ECONOMIC RESTRUCTURING OF HONG KONG ON THE BASIS OF INNOVATION AND TECHNOLOGY

Edward Chen and Raymond Ng

INTRODUCTION

Hong Kong experienced perhaps the most severe economic downturn in its recent economic history following the outbreak of the 1997 Asian financial crisis. The economy contracted sharply by 5.1 percent in real terms in 1998 and rebounded to grow moderately by 2.9 percent in 1999. The unemployment rate has been on the increase, from 2.2 percent in 1997 to a record high of 6.2 percent in 1999. Arguably, Hong Kong's small size and extreme outward orientation have rendered the economy particularly vulnerable to adverse external economic shocks. Nonetheless, the apparently robust economy suffered from certain structural weaknesses that made the downward adjustment more severe than it otherwise would have been.

The Hong Kong economy has undergone a drastic structural shift since the early 1980s, and it has now become extremely service-oriented. This heavily skewed industrial structure greatly increased the concentration risk. The rapid increase in land, labour, and other operating costs in Hong Kong since the 1970s worsened the international competitiveness of its manufacturing industry, which is dominated by the production of labour-intensive light consumer goods. To maintain their cost advantage, manufacturing firms took steps to restructure their operations and relocate labour-intensive production processes to China, while keeping the more sophisticated processes and headquarters operations in Hong Kong. The rapid growth in outward processing activities in turn created strong demand for transport, finance, managerial, and related services, which further accelerated the process of industrial restructuring. In addition, the finance and real estate industries dominated the equity market and the economy as a whole. This added to concentration risk too and exposed the economy to adverse interest rate movements and investor sentiment, increasing macroeconomic instability.

Hong Kong is well known for its positive, non-intervention approach to industrial policy (Haddon-Cave 1980). Hong Kong policymakers are reconsidering this long-followed laissez faire strategy, however, since other Asian emerging economies, which in general have more active industrial policies and more balanced industrial structures and have diversified into technology-intensive industry, outperformed Hong Kong in recovering from the recent economic turmoil. The policymakers need to examine the economy's resource base and competitive advantage and identify the direction for industrial restructuring. Economic and industrial policies should be adopted to facilitate the upgrading of Hong Kong's manufacturing and service industries to rebuild international competitiveness and promote sustainable economic growth in the long run.

The government has seemingly switched to a more active industrial strategy, having announced in 1998 an ambitious plan to develop Hong Kong as a knowledge- and innovation-based economy and to

promote high technology and value-added industries. The Commission on Innovation and Technology has been appointed to examine the strengths and weaknesses of Hong Kong's technology and resource base and to recommend appropriate technology and industrial policy measures to reshape the resource base and competitive advantage accordingly. New economic opportunities such as the development of a cyberport, a Chinese medicine centre, and a Disney theme park are also being explored. The recommendations in general call on the government to more actively provide infrastructure and financial support for R&D activities and to invest in development of human resources.

This chapter examines the direction and strategy for industrial restructuring in Hong Kong, specifically the government's attempts to transform Hong Kong into a knowledge- and innovation-based economy and to facilitate the development of technology and knowledge-intensive industry. It begins by examining economic restructuring trends in Hong Kong over the past two decades. It then reviews the recent literature on determinants of long-term economic growth and discusses the strategy that this theory implies for economic restructuring. After a brief review of past industrial policy in Hong Kong it discusses the government's current plan and strategy to promote knowledge- and technology-intensive industry.

ECONOMIC RESTRUCTURING IN HONG KONG

The structure of the Hong Kong economy has shifted dramatically in the past two decades to become extremely service-oriented. The industry sector contracted sharply from 31.7 percent of GDP in 1980 to 15.2 percent in 1998 and manufacturing industry, in particular, contracted even more sharply, from an average 22.6 percent of GDP in the first half of the 1980s to as low as 6.6 percent during 1996-99 (Table 7.1). In contrast, the service sector expanded rapidly from 67.5 percent of GDP in 1980 to 84.7 percent in 1998. Within the service sector, the finance industry's share of GDP rose from an average of 19.1 percent in the first half of the 1980s to an average of 25.6 percent in 1996-98. During the same period, the share of commercial and trade services expanded from 21.3 percent to 25.4 percent, community and personal services expanded from 15.2 percent to 18.5 percent, and transport and storage services grew from 7.8 percent to 9.4 percent of GDP.

The drastic decline in Hong Kong's manufacturing industry and the expansion of the service sector are reflected in the changing pattern of exports (Table 7.2). As domestic merchandise exports decreased, Hong Kong again emerged as a re-export oriented economy. While domestic goods exports averaged 48.9 percent of total goods and services exports in the first half of the 1980s, this share dropped to a record low of 12.1 percent during the period 1996-98. The share of re-exports more than doubled, from an average of 29.2 percent of total exports of goods and services during 1981-85 to 71 percent in 1996-98. Service exports also gained relative to domestic exports. The ratio of services to domestic merchandise exports increased from an average of 44.9 percent for 1981-85 to 140 percent in 1996-98. From HK$29.2 billion in 1980, service exports grew by eight times to reach HK$264.7 billion in 1998, while domestic goods exports expanded by only 1.8 times during the same period.

The massive relocation of manufacturing industry to China in the 1980s and early 1990s was largely responsible for this industrial hollowing-out. The manufacturing industry in Hong Kong was dominated by the production of light consumer goods with low technology content. Also, the small-size of most firms in the industry kept them from conducting R&D or upgrading to higher technology activities. With local land and labour costs surging, manufacturing firms in Hong Kong took steps to restructure and relocate labour-intensive production processes across the border to Mainland China where cheaper land and labour were abundant. By moving their production bases to a low-cost location, they were able to improve their cost position and maintain competitiveness without diversifying into the production of capital- or technology-intensive goods. The wholesale relocation of production to China in turn brought about drastic growth in Hong Kong's re-export and out-processing activities and created huge demand for transportation, managerial, banking, and other trade-related services. China's Open Door policy, adopted in 1978, also fuelled demand for such services, pushing Hong Kong to become a commercial and financial centre and a regional hub for headquarters to co-ordinate manufacturing and other business activities in Mainland China and in other Asian emerging markets.

Economic growth requires continuous upgrading from traditional labour-intensive industries to new industries with high capital- and technology-content. Continual increases in value added are needed in order to cover the rising costs of production and to warrant higher standards of living for the workforce. In Hong Kong, value added by the industrial sector averaged a much smaller percentage of gross output than value added by the service sector during the years 1981 to 1996 (Table 7.3). (Value added is the sum of compensation to employees and gross operating surplus.) Nonetheless, industry's share increased gradually from 30.4 percent in 1980 to 33.5 percent in 1990 and further to 38.7 percent in 1996. The profit margin of the industrial sector also improved moderately, as compensation to employees declined from an average of 65.1 percent of value added during 1981-85 to 58.8 percent during 1991-96 (Table 7.4). For manufacturing, the average value-added share of gross output dropped from 28.1 percent in the first half of 1980s to 27.5 percent during 1986-90, and then improved gradually to 29 percent during 1991-96 (Table 7.3). Employee compensation fell from an average of 65.4 percent of manufacturing value added in the first half of 1980s to 56.6 percent during 1991-96 (Table 7.4). The service sector has been more profitable than manufacturing, with higher added value and a lower share of employee compensation. Nonetheless, value-added share of gross output in the service sector declined slowly, and the profit margin also narrowed as the share of employee compensation gradually increased. Finance has been most profitable service industry, with value-added averaging 73.6 percent of gross output from 1981 to 1996 and employee compensation accounting for an average of 33.2 percent of gross output.

The process of industrial restructuring in Hong Kong could be seen as an attempt by local manufacturing firms to maintain their competitiveness and profitability by relocating production to China. Given the limited technology base as well as managerial and financial resources for conducting R&D, it was not to Hong Kong's advantage to try to transform into the production of high-technology

and capital-intensive industries. Instead, Hong Kong diversified into the more profitable and higher value-added service industry. The economic success of Hong Kong lay in its entrepreneurial and managerial expertise and its ability to respond and adjust quickly to new market opportunities.

THE ROLE OF GOVERNMENT POLICY IN INDUSTRIAL DEVELOPMENT

Innovation and technology have long been seen as crucial sources of economic growth. Conventional development theory emphasises the role of technological improvement in offsetting diminishing returns to production and boosting the output that can be produced with fixed amounts of capital and labour. Economists have made substantial efforts to measure the contribution of technological progress to output growth and to learn about the mechanism through which technology advancement affects growth. In a pioneering effort Solow (1957) focused on the portion of measured economic growth that is not explained by growth in labour and capital inputs. He attributed this unexplained residual growth, or growth in total factor productivity, to technological improvement. Despite its crudeness, Solow's model laid the foundation of many later studies. In his later works, Solow discussed further the relative importance of embodied and disembodied technological progress in boosting economic growth. Disembodied technological progress contributes to output growth independently of capital accumulation, whereas embodied technological change affects output by enhancing, for instance, the quality or efficiency of capital accumulation. It is crucial to distinguish between these two types of technological change as sources of growth in order to interpret correctly the residual from conventional total factor productivity.

One important implication of the Solow model of economic growth is that while government policies do not have any permanent impact on the rate of economic growth although they can raise the rate of growth rate temporarily, as an economy moves to a higher level of income. Endogenous theories of growth, in contrast, hypothesise that government policies can influence the long-term rate of growth (Romer 1986 and Lucas 1988). Endogenous growth models presume that the returns to capital can continue to increase. Any government policy that increases the rate of investment in the economy will permanently raise the rate of growth. This is because economic growth hinges on knowledge, and knowledge depends on investment. Lucas (1988) placed sole importance on human capital. He assumed that the rate of economic growth depends on time individuals spend accumulating skills, i.e., investment in human capital. Any policy that leads to a permanent increase in an economy's accumulation of human capital per person will increase the long-term rate of growth. In the Solow model, on the other hand, diminishing returns to capital eventually result in negative capital accumulation when the amount of investment falls short of depreciation.

The importance of government policy in industrial development has conventionally been argued in terms of the divergence between private and social benefits to investment in R&D and human capital, and in industrial restructuring. Mansfield et al. (1977) present a framework to measure the social benefits of innovation. When innovation shifts an industry's cost and supply curves downward, the

social benefits of the investment in the new technology are the sum of the increase in consumer surplus due to lower prices and the resources saved by producing with the new technology. The social benefits will increase further as other firms imitate the innovation. According to their estimates for seventeen product and process innovations, social rates of return on average have been remarkably high. The median social rate of return they estimated was about 56 percent, which is much higher than the median private rate of return of about 25 percent.

The divergence between private and social returns and the existence of spillover benefits both suggest that private markets tend to under-invest in R&D and human capital. Firms cannot appropriate fully the benefits generated from their innovations, as technical knowledge spills over to other firms without compensation to the innovating firms. The problem of appropriability combined with the risky nature of R&D inhibit private sector investment in technology and innovation. Technical risks arise from uncertainty about outcomes and technical performance of innovations, especially during the early phases of R&D. Investment in technology and innovation may also entail significant market risk because of the long time until innovators finally gain from the commercialisation of R&D results. Furthermore, individual firms may lack the unique facilities or diversity of talent to undertake certain R&D investments.

Market failure such as this justifies a government role in supporting investment in R&D. Because the market-determined level of investment is socially sub-optimal, government should invest actively in such activities that would otherwise be under-invested. Many technologically advanced countries have long followed an active science and technology policy based on this rationale, using direct funding programmes and fiscal incentives (tax reduction or tax credits for R&D expenditure) to encourage private sector R&D activities. The post-war science and technology policies of the United States and Japan illustrate two distinct approaches to building science and technology capacity. In the United States, federal support for basic research by universities expanded rapidly after the 1945 Vannevar-Bush report "Science: The Endless Frontier" selected the university as the centrepiece of post-war science policy. This was so despite the fact that most government-funded research was related to defence, space, and atomic energy technology. The university-based research system has become the key part of the U.S. national technology network and a major source of innovation. In contrast, in post-war Japan, the Ministry of International Trade and Industry (MITI) was responsible for carrying out industrial and technology policies and was the major source of government funding for R&D. Government-funded R&D was mainly conducted in the form of large, on-going projects. MITI also strategically focused on funding applied R&D in a limited number of large technology firms. Importantly, the government promoted a system of research associations, which were non-profit, project-specific groups established to conduct government-led joint R&D projects. By 1989 Japan had a total of 168 such research associations (Sumita and Namiki 1997).

Referring especially to industrial restructuring in East Asia, Smith (1995) argues that government industrial policy generally fits into one of two categories: functional or selective intervention.

Functional intervention is aimed to correct market failure without favouring any particular activity or industry, while selective intervention is designed to favour a certain activity or industry in order to overcome sub-optimal resource allocation. For the former, the government tends to invest in broad-based institutional and infrastructure support for R&D and human resource development and to deregulate trade and investment regimes to promote competition and create new opportunities. Selective intervention, on the other hand, is usually firm- or industry-specific and uses trade, financial, fiscal, or investment policies as incentive instruments to direct private sector resource allocation to targeted activities. Direct government investment and ownership may sometimes be adopted to develop the strategic industry. Importantly, both approaches tend to identify high-technology industry as the strategic sector based on its potential to generate beneficial external economies and exports.

This growth-based argument implies a straightforward strategy for economic restructuring in developing economies. In addition to conventional, sector-neutral measures to provide adequate infrastructure, an investment-friendly environment, a well-educated workforce, a free economy, and a well-functioning financial market, to promote optimal growth the government should also adopt a science and technology policy to develop the economy's technology and knowledge base. First of all, it should invest in public R&D and perhaps more importantly provide institutional and infrastructure support to encourage private sector R&D activities. Developing economies with a low technology base should perhaps focus on applied technology R&D and on enhancing their ability to absorb, upgrade, and commercialise technologies imported from advanced countries. Second, the government should work to develop the economy's human resources and to ensure that the education and training system meets the fast-changing skill requirements. It should give special attention to ensuring an adequate supply of well-educated professionals with technology-specific training and with the ability to digest, absorb, and diffuse modern technology. The government should also encourage the workforce to continuously upgrade its knowledge and skills. Finally, the government should ensure that the economy can tap into external advances in technology. It should provide institutional support and infrastructure so that imported technology is effectively assimilated, adapted, diffused, and acquired for commercial utilisation. In particular, it should ensure the availability of appropriate human resources and R&D infrastructure, which are crucial to the transfer and absorption of advanced technology. The government should also attempt to attract inward FDI in technology-based industry, for instance, by providing proper infrastructure and an environment conducive to rapid industrial and technological development and by actively improving the industry's capacity to absorb more sophisticated technology. The eventual aim should be for industry to become capable of generating new technology on its own.

Underlying currents in the international economy are pushing policymakers to adjust and re-focus their R&D and industrialisation policies designed to foster competitive advantage. The increasing integration of the global economy (with rapidly growing multinational corporations adopting cross-border production, sourcing, and marketing strategy) poses a major challenge to the conventional wisdom on economic growth and restructuring. Advances in transportation, telecommunication, and

information technology have lowered the transactions and operating costs associated with physical distance. Liberalisation of trade and investment regimes in many developing countries has removed barriers to international trade and capital flows. These changes in turn are encouraging firms to move toward more fragmented production and supply structures and to seek out international suppliers. Ultimately, these changes are impelling firms to take a global perspective, locating the various parts of the production process according to the factor price, productivity, or other technology-based advantages of each location, if they are to achieve efficiency and sustain profit growth.

These developments challenge the traditional view that large scale brings economic advantages. Economies of scale achieved through standardised and mass production (i.e., so-called 'Fordism') have been edged out by the advantages of flexible manufacturing systems characterised by the networking of small, specialised, and innovative production units (Teubal et al. 1995). In addition, following the rapid growth of the IT industry and the integration of the global economy, size no longer seems as important a factor in the growth prospects of an economy or a firm. In fact, some small countries such as Ireland, Israel, New Zealand, and Singapore have already achieved rapid development in the information technology industry. Advances in electronic commerce and Internet technology facilitate access to market and technical information anywhere in the world, independent of size. These advances also facilitate the formation of industrial alliances and the efficient exchange of information between suppliers and purchasers. Smaller firms can now develop their own competitiveness by flexibly applying production technology to produce customised products that cater to the needs of individual customers or differentiated products for multiple markets. More importantly, internationalisation of production chains facilitates the transfer of knowledge and technology and extends sourcing and marketing linkages to smaller, developing economies. These economies are now in a stronger position to leapfrog development in certain industries even if they lack a technology and industry base. The dramatic transformation of Ireland from an agriculture-based to a technology-based economy (and a leading exporter of computer software) is a perfect example. Therefore developing economies may not need to follow the conventional course of economic development or industrialisation.

The strategy for government support of R&D and innovation may also need to be revised in the face of the new economic paradigm. Up to now, R&D has generally tended to be large scale, aimed at achieving radical technology breakthroughs. Moreover, largely due to limited foreign competition, new technologies used to enjoy a long technology and market life cycle and hence to entail relatively low risk. Innovators had relatively more control of the market. Now, particularly since most advanced and emerging countries have already adopted a technology-based growth strategy, global competition has intensified, and this has greatly shortened the technology life cycle. Innovators are forced to focus R&D efforts on less risky and shorter-term (but on-going) projects, such as process-innovation or minor production improvement, for example, which generate results that can be commercialised quickly. Technology advances are more likely to come as incremental improvements instead of major changes, and maintaining economic competitiveness depends on continuously improving innovative capacity.

Thus, a government should, among other things, adopt a human resource development strategy that focuses on encouraging a creative and technologically sophisticated workforce. Such a strategy should also encourage people to work smarter and pursue life-long education and training. To engender such a quality, the government should consider removing the traditional distinction in education between arts, humanities, and science disciplines and focusing the education system on development of the whole person. This is particularly crucial as industrial restructuring has already proceeded toward increasing knowledge- (or perhaps wisdom-) orientation.

The traditional path of economic restructuring, moving from manufacturing- to service-orientation may also need to be reconsidered. Particularly in the case of Hong Kong, the production process is highly fragmented with substantial processing and sourcing taking place outside the economy. A significant proportion of Hong Kong's service industry, including transportation, telecommunication, accounting, managerial, and other professional services, is tied to manufacturing activities that are located elsewhere. In addition, major real property developers, including Cheung Kong Holding Limited, Henderson Company Limited, Sun Hung Kai Properties Limited, and New World Development Company Limited, have already diversified into Internet-based and e-commerce businesses. Thus, to a large extent, Hong Kong's manufacturing and service sectors have already been integrated, and it is no longer practical or accurate to draw a distinction between them. Therefore policymakers should adopt an integrated approach to industrial and technology policies. They should support particularly manufacturing-related service R&D based on a wide range of information and Internet technology. The new technology should help manufacturers add value at the service stage of the vertical supply chain.

INDUSTRIAL POLICY IN HONG KONG

The industrial policy of Hong Kong can best be described as a strategy of "maximum support but minimum intervention". The Hong Kong government has long adopted a laissez faire strategy for industrialisation. Unlike many Asian high-performing economies, the government has not selected any strategic industry for development and has therefore played a minimal role in allocating resources. Industrial support was generally indirect, primarily aimed to ensure the adequacy of infrastructure and factor inputs (especially industrial land) and an institutional environment conducive to competition and private investment in physical capital (e.g., an open and market-oriented system, a low and simple tax system, and a well-developed financial market). Nonetheless, the government intervened to a certain extent on the microeconomic level through its considerable control over the supply (and hence price) of land. For example, the government assisted targeted industries by offering land in industrial estates through private treaty instead of public auction.

In Hong Kong the public sector has had very limited direct involvement in R&D and it has provided minimal support for private-sector R&D activities. Public support for industry concentrated on developing education, infrastructure, and institutions that indirectly promoted all industries. The

government has made special efforts to provide training and technical services to support the upgrading of traditional industry. The Industry and Technology Development Council was established in 1992 to replace the former Industry Development Board and the Committee on Science and Technology to advise on Hong Kong's industrial and technology policy. The Industry Department facilitates the development of manufacturing industry by promoting inward investment, improving access to relevant technologies, encouraging applied R&D activities, and conducting research on market trends. The Hong Kong Trade Development Council is responsible for promoting trade and the service sector. Its major functions include exploring new export markets, providing information to local manufacturers and traders about foreign buyers, and working closely with them to upgrade the quality and design of their products. The Hong Kong Productivity Council acts as an agent for technology transfer and productivity enhancement. It provides a variety of training programmes, industrial and management consulting, and technical support services. The Vocational Training Council provides technical education and industrial training. It runs a New Technology Training Scheme, which provides financial assistance for employers to train their technicians and managerial staff.

Since the early 1990s the government has increased its efforts to boost the technological and technical capacity of Hong Kong's manufacturing industry. The Industry and Technology Development Council was established largely to ensure that Hong Kong could respond promptly to the fast-changing technological environment and to enhance the vital connection between industry and technology. The Hong Kong Industrial Technology Centre Corporation was established in June 1993 to facilitate technological innovation and the application of new technology in domestic industry. It provides incubation programmes for start-up technology-based business, technology transfer services, and product design, development, and support services. The government also took steps to expand tertiary education and postgraduate training to meet increasing manpower needs. It established the Open Learning Institute in 1990 and the Hong Kong University of Science and Technology in 1991. Polytechnics and other colleges were upgraded to university status providing more degree programmes.

The government is committed to developing Hong Kong as an innovation-driven and knowledge-based economy with the focus on technology and knowledge-intensive industries. As the economy transformed from a manufacturing base to become heavily biased towards the service sector, its resource base and comparative advantage also became biased toward services. The goal of making Hong Kong competitive in knowledge- and technology-intensive industry calls for drastic measures to actively re-shape the technology and resource base of the economy.

In a knowledge-based economy the key input to production is intangible capital, such as knowledge and human capital, rather than labour or physical capital. Hence, improvements in productivity and economic growth depend on increasing this intangible capital, that is they depend on the capacity to innovate and to create and accumulate knowledge. Knowledge-intensive industry such as information technology becomes the strategic industry, while raising the knowledge-content of traditional industries also becomes a policy objective. Hong Kong should concentrate, in particular, on

the technology and knowledge content of such services industries as banking, insurance, and brokerage with the support of advances in information technology and the increasing popularity of Internet usage.

In contrast to these objectives, the existing technology stock and resource base for high-technology industry in Hong Kong is weak, and the economy seriously lags behind in technological development. Although Hong Kong remains one of the most competitive economies in the world, its technology competitiveness has weakened in recent years. According to a study of technology competitiveness in 46 countries by Chen (1999), Hong Kong fell from an overall rank of 10 in 1992 to 25 in 1998 and its overall competitiveness was below the average for the group of countries in the study (Table 7.5). In R&D investment Hong Kong dropped from a ranking of 15 in 1992 to 29 in 1998, in scientific environment it dropped from 9th place to 23rd, and in technology management if fell from 6th to 11th place. On the other hand, between 1992 and 1998 Hong Kong's ranking in intellectual property protection rose from 27 to 23. Hong Kong's weakness in technology development can be attributed in part to the fact that the manufacturing industry was dominated by small firms and by the production of labour-intensive light consumer goods. Such producers were not likely to undertake R&D activities. Moreover the government did not have an active technology development policy and it consistently invested fewer resources in R&D than did other advanced economies or NIEs (Table 7.6).

Hong Kong also lacks a resource base of scientists and engineers to support technology development. Hong Kong has fewer scientists and researchers than other countries. For every 10,000 workers Hong Kong has only 10 scientists compared to 80 in Japan, 78 in the United States, 57 in Taiwan, and 45 in Singapore (Chen 1999). Despite heavy investment in education and expanded tertiary education in the 1990s, students enrolling in Hong Kong universities tend not to focus on science and engineering subjects. According to official statistics, in 1997 business administration programmes accounted for 24.6 percent of total enrolment and social and arts subjects accounted for 32.7 percent. In comparison, biological, physical, and mathematical sciences accounted for 10.6 percent of total enrolment and computer science, information technology, and engineering and technology together accounted for 22.8 percent. The rapid growth of Hong Kong's service sector attracted a significant share of talented students away from physical science or engineering, and even many science and technology graduates chose to work in the booming, dynamic service sector.

On the other hand, Hong Kong already has a well-developed infrastructure, an educated and hard-working workforce, and a favourable business environment with a developed financial market and an open, competitive economy. With cautiously designed and properly implemented technology and human resource development policies, Hong Kong will be in a strong position to leapfrog to become a knowledge and technology-based economy. Particularly, in view of the more scale-neutral competition and the shift in industrial advantage toward small-scale production units, the small and medium-sized enterprises (SMEs) that predominate in Hong Kong could even be a source of competitive advantage and industrial dynamism. According to official statistics, in June 1999 the more than 280,000 SMEs in Hong Kong accounted for over 98 percent of total business establishments and employed about 60

percent of the workforce. The majority of SMEs were in the import and export sector. These SMEs have long been crucial suppliers of parts and components to the global market. They have already developed entrepreneurial talents and international linkages, and adopted flexible production and marketing techniques.

STRATEGY FOR INDUSTRIAL RESTRUCTURING

The Hong Kong government established the Commission on Innovation and Technology in March 1998 to examine the feasibility of various policies to promote high-technology and knowledge-intensive industries in Hong Kong. Based on the Commission's recommendations the government announced a plan to develop Hong Kong as a centre for innovation and technology with a focus on information technology, fashion and design, multi-media-based information and entertainment services, and bio-technology especially related to Chinese medicine. The Committee's recommendations included reforming government institutions related to formulation and implementation of technology, providing infrastructure facilities for R&D, investing in human resource development, and fostering an innovation and technology culture. Specifically, the Commission recommended establishing a cross-bureau policy group to set and co-ordinate technology and related policy. A standing advisory body and a common secretariat with full-time science advisors should support the policy group. The Committee also recommended merging the Hong Kong Science Park, Hong Kong Industrial Estates Corporation, and Hong Kong Industrial Technology Centre Corporation. Together, these reforms should enhance the government's ability and efficiency to introduce and co-ordinate various technology development and human resource programmes.

Investment in R&D Infrastructure and Private Sector R&D Activities

The relative underdevelopment of Hong Kong's technology resources is the expected outcome of the government's past stance toward technology investment and the economic nature of such investment. The Hong Kong government has not had a comprehensive long-term plan for technology development and it has provided very limited support for R&D activities. Without public support, R&D and other knowledge-creating activities tend to be under-invested, since investment in new technology or knowledge represents a typical case of market failure, as discussed above. Now, government has committed to expanding infrastructure to support for R&D activities and incubator programmes to promote high-technology industry, especially among small firms. It launched an Innovation and Technology Fund replacing the Industrial Support and Services Support Funds to stimulate private-sector interest in R&D and to encourage various activities that promote an innovation and technology culture, such as conferences and training programmes. Specifically, the Innovation and Technology Fund (ITF) runs a HK$250 million University-Industry Collaboration Programme, which is a matching grant scheme to encourage collaborative research between industry and academia. The collaboration will encourage industry to conduct R&D by making greater use of the available research resources of universities, and it will establish a network for technology creation and transfer. The ITF

also operates a HK$500 million Small Entrepreneur Research Assistance Programme (a technology incubator programme) to assist small entrepreneurs undertaking commercial R&D at the pre-market launch stage.

In order to improve the infrastructure for R&D activities, the government is building a Science Park at Tai Po in the New Territories to provide land and premises especially for high technology firms and activities. The park will provide a focal point and create an environment to attract overseas technology firms to invest in Hong Kong and to stimulate growth of local technology-based business. The first phase, estimated to cost HK$3.3 billion, will be in operation by 2001. The government is also building an Applied Science and Technology Research Institute (ASTRI), located in the Science Park, to provide technological infrastructure for mid-stream R&D. ASTRI will play an important role in facilitating technology transfer and technological human resource development. It will also help to attract R&D professionals from overseas to work in Hong Kong and to encourage industry-university collaboration. In addition, the government should adopt measures to facilitate the inflow of technological expertise from China to allow Hong Kong industry to draw on the Mainland's human and other resources on basic research. Hong Kong should focus on mid- to down-stream applied research and play a strategic role in commercialising research results for the Mainland.

The government has begun to partner with the private sector in order to promote Hong Kong's information technology industry. For example, in March 1999, the government launched a cyberport project through a private agreement with Pacific Century Cyberworks Ltd. The project aims to provide the infrastructure appropriate for promoting the strategic information technology industry in order to attract foreign technology companies to invest in Hong Kong, to expand the pool of talent and expertise, and to facilitate technology transfer. As a way to upgrade and diversify the tourist industry, the government got Disney Enterprises to agree to build a theme park in Hong Kong. It is also working on other opportunities to promote technology-intensive industry, such as a Chinese medicine centre. In addition to fostering the transfer of technical knowledge, attracting MNEs in the technology sphere to Hong Kong could create horizontal and vertical linkages that would open commercial opportunities for local firms through parts supply or logistics support, for instance. Local emerging technology firms that find it difficult to compete in international markets could also form strategic alliances with large multinational corporations to take advantage of their marketing networks.

In addition to pursuing steps such as these, Hong Kong should establish a national innovation network with the combined effort of the government, industry, and academia. This tripartite collaboration is crucial for pooling and synthesising the wide-ranging talents and expertise of the network participants. These include the skill base and market insights of industry and the research capabilities and intellectual stock of universities. The government should be the catalyst, facilitating technology development and technology transfer through a clearly articulated strategic vision and both short- and long-term plans and targets for technology development. A civil service with a higher level of professional expertise in technology development could be a better at facilitor. The government

should take the initiative by evaluating the economy's existing technology level, identifying emerging areas of technology advancement, and introducing appropriate policies to close the identified technology gaps. It should also introduce mechanisms to enhance communication and information exchange among policymakers, industry, and academia in order to keep track of the latest technology developments and market changes. Finally, it should support specific R&D activities that will help SMEs to upgrade production and delivery systems, enhance design capability and quality control, and develop new customers and markets.

Human Resource Development Strategy for Technology-based Growth

The government is committed to reforming the education and training system in order to produce the sort of workforce required by a knowledge economy. In addition to promoting creativity, language and communication skills, information technology, and analytical thinking, it is important to inspire young people to pursue science and technology studies and to develop a culture of the whole-person and life-long learning. School curricula and assessment systems should be reformed to support these aims, and the government has issued a consultation paper with proposals for reform. For secondary education the proposals include removing the streaming of natural science and humanity disciplines, phasing-out vocational schools, and emphasising multifaceted intelligence assessments rather than subject-based examinations. For tertiary education, the government proposes to develop a credit transfer system for universities and post-secondary educational institutions to allow students more flexibility, choice, and mobility among programs, to encourage cross-disciplinary learning, and to improve post-graduate programs for specialised training. In addition, to encourage private firms to take on graduate students to work on specific R&D research projects, the ITF instituted a Teaching Company Scheme under which it pays half the students' salaries and the participating universities provide guidance.

The government should take serious steps to encourage university graduates to pursue graduate degrees in science and engineering research and it should consider providing more scholarships for post-graduate study (locally and overseas). It should also examine the feasibility of establishing a graduate division within ASTRI, with faculty and students perhaps involved in ITF-funded research projects. In addition to an adequate supply of workers with higher education and training in science and engineering, technological improvement demands an adaptable and trainable skilled labour force that can adjust to new technologies and production processes. Firms should provide both continuous pre-service and on-the-job-training. The government should also encourage a culture of life-long learning and trainability among the workforce. In addition to providing better infrastructure for technical and vocational training, the government should provide more fiscal incentives to encourage continuing studies, in-house training programmes, and government re-training programmes. As it will take time for Hong Kong to upgrade the scientific skills of the local population, in the short run the government should amplify its efforts to attract overseas talents in order to immediately boost Hong Kong's intellectual capital and energise the technology sector. Overseas professionals with exposure to and experience in technology-based industry or R&D could bring in new knowledge, technology, and

management skills, and they could identify the market gap for future development. The government has already launched a scientist importation scheme by relaxing immigration restrictions on Mainland talents working in Hong Kong.

In the long term, education reform should promote liberal arts education, which emphasises development of the whole person and offers flexible courses of study that combine the arts, humanities, and science disciplines. Many graduates of liberal arts colleges in the United States pursue higher degrees in mathematics and science. According to Stephen Lewis, Jr., President of Carleton College, of the 100 tertiary educational institutions in the United States with the highest percentage of graduates earning PhDs in science and mathematics, 61were liberal arts colleges. Furthermore, certain American liberal arts colleges, including Carleton, consistently lead the large universities in the number of graduates going on to obtain PhDs in all fields of science and mathematics and particularly in physics, astronomy, and chemistry.

Mobilise Financial Resources for Innovative and High-technology Industries

The ability to raise and channel adequate financial resources to fund business start-ups and expansion is crucial to promoting R&D activities and high-technology industry. Compared with large enterprises, small firms tend to have less financial resources and to find it more difficult to raise capital, through public listing or bank lending for instance, to invest in R&D. Hong Kong needs to pay particular attention to the funding needs of small and medium-sized enterprises because they have dominated the manufacturing industry. In addition to the Small Entrepreneur Research Assistance Programme already mentioned, the government started an Applied Research Fund Scheme to provide equity capital to promising local technology ventures. Launched in November 1998, the HK$750 million fund is operated by three private venture-capital firms that have market and management expertise. The government also established a Growth Enterprise Market at the Stock Exchange to help emerging technology companies raise equity capital.

Equally important to meeting the financing needs of technology start-ups are efforts to encourage venture credit lending by banks and a private sector venture capital market for technology-based industries. In general, Hong Kong banks are inexperienced with venture capital issues and lack expertise in risk and return evaluation of high-technology projects. Traditional practice in the banking sector requires loans to be fully secured by real property collateral. The sharp decline in property prices following the 1997 Asian financial crisis further constrained small firms from securing bank credit. Above all, small technology firms are in an unfavourable position because their assets are mostly intangible ones, such as innovative ideas and business potential. The government should encourage banks to revise their lending practices to provide more unsecured loans to high-technology companies based on their intangible assets or their investment in machinery and equipment. It could help introduce a venture loan insurance scheme to diversify the risks of such lending.

Bank credit and other debt financing can play only a limited role in funding young technology firms due to their pronounced technical and commercial risks. Equity is the obvious preferred private

fund-raising vehicle for such firms. Reform of the financial market should address market imperfections and the funding needs of a technology-based growth strategy. The government should consider enlarging incubation programmes and other forms of funding assistance (e.g., venture capital or subsidised loans) to start-up technology firms. The government should also strive to get more qualified emerging technology firms to list in the Growth Enterprise Market. This would give the market a more balanced structure and attract wider participation among institutional investors.

CONCLUSION

The course of industrial restructuring in Hong Kong can be characterised by a shift from the production of low-technology, light consumer goods to production of high value-added services. Instead of developing their own product-based advantage or diversifying into technology-based industry, local producers have upgraded their business activities by actively relocating geographically and becoming involved in outward processing activities in China. The slow pace of technological development in Hong Kong should be attributed to the small size of most manufacturers and to the government's laissez faire policy, which did not favour R&D activities with special infrastructure or financial support.

In the late 1990s the government switched to a more active industry and technology policy. It committed to developing Hong Kong as an innovation and knowledge-based economy. This transformation is a great challenge because the economy's comparative advantage and resource base have become so skewed toward the service industry. The government has formulated various R&D and human resource development policies that assist smaller firms, promote entrepreneurship in technology-based industry, encourage applied research and mid-stream R&D, and establish a network of technology creation and transfer among the government, industry and academia. These programs are appropriately focused and, with proper implementation and co-ordination, they should raise the economy's knowledge- and resource-base as well as its innovative capacity. This strategy and the scale of government involvement must be monitored continually, however, to ensure that they remain appropriate and sufficient to make Hong Kong competitive as an innovative, knowledge-based economy.

The government's technology policy should be market-based and focused on the traditional industries in which Hong Kong has already accumulated a stock of knowledge and other production and marketing expertise. It should help traditional industries re-structure toward higher knowledge-content products and developing product-based advantages perhaps supported by advances in information technology. Hong Kong should concentrate on mid- to down-stream applied research and take a strategic role in commercialising pure research results from Mainland China. As important as upgrading technology is the need to re-shape the human resource base and intellectual stock. While waiting for the effects of educational reforms and training programs on indigenous human resources, Hong Kong should seek out and attract talent from overseas and Mainland China. In this regard, the government should increase its financial support for collaborative projects with overseas research centres and

programmes to bring overseas scientists to work in Hong Kong on a short-term or project basis.

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TABLE 7.1
Ratios of Selected Industries' Output to GDP, 1980-98

(Percent)

	Industry		Services				
	Total	Manufacturing	Total	Wholesale, retail, import/ export trade, restaurants & hotels	Transport, storage & communications	Finance, insurance, real estate & business services	Community, social & personal services
1980	31.7	23.7	67.5	21.4	7.4	23.0	12.1
1981	31.8	22.8	67.5	20.3	7.4	23.9	12.9
1982	30.0	20.8	69.3	20.0	7.7	22.5	15.2
1983	31.9	22.9	67.5	20.4	8.2	17.6	16.0
1984	32.2	24.3	67.3	23.1	7.8	15.6	15.4
1985	29.9	22.1	69.6	22.8	8.1	16.0	16.7
1986	30.3	22.6	69.2	22.3	8.2	17.0	16.0
1987	29.4	22.0	70.3	24.3	8.6	17.9	14.5
1988	27.6	20.5	72.0	25.1	9.1	18.9	13.9
1989	26.7	19.3	73.1	25.0	8.9	19.5	14.1
1990	25.3	17.6	74.5	25.2	9.5	20.2	14.5
1991	23.1	15.4	76.7	25.9	9.6	22.7	14.9
1992	20.9	13.6	78.9	26.1	9.7	24.4	15.1
1993	18.5	11.2	81.3	27.0	9.5	25.8	15.7
1994	16.4	9.2	83.4	26.2	9.7	26.8	15.9
1995	16.1	8.3	83.8	26.6	10.1	24.4	17.3
1996	15.5	7.2	84.4	26.7	9.8	25.1	17.6
1997	14.7	6.5	85.2	25.4	9.1	26.2	17.9
1998	15.2	6.2	84.7	24	9.3	25.6	19.9
Average							
81-85	31.2	22.6	68.2	21.3	7.8	19.1	15.2
86-90	27.9	20.4	71.8	24.4	8.9	18.7	14.6
91-95	19.0	11.5	80.8	26.4	9.7	24.8	15.8
96-98	15.1	6.6	84.7	25.4	9.4	25.6	18.5

Source: Census and Statistics Department, Hong Kong SAR Government, 1999, *Estimates of Gross Domestic Product 1961 to 1998.*

TABLE 7.2
Hong Kong's Export Pattern, 1980–98

	Total Goods and Services Exports		Domestic Merchandise Exports		Re-exports		Services Exports		
	Amount HK$ million	Growth rate %	Amount HK$ million	Share of Total %	Amount HK$ million	Share of Total %	Amount HK$ million	Share of Total %	Ratio to domestic exports
1980	127,407		68,171	53.5	30,072	23.6	29,164	22.9	42.8
1981	157,494	23.6	80,423	51.1	41,739	26.5	35,332	22.4	43.9
1982	167,739	6.5	83,032	49.5	44,656	26.6	40,051	23.9	48.2
1983	207,006	23.4	104,405	50.4	56,294	27.2	46,307	22.4	44.4
1984	277,810	34.2	137,936	49.7	83,504	30.1	56,370	20.3	40.9
1985	296,202	6.6	129,882	43.8	105,270	35.5	61,050	20.6	47.0
1986	348,344	17.6	153,983	44.2	122,546	35.2	71,815	20.6	46.6
1987	470,306	35.0	195,254	41.5	182,780	38.9	92,272	19.6	47.3
1988	604,051	28.4	217,664	36.0	275,405	45.6	110,982	18.4	51.0
1989	697,656	15.5	224,104	32.1	346,405	49.7	127,147	18.2	56.7
1990	782,195	12.1	225,875	28.9	413,999	52.9	142,321	18.2	63.0
1991	926,973	18.5	231,045	24.9	534,841	57.7	161,087	17.4	69.7
1992	1,114,305	20.2	234,124	21.0	690,829	62.0	189,352	17.0	80.9
1993	1,261,827	13.2	223,027	17.7	823,223	65.2	215,577	17.1	96.7
1994	1,410,681	11.8	222,092	15.7	947,921	67.2	240,668	17.1	108.4
1995	1,609,762	14.1	231,657	14.4	1,112,470	69.1	265,635	16.5	114.7
1996	1,694,106	5.2	212,160	12.5	1,185,758	70.0	296,188	17.5	139.6
1997	1,751,532	3.4	211,410	12.1	1,244,539	71.1	295,583	16.9	139.8
1998	1,612,314	-7.9	188,454	11.7	1,159,195	71.9	264,665	16.4	140.4
Average									
1981-85	221,250	18.9	107,136	48.9	66,293	29.2	47,822	21.9	44.9
1986-90	580,510	21.7	203,376	36.6	268,227	44.4	108,907	19.0	52.9
1991-95	1,264,710	15.6	228,389	18.7	821,857	64.2	214,464	17.0	94.1
1996-98	1,685,984	0.2	204,008	12.1	1,196,497	71.0	285,479	16.9	140.0

Note: Figures in italics are percentage shares of total exports of goods and services.

Source: Census and Statistics Department, Hong Kong SAR Government, 1999, *Estimates of Gross Domestic Product 1961 to 1998.*

TABLE 7.3
Value Added as a Share of Gross Output, by Industry, 1980-96

(Percent)

	Industry		Services				
	Total	Manufacturing	Total	Wholesale, retail, import/export, restaurant, hotel trade	Transport, storage and communications	Finance, insurance, real estate and business services	Community, social and personal services
1980	30.4	27.3	62.8	61.7	45.8	83.7	61.1
1981	31.1	27.6	60.3	59.9	44.6	81.2	58.1
1982	32.9	28.9	59.3	57.0	44.1	78.3	60.8
1983	31.4	27.6	57.6	56.1	44.8	73.3	59.7
1984	31.3	27.9	57.9	57.9	43.3	71.9	60.1
1985	32.1	28.5	57.6	55.2	44.6	70.5	60.8
1986	31.5	27.7	57.8	54.0	45.3	71.9	61.5
1987	30.7	26.9	58.7	55.6	49.7	71.8	61.7
1988	30.3	26.4	58.3	53.9	51.6	72.4	60.7
1989	31.8	27.6	57.2	51.6	50.0	72.0	59.8
1990	33.5	28.8	55.1	48.3	49.8	70.8	59.9
1991	33.9	28.7	55.6	49.0	52.8	72.7	61.5
1992	35.1	29.5	58.7	55.2	52.5	75.0	61.8
1993	35.8	29.3	57.8	54.3	50.9	75.3	59.5
1994	36.9	29.3	58.2	53.4	52.7	74.1	59.3
1995	36.2	28.1	57.9	54.2	52.7	72.7	59.7
1996	38.7	29.2	58.5	55.5	52.5	72.9	60.3
1981-85	31.8	28.1	58.5	57.2	44.3	75.0	59.9
1986-90	31.6	27.5	57.4	52.7	49.3	71.8	60.7
1991-96	36.1	29.0	57.8	53.6	52.4	73.8	60.4

Source: Census and Statistics Department, Hong Kong SAR Government, 1999, *Estimates of Gross Domestic Product 1961 to 1998*.

TABLE 7.4
Employee Compensation Share of Value Added, by Industry, 1980-96

(Percent)

	Industry		Services				
	Total	Manufacturing	Total	Wholesale, retail, import/export, restaurant, hotel trade	Transport, storage and communications	Finance, insurance, real estate and business services	Community, social and personal services
1980	70.7	71.2	38.7	41.9	48.3	18.4	77.5
1981	67.0	66.1	40.4	45.6	48.0	20.6	73.6
1982	66.9	66.9	44.4	48.8	52.3	24.3	75.9
1983	63.1	63.6	47.5	49.9	49.7	33.3	74.8
1984	62.4	62.7	46.9	45.1	48.6	36.0	75.9
1985	66.3	67.7	49.1	49.7	49.4	38.9	75.4
1986	62.7	63.1	48.4	49.6	47.1	36.4	77.4
1987	60.9	60.1	46.0	45.5	42.7	34.8	78.3
1988	60.3	59.0	45.4	46.2	41.2	34.8	77.5
1989	60.3	59.0	47.1	49.0	44.3	36.1	79.2
1990	60.6	58.6	49.1	51.5	46.8	37.1	80.4
1991	59.6	57.2	49.2	52.6	43.6	34.4	81.6
1992	58.4	55.3	48.3	51.5	44.9	31.8	83.3
1993	59.1	56.8	48.4	52.0	45.8	30.3	83.5
1994	58.2	57.4	47.0	52.0	44.9	30.7	81.5
1995	58.9	56.9	49.9	53.7	46.6	35.0	82.1
1996	58.3	55.4	49.5	51.0	46.1	36.4	82.4
1981-85	65.1	65.4	45.7	47.8	49.6	30.6	75.1
1986-90	61.0	60.0	47.2	48.4	44.4	35.8	78.6
1991-96	58.8	56.5	48.7	52.1	45.3	33.1	82.4

Source: Census and Statistics Department, Hong Kong SAR Government, 1999, *Estimates of Gross Domestic Product 1961 to 1998*.

TABLE 7.5
Hong Kong's Ranking on Selected Competitiveness Factors, 1992-98

(Ranking out of 47 countries surveyed)

	1992	1993	1994	1995	1996	1997	1998
Overall	10	10	19	19	20	18	25
R&D Resources	15	17	21	21	19	18	29
Technology Management	6	6	13	16	16	18	17
Scientific Environment	9	9	17	17	22	20	23
Intellectual Property	27	26	27	27	29	23	23

Note: Lower rank indicates greater competitiveness.

Source: International Institute for Management Development, *The World Competitiveness Yearbook*, various issues, cited in X. Chen, 1999, p.15.

TABLE 7.6
Ratio of R&D Expenses to GNP in Selected Economies, 1990-96

(Percent)

	1990	1991	1992	1993	1994	1995	1996
Australia	1.37	-	1.57	-	-	-	1.38
Canada	1.46	1.51	1.55	1.59	1.57	1.52	1.64
China	0.68	0.66	0.63	0.57	0.48	0.49	0.48
Hong Kong	-	-	-	-	-	-	0.26
Indonesia	-	-	-	-	-		0.08
Japan	3.04	3.00	2.95	2.88	2.84		3.33
South Korea	1.87	1.93	2.08	2.30	2.58	2.69	2.81
Malaysia	-	-	0.38	-	0.33	-	0.23
Mexico	-	-	-	0.24	-	-	0.26
New Zealand	-	-	-	-	-	-	0.90
Philippines	-	-	-	-	-	-	0.14
Singapore	0.86	1.04	1.18	1.08	1.11	1.15	1.35
Taiwan	1.66	1.70	1.78	1.76	1.80	1.81	1.85
Thailand	-	-	-	-	-	-	0.11
U.S.A.	2.82	2.84	2.78	2.64	2.54	2.45	2.42

Source: Australian National University, cited in *Capital*, August 1998, No. 129, p. 74.