace. At the same time, the NICs' poorer Southeast Asian neighbors are also benefitting, both from the relocation of low-tech industries from the NICs, and from investments in other industries supplying the NICs' high-tech industries with labour-intensive inputs.

Conclusion

In short, the Asian NICs' experience with high-tech industry has so far been overwhelmingly positive. It shows that, especially with state assistance, developing countries **can** transcend the technological barriers which in the past have contributed to their economic backwardness compared with advanced industrial countries; that they **can** develop the **indigenous** scientific and entrepreneurial capacity to develop new technology; and that they **can** pose a strong competitive challenge to the industrial countries even in high-tech industry. Participation in the world economy through the

import of technology and capital and the export of electronic products has facilitated rather than hindered the NICs' move up the technological and industrial ladder, enhancing their indigenous technological capabilities. The NICs' economies have benefitted from their move into high-tech industry, as have the economies of neighboring countries to which they have relocated both low-tech industries and labour-intensive segments of high-tech industries. Labour in the NICs has also benefitted from the move into more modern, capital-intensive and skilled industries, which have provided local entrepreneurs (even in Singapore) with many opportunities to establish their own globally-oriented high-tech businesses.

High-tech has thus accelerated the process of capitalist industrialisation in the NICs, confounding the theoretical predictions of mainstream neoclassical theorists, product life-cycle theorists and dependency theorists. Its progressive consequences, including for labour, more closely match the dynamic predictions of classical Marxists than the negative ones of neo-Marxist critics of "dependent development". But a full explanation of the evolution of high-tech industry in the NICs must take into account international, regional and local changes in technology, trade and industrial policy, and how the NICs' governments and local entrepreneurs, as well as multinational firms, have accommodated to or taken advantage of market opportunities created by these changes. In particular, attention must be focussed on the catalytic role that accumulation of human capital and the international mobility of labour as well as capital have played in quickening the development of high-tech industry in the NICs. This subject deserves to be closely analysed in future research.

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