**Functional versus Sectoral Industrial Policy:**

**A Comparative Study of the Biotechnology Development in Hong Kong and Singapore**[*]

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Text: 7,635 words

[*]The author wishes to thank Professor Ortwin Renn (Director, Center of Technology Assessment in Baden-Württemberg, Germany) for the funding of the research on "Biotechnology Development in Asia" in 1995, upon which this article is based. She thanks also Mark Auch with assistance with data search and _____ for technical editing.

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## Abstract

The article discusses the desirability of the sectoral versus functional industrial policies by evaluating the biotechnology industry in Singapore and Hong Kong. The biotechnology industry of Hong Kong remains at the "infancy stage", whereas that of Singapore has succeeded in obtaining patents and commercializing products. The author argues that the different results are due to the practice of different industrial policies. The policy debate is relevant not only to the two city-states but to countries struggling with economic restructuring, including those confronting the current Asian currency and stock market crises. The article consists of three parts. Part I reviews the arguments of the functional versus sectoral industrial policy. Part II compares the two city-states on the biotechnology policy and the state of the biotechnology research and industry. Part III explores the desirability for Hong Kong to change the industrial policy in light of its changing political and economic contexts and the experience of Singapore. The author argues that comparative advantages are subjected to change and can be nurtured with the implementation of a sectoral industrial policy appropriately designed to accommodate historical specificity and institutional arrangements. The Hong Kong government should exercise leadership in strengthening the biotechnology development and industry through the configurations of agencies, policy goals and instruments.

## INTRODUCTION

This article evaluates the arguments of sectoral industrial policy versus functional industrial policy by comparing the biotechnology development of two city-states--Singapore and Hong Kong. The sectoral industry policy refers to a policy by which the state directs resources to targeted industries identified as crucial for their future competitiveness. Japan, South Korea, Taiwan and Singapore are taken as examples in practicing this policy. The functional industrial policy refers to a policy by which the state confines itself to stimulating an ideal market by fulfilling general economic functions. Hong Kong has been recognized as the archetypal example. Yet, the present Chief Executive, Chi-wah Tung, has openly advocated a direction different from the functional industrial policy held by the colonial government. "With suitable guidance from the government," Mr. Tung predicted, "Hong Kong entrepreneurs will quickly be able to find a new industrial direction and rally Hong Kong´s manufacturing industry." (quoted in Smith, 1997: 14). He even endorsed a call to subsidize selected industries (FEER, 1997). The pro-status quo analysts and business personnel, however, opposed to any change in the industrial policy. Nancy Smith, editor of the Asian Wall Street Journal´s editorial page, reacted, "If Mr. Tung--or any other public official in the world--hopes to come anywhere near the record of achievement, he would do well to follow the footsteps that so clearly mark the correct path" (1997:14). An assessment of the industrial policy is timely to contribute to the policy discourse in the pro-handover Hong Kong (Stone & Lam, 1997).

This article evaluates the desirability of the industrial policies by comparing the biotechnology development of Hong Kong and Singapore--two city-states of comparable stages in economic development, domestic and regional market size and entrepreneurial tradition. The two city-states are archetypal examples of development by a natural resource poor, export-oriented

economy. Having fully utilized land and labor resources during the three decades of post-war development, both city-states are now trying to solve problems associated with a maturing manufacturing economy (Chiu et al., 1997)

Biotechnology is considered to be one of the most pervasive technologies developed in the second half of the twentieth century, as with microelectronics. Biotechnology is defined here as an activity involving recombinant DNA and/or cell fusion technology (ATAS, 1992). This technology has the potential to improve areas in agriculture, food processing, organic chemicals, medicine and waste treatment. The biotechnology industry demands low labor and energy input, modest capital outlays and high knowledge intensity, and the production yields high added value. The development of the technology and industry has been identified as one of the priorities in economic development by Japan, South Korea, Taiwan, Singapore and Hong Kong (Tsui-Auch, 1997a).

The biotechnology development has caused a lot of controversies. Products that have been generated are mostly health care products and foodstuffs. Public perception surveys in both Western and Asian countries report a similar anxiety about the unknown health risks, side effects, and danger of misuse (Macer, 1992; Tsui-Auch, 1997b). The commercialization of biotechnology research may take a longer time than that of, say, the semiconductor, owing to long waiting periods for approval and huge costs in development and clinical tests.

Both Hong Kong and Singapore, being latecomers with a comparatively small pharmaceutical and food production sector, small domestic market, little venture capital and limited bioscience base, are expected to encounter barriers to the technology and markets. Nevertheless, both enjoy an environment favorable to the development of high value-added activities--with the strategic position to the growing Asia-Pacific market, international business and language environment, advanced communication and transportation infrastructure, and supply of educated

workforce. Despite the comparable economic base, the city-states have different results of biotechnology development. The biotechnology industry of Hong Kong remains at the "infancy stage"[i], whereas that of Singapore has achieved significant milestones in obtaining patents and commercializing products. I argue that the different results are due to the practice of different industrial policies.

This article consists of three parts. Part I reviews the arguments of the functional versus sectoral industrial policy. Part II compares the two city-states on the biotechnology policy and the state of the biotechnology research and industry. Part III explores the desirability for a change of industrial policy of Hong Kong with reference to its changing political and economic context and the experience of Singapore.

**REVISITING THE ARGUMENTS**

The past three decades' rapid industrialization and economic growth of the Asian economic powers have continued to trigger debates over development theories and policies. The Asian industrial success has been attributed to the interventionist state that not only maintained the general conditions conducive to commerce and investment but channeled resources to selected industries. The governments of Japan, South Korea, Taiwan and Singapore directed industrial development through (1) using direct and indirect subsidies to protect selected industries and to promote export, (2) setting up planning agencies and public institutes for R&D, (3) investing heavily in industry- and technology-related education, and (4) generating a national consensus to support the industrial development despite their short term costs ( Johnson, 1982; Amsden, 1989; Wade, 1990; Chiu, 1997).

An increasing number of researchers, however, increasingly question whether the state can and should maintain an activist role, in view of the rapid world economic restructuring since the

1980s (Maclntyre et al., 1995). The domestic capital has been demanding for a greater autonomy from the state (Harris, 1991). The Western industrialized countries and their allies--World Bank and International Monetary Fund--have been pressing the Asian governments for reducing state intervention and allowing for "more market". The enormous ideological and reform pressure from the IMF on the governments of South Korea, Indonesia and Thailand is vividly demonstrated in the current Asian currency crises (Wyszomierski , 1998).

The beliefs about the inherent inefficiency of government intervention have revitalized the neo-classical economics--the pre-Keynesian economic theory which had long been discarded (Balassa, 1981; Friedman, 1980). Neo-classical economists suggest that an economy be normally better off if a state limits its role to stimulate an ideal market by performing general economic functions: (1) maintaining macro-economic stability; (2) providing physical infrastructure; (3) supplying public goods; (4) contributing to the development of institutions to improve the markets for labor, finance, and technology; (5) offsetting price distortions arising in the case of demonstrable market failure; and (6) redistributing income to the poor to enable them to meet basic needs (summarized by Wade, 1990).

The lists of functions are supposed to meet broad developmental objectives but not to promote specific industrial activities. The neo-classical economists advocate a "neutral" policy regime, with no sectoral discrimination among industries, unless this is an essential step to overcome market failures (Balassa, 1981; Krueger, 1980). Some neo-classical economists, nevertheless, will advise the state provision of social overheads which are too expensive to be undertaken privately, or even a modest degree of temporary protection of infant-industry (Stiglitz, 1996). In its publication "East Asian Miracle", the World bank terms this approach a "functional industrial policy" or "market-friendly" policy" (World Bank, 1993). To the neo-classical

economists, this policy has the strength to allow resources to flow freely to profitable industries based on market signals. In the case of Hong Kong, it will be better off specializing in commercial and financial service provision rather than nurturing high-tech industries. Hong Kong is a latecomer in biotechnology and the commercial viability of the industry is unknown. To break the barriers to technology and market, the industry will require strong government financial and policy supports. The neo-classical economists assume that government intervention is likely to increase the possibility of government failures, which is more damaging than market failures.

Is the functional industrial policy more desirable than the sectoral industrial policy for latecomers? Several development economists (Lall, 1994; Pack and Westphal, 1986) argue for the opposite. They criticize the neo-classical economists for using the highly simplified trade theory, whose assumptions of efficient markets, perfect competition, and equal access to technology, knowledge and information did not match the reality. They argue that the technological upgrading requires the development of new knowledge, skills, and inter- firm linkages, and that the high risks and costs discourage individual firms from undertaking this. They suggest that a state should adopt a sectoral industrial policy to subsidize technological upgrading, and to help producers move away from low-tech production and areas of established competitiveness.

However, in spite of sharing similar critiques of the neo-classical economic theory, development economists vary in the policy advice to nations. Pack and Westphal (1986) suggest that the effectiveness of a sectoral industrial policy depends on the "government's ability" which is shaped by the "socio-political factors," namely, the internal workings of the government and its interactions with various interest groups. Lall (1994), while seeing no single model of the state-market mix, argues strongly for a sectoral industrial policy, with the government carefully monitoring the selected strategic industries in order to achieve technological upgrading and

competitiveness in the world markets, without returning to the old strategies of import substitution, irrational intervention, and rent-seeking. He sees the question of state capacity to undertake effective intervention as going beyond the realm of economy to that of political economy.

Lall (1992) does not see Hong Kong´s economic growth as a validation for the functional industry policy. He considers Hong Kong to have failed in technological upgrading. He attributes its capability to maintain economic growth, despite its technological backwardness and deindustrialization, to its unique location and its ability to serve important functions for Mainland China. However, with the establishment of direct links between China and other Asian countries and the increasing regional competition in financial, commercial, and transport service provision, Hong Kong´s ability to maintain its economic growth is increasingly called into question. To the advocates of sectoral industrial policy, the Hong Kong government will need to provide direct supports to selected technology and high-tech industries crucial for future competitiveness.

## BIOTECHNOLOGY DEVELOPMENT OF SINGAPORE & HONG KONG

The design of industrial policies has never been isolated from the historical legacy and institutional environments (the relationship between the state, capital and labor) (Chiu et al., 1997). Hence, the historical context and institutional environments of each city-state and the path each has taken in industrial development needs to be taken into account in discussing the biotechnology policy.

### A. Singapore

As with Hong Kong, Singapore was developed primarily as an entrepot under the British colonial policy and local industries were treated as secondary. However, the entrepot trade was

negatively affected by the turbulence of the regional politics in the 1960s. The nationalist movements in the South-East Asian countries led to the adoption of the import-substitution industrialization, hence reducing the imports from the Singaporean port. Singapore´s independence from Malaysia meant a loss of the Malaysian market (Ho, 1993). The setback in the entrepot trade paved way for the shift to focus on industrial development. Facing a lack of strong indigenous capital, the government focused on encouraging foreign direct investments and succeeded in attracting investments in textiles, petroleum, pharmaceuticals and electronics industries. However, the rising labor costs since the 1970s made Singapore less competitive in attracting labor-intensive production investments than its neighboring countries. Yet, it became increasingly competitive in the provision of regional business and financial services. The government gradually shifted its focus to that of fostering a technical and geographical division of labor with its neighboring countries (Chiu et al., 1997). It initiated the Operational headquarters scheme in 1986, offering tax incentives to attract multinational corporations to locate their regional headquarters function in Singapore. It announced the "growth triangle" concept in 1989, inviting the state of Johor (Malaysia) and the Riau island (Indonesia) to form an economic cooperative zone with Singapore. Nevertheless, both Indonesia and Malaysia remained unsure about the balance of the advantages for them and were not fully committed to offering strong support for infrastructure and human resources development. Johor and Riau, unlike the southern Chinese coastal provinces, have no massive hinterlands to recruit additional labor and no potential market for the foreign production (Abegglen, 1994).

Lacking in a "natural" hinterland for cheap labor and land supply as compared to Hong Kong, Singapore has fewer alternatives but to commit to higher value-added activities. The government identified the route to move the economy up the value chain as that of raising the technology content. Biotechnology was identified as one of the technologies Singapore would be

able to contribute and gain. Despite a small domestic market, Singapore is well positioned to facilitate multinational corporations to penetrate the potential markets of South-East Asia and China. The government has long directed the universities, especially the science and engineering departments, to orientate toward market-driven technological research and international linkages. The country has been open to the recruitment of expatriates. Singapore has attracted significant foreign investments in the chemical and pharmaceutical industry. As of 1978, Singapore became one of the only ten countries in the world that exported more pharmaceutical products by value than what they imported (Gereffi, 1987). As of 1995, there were 61 companies in the chemical/petrochemicals sector. However, the presence of multinationals did not lead to substantial technological spin-offs as expected, since most of them had not set up R&D facilities on the island. There were 20 firms in the chemical-linked sector (food products, beverages and tobacco, and rubber and plastic products), seven of which were local small- and medium-sized enterprises and four of which were Singaporean multinational corporations (NSTB, 1995). The Singaporean enterprises lack capital for investing in new technologies and have limited access to financing in the private sector, since Asian venture funds hesitate to finance ventures that do not guarantee profit.

**The biotechnology policy**

To overcome the initial disadvantages of the latecomer, the Economic Development Board (a statutory board under the Ministry of Finance) spearheaded the biotechnology development. They first developed the infrastructure for R&D and human resource training and technology, and made a gradual shift towards the promotion of biotechnology investments (Teoh, 1996). The National Biotechnology Program Unit was established in 1988, and the National Biotechnology Committee was appointed to head the program (Teoh, 1996). The Economic Development Board set the priority on developing pharmaceutics and diagnosis that were expected to yield high value.

Nevertheless, it also encouraged the development of agricultural and food biotechnology for the future penetration into the South-East Asian markets and to meet the needs of local small- and medium-sized enterprises in the food sector (Komen & Cohen, 1995).

The government contributed substantial financial support for the establishment of centers of excellence. The Economic Development Board has offered over US$100 million to the sector through the funding of the Institute of Molecular and Cell Biology (Miller, 1996). The institute, set up in 1987, hosted 161 research scientists and engineers as of 1995, with 66% holding Ph.D. and many recruited from Western countries, working on a hundred projects on cell regulation, molecular neurobiology, plant genetic engineering, and tumor virology and immunology (IMCB, 1996). The institute has established three spin-off companies to commercialize its research, with Gene Singapore for the development and marketing of human health care products for the Asian market, GeneSing China for the development of biotech products for the China market, and TetGen for the development of technologies for novel plants and produce (Yuan & Hsu, 1996).

The second major institute is the Institute of Molecular Agrobiology on agrobiology research and development of agro-business partnerships. It has succeeded in forging links with the Chinese Academy of Science (Beijing) to co-develop and commercialize agro-biotechnology products. Through its investment arm, IMAGEN Holdings, the institute has been collaborating with two US partners to produce and market genetically-engineered bollworm-resistant cotton seed technologies to China (Synergy, 5/1997).

To bring laboratory scale research closer to commercial scales, the Bioprocessing Technology Center was established. It provides bioprocessing assistance and custom services to clients for specific product development (BTC, 1996). Its incubator unit plays the role of

"nursery" for biotech company start-ups by sharing the expensive common infrastructure. It has facilitated the fast launch of companies like GeneSing (Singapore), Specialty Laboratories (US) and Oculex Pharmaceuticals (US) (BTC, 1996).

The clinical research environment has also been improved to meet the needs of a maturing biotechnology industry for clinical trials of therapeutic products. Quintiles East Asia Pte Ltd. collaborated with the National University of Singapore to establish a regional clinical research program. By 1998, the program is expected to have trained some 300 professionals in procedures that meet up to Good Clinical Practice standards (Synergy, 6/1996).

The Economic Development Board has been careful to balance the interest between the large multinational corporations and small-and medium-sized enterprises. It has devoted resources to improve the biotechnology manufacturing capabilities. The Department of Pharmacy of the National University of Singapore collaborated with GEA, a well-known German manufacturer of bioprocessing equipment to set up the Pharmaceutical Processing Research Laboratory. For example, herbal medicine manufacturers can get help from the Laboratory to modernize their processes, an essential step for the entry into the global markets (Synergy, 5/1997).

Science parks were also built to foster frequent exchanges and linkages between the industry, academy and government. In a location close to the National University of Singapore, the Singapore Science Park was established. Complementing the science parks are two dedicated parks: (1) Agro-biotechnology Park for companies to conduct pilot field tests of agricultural products and (2) the Pharma Zone for pharmaceutical activities (Synergy, 1997).

Singapore cannot supporting a large academic infrastructure like the big national economies of the US and Western European countries. Only three universities provide undergraduate and

post-graduate training in bioscience. Two schemes were established with the provision of funding: (1) to support personnel from the industry and academy for taking short courses and research attachments overseas, and (2) to encourage companies to send employees to local universities to work on projects for technological learning (Tan & Byrue, 1996).

Since 1991, the Economic Development Board has made a gradual shift from building infrastructure for research to strengthening the biotechnology industry and the commercialization of R&D. It set up a venture capital fund (of $20 million), Singapore Biotech Pte Ltd, to enhance the commercialization of indigenous inventions and to make investments in viable biotech projects both locally and abroad. It has already made investments in 15 firms from Asia, UK and US. It established a subsidiary in the US to tap the advanced biotechnological knowledge (Chaturvedi,1996). The subsidiary identified a market niche of a vaccine against Hepatitis B (an endemic disease in Asia), and ventured into a licensing and marketing agreement with a US start-up biotechnology company, to bring the vaccine to the Asian market (Synergy, 5/1997).

The Economic Development Board has provided generous tax and financial subsidies and incentives to both local and foreign firms (Yuan & Hsu, 1996). As of 1992, the National Science and Technology Board committed grants for R&D in the private sector that amounted to US$25.7 million. A number of companies have set up R&D, clinical trials and manufacturing in Singapore, and used Singapore as a stepping stone to penetrate the Asia-Pacific market including China.

The promotion of R&D and investments have been complemented by the efforts to establish a conducive legal and regulatory climate for the industry. Singapore is a signatory of the Patent Cooperation Treaty (PCT): a patent approved in the country is valid in the other 44 PCT

countries including US and Western European countries (Synergy, 6/1996). The formulation of Good Manufacturing Practice certification, ISO 9000 Schemes and especially the patenting scheme are important steps taken to enhance biotechnology industry (Teoh, 1996).

**The state of biotechnology development and industry**

The biotechnology institutes and industry have achieved significant milestones in obtaining patents, commercializing products, developing technologies for biotechnology research, and forging international linkages. The Institute of Molecular and Cell Biology has got patents on potential cancer treatments and diagnosis and filed several other patents on the biomedical research. It has commercialized DNA repair enzymes as a prognostic tool in cancer therapy. The institute has developed new technologies in the field of cancer immunotherapy and transgenic rat-related technologies. Stocks of recombinant human tumor necrosis factor-ß have been manufactured and are available on a commercial basis. Science magazine described the institute as "the biology lab to watch in Asia"(IMCB, 1996). The Bioprocessing Technology Center has filed a joint patent with the Department of Chemical Engineering, National University of Singapore on a novel technique for determining ascorbic acid, and developed a flow injection biosensor system for fermentation and cell culture needs. The "Singapore Biotech Pte Ltd" succeeded in bringing the Hepatitis vaccine to the Asian market. A number of multinational corporations have conducted clinical trials of their products in Singapore for the Pacific Rim region. The Economic Development Board predicted in 1997 that Singapore´s pharmaceutical, healthcare and biotechnology cluster would grow more than 10% annually over the next few years. As of 1996, the total output from this cluster amounted to US$1.57 billion (Synergy, 5/1997).

Singapore has already made advances in agro-biotechnology. As of 1996, Singapore has captured about 80% of the premium niche market for orchids and about 20% of the mass orchid market (Synergy, 6/1996). Wiltech Agro, a Singapore-based orchid grower has set its aim to capture 50% of the world market for orchids by franchising its concept of high-tech orchid farming in Singapore, Malaysia and Indonesia (Synergy, 6/1996).

Singapore succeeded in forging international linkages. 80 multinational corporations are operating in the city-state, including Glaxo Wellcome, SmithKline Beecham, Becton Dickinson, Baxter, Schering Plough, Oculex, Corning Pharmaceutical (Synergy, 5/97). Glaxo donated US$50 million to the Institute of Molecular and Cell Biology, the only example of a leading multinational corporation investing in an Asian basic research institute. Genelabs Diagnostics collaborated with the National University of Singapore on the research of various molecular approaches to identify and verify infectious agents. Eli and Company collaborated with the National University of Singapore and the National Science and Technology Board to set up Singapore´s first clinical pharmacology Center (Synergy, 5/1997). The World Health Organization collaborated with the National University of Singapore to set up the WHO Immunology for the research on Hepatitis B diseases (EDB, 1995). The Institute of Molecular and Cell Biology set up a West-East Center for Microbial Diversity jointly with the Economic Development Board, Glaxo, and University of British Columbia (Canada). The Institute of Molecular Agrobiology has forged a strategic alliance with CIRAD, a French state-owned research organization to develop biological techniques to study tropical crops and livestock (Synergy, 6/1996). Singapore has become the location for the APEC Coordinating Center for Good Clinical Practice in 1996 to bring the APEC countries together for the development of a

common framework to assess medicines for the region and to gain regulatory approvals (Synergy, 5/1997).

**B. Hong Kong**

From its inception as a British colony till the mid-20th century, Hong Kong was defined as an East Asian entrepot, although modern manufacturing had become the largest employment sector in the 1930s (Ngo, 1997). The colonial government regarded any economic investment other than trade as politically risky, given the political turbulence in China. Furthermore, it had never wanted to promote industrial development since it was beyond the imperial plan and the control of the trading and financial interests. However, Hong Kong lost virtually all of its entrepot trade with China as a result of the US´s imposition of an embargo on all the goods of Chinese origin and the United Nations' prohibition of the export of essential materials and strategic goods to China--steps taken to penalize China for its support of North Korea during the Korean War. The late 1950's saw the beginning of industrial diversification toward the manufactures of plastics products, clothing and textiles, and electronics. Throughout the 1950s to the 1970s, there were several attempts from industrialists to seek subsidies for industrial development, especially in the face of rising land costs resulting from the high land price policy of the government. These proposals, however, encountered strong opposition from the financial-trading capitalists, who insisted on the maintenance of a free market, a low profit tax and a "small" state. The government subscribed to the functional industrial policy and remained unwilling to subsidize industrial and technological development (Tsui-Auch, 1998). The public expenditure on R&D as a percentage of GDP accounted for only 0.1 percent in Hong Kong as compared to 1.13 % in Singapore as of 1995 (NSTB, 1995).

To cope with the intensifying regional competition and high wage and land costs, manufacturers relied on cost-cutting by relocating their labor-intensive processes to Southeast Asian cities in the 1970s, and to China since the early 1980s. With cheap labor and land in China, manufacturers felt no urgency for industrial upgrading. Hong Kong was increasingly relying on the booming financial and business service sector to generate jobs and growth. However, some academics and policy-makers have been worried about the fact that the growth of the service sector might not increase drastically enough to offset the negative impact of deindustrialization, and hence pressed the government to provide support for high-tech development, including biotechnology (see Kao & Young, 1991). Finally in 1992, the government established the Biotechnology Committee to "keep a close contact" with tertiary research institutes and business organizations. Nevertheless, the Committee was only an advisory group without any financial power (Yuan & Hsu, 1995).

Hong Kong lacks an industrial base in agriculture and pharmaceuticals. There are about 100 pharmaceutical companies operating in the territory, performing functions of marketing and distribution of generic pharmaceuticals (off-patent drugs, antibiotics) and traditional Chinese medicine and regional co-ordination (Berger & Lester, 1997). There were about 35 firms in the food industry, mainly for processing Chinese food products, and supplying Western food products (Yuan & Hsu, 1995). The financial institutions did not support high-risk industrial ventures. Nevertheless, a number of overseas funds that used Hong Kong as a springboard to invest in China had an access to an investment fund of $5 billion (Yuan & Hsu, 1995). Furthermore, Hong Kong lacks a bioscience infrastructure and expertise to give a push to the basic research on biotechnology.

**The biotechnology “policy”**

The Hong Kong government made no plan and program on biotechnology. With the impending China takeover of Hong Kong, the government had no intent to steer the colony toward high-tech industrialization. Its approach was highly market-driven, encouraging the survival of the fittest. The government offered a total funding of only $3.2 million on biotechnology development (including infrastructure, R&D and information and training) in the fiscal year 1993/94 (Yuan & Hsu, 1995). It provided some modest support to the biotechnology industry--offering industrial lands at lower costs, modest assistance to start-up firms, and overseas promotion schemes.

Biotechnology research has been undertaken in only two institutes: (1) the Biotechnology Research Institute, and (2) the Hong Kong Institute of Biotechnology. The former was set up to conduct basic research in genetic engineering, protein design, drug delivery, diagnostics and Chinese herbal medicine (Miller, 1996). However, it did not even have its own site and building but was established as a center in the Hong Kong University of Science and Technology. The latter was established to transfer technology to private companies, and to introduce new products and processes. The establishment of both institutes relied predominantly on the donation of the then Royal Hong Kong Jockey Club (now Hong Kong Jockey Club), which derived its revenues from horse races and contributed to local charity. Both have used the donation for equipment procurement or construction of buildings, leaving little for R&D (Berger & Lester, 1997). Some research in rDNA technology was carried out in several universities, but there are no products at the discovery stage. The strongest branch of biotechnology R&D in the universities is traditional Chinese medicine (Berger & Lester, 1997).

The Hong Kong Institute of Biotechnology is the only institute that is close to the industry. It offers facilities and equipment for researchers from tertiary institutions to do R&D, and assists in postgraduate training. It offers an incubator facility to enhance the commercialization of locally

generated biotechnology-based innovations. It has strengthened the in-house R&D capabilities in bioprocessing, bioengineering, receptorology, drug discovery and plant tissue culture (HKIB, 1995). Its GMP Manufacturing Center is being upgraded for the manufacture of recombinant malaria vaccine licensed by the National Institute of Health (US). The Center has been offering consulting services to two local manufacturers of Chinese traditional medicine on GMP implementation to facilitate the overseas sales of their products.

To enhance the partnerships with Chinese biotechnology research institutes, the institute signed an agreement with the China Innovation Center for Life Science to explore the opportunities for biotechnology R&D between Hong Kong and China. It has also formed a joint venture with Techpool Hong Kong Ltd. (a subsidiary of Guangdong Techpool) to develop purification technologies of human urine (based on samples from China) for both research and clinical purpose (HKIB, 1997).

As for international linkages with biotechnology firms, the institute has established a joint venture with Syntex Pharmaceutical International Ltd in 1990 to use advanced biotechnology techniques to screen drugs in traditional Chinese herbal medicines (HKIB, 1995). It collaborated in research with two firms, Neuromedical Systems (US) and Amersham Radiopharmaceuticals (UK) (HKIB, 1997).

**The state of biotechnology development and industry**

Some research in rDNA technology was carried out in Hong Kong, but there are no products at the discovery stage. The strongest branch of biotechnology R&D is traditional Chinese medicine. Biotechnology industry remained at an infancy age with a very small number of firms involved in the manufacture of diagnostic kits. There is no manufacturing of biopharmaceuticals and generic pharmaceuticals. So far, only a handful international pharmaceutical and medical device

firms have set up facilities in Hong Kong such as 3M, Abbott Labs, Conner Pharmaceuticals, Ferring Pharmaceuticals, Schering-Plough, and Vickmans Laboratories (Miller, 1996). The local pharmaceutical firms are unlikely to undergo technological upgrading, although the Hong Kong Health Department has attempted to introduce Good Manufacturing Practices.

**FUNCTIONAL VERSUS SECTORAL INDUSTRIAL POLICY**

The state of biotechnology development and industry in Singapore and Hong Kong is very different: Singapore has achieved significant milestones but Hong Kong remains at the infancy stage. The neo-classical economists might argue that the underdevelopment of the biotechnology industry of Hong Kong shows limited commercial viability and that it is unworthy of any selective support. They might also argue that the service sector and manufacturing opportunities in China can well support its economic growth and provide ample lucrative investment opportunities for investors (Enright et al., 1997). However, such dependence on the service sector and China´s supply of cheap labor and land carries many risks for the future. On the one hand, Hong Kong has already lost some competitiveness in container port service and transhipment port service to Singapore, and potentially to Kaohsiung (Taiwan) and the ports in the Pearl River Delta region and Shanghai (FEER, 1994). Its entrepot business that has been revitalized especially after the opening of China is likely to decline with the possible introduction of direct shipping services between China, Taiwan and South Korea. On the other hand, the dependence on labor and lands of China might subject the manufacturers to the possible threat of labor unrest and breakdown of law and social order in China (Wehrfritz, 1995). Manufacturers pumped much of the profit made in China into real estate and stock markets in both Hong Kong and China, to make a quick profit, instead of investing in technology upgrading to raise productivity. Such a "rational" choice of the manufacturers from a neo-classical perspective has nurtured the "bubble economy". The fall of the

stock prices and the resultant chain effects of property price slump, business downturn, downsizing and bankruptcy have vividly demonstrated the problems of the unbalanced economy. In fact, corporate downsizing has taken place even before the current Asian currency and stock market crises. Service providers gradually shifted lower value-added operations to cheaper sites. For services which could not be shifted overseas, providers cut costs by introducing labor-saving office equipment. Even large firms (Hong Kong Telecom, China Light and Power, Cathay Pacific, and SM Brewery) laid off employees or offered early retirement (Ngo & Lau, 1996).

In view of the vulnerability of the service economy and the history of the ups and downs of the entrepot trade, I argue for a balanced development between service and manufacturing based on industrial upgrading. The maintenance of the balance depends certainly on the state rather than the market in the case of Hong Kong. The present government needs to reassess the functional industrial policy long held by the previous colonial regime, which is in contrast to the sectoral industrial policy of the other strong Asian economies. Upholding too strong the past identity and pride prevents learning.

Yet, a mindless copying of a foreign system does not survive the test of local context (Czniawaska, 1996). History and institutions do matter on the different paths Singapore and Hong Kong have taken and will develop, argues Chiu et al. (1997). Berger & Lester (1997), based on a year-long study of the selected industries in Hong Kong, argue that the Hong Kong government is inapt in taking up the role as a financier of industry. Due to the long tradition of non-intervention, the government lacks the expertise and capacities to invest in the emerging technology sector. While some firms express an interest in a general subsidy of industry, most firms in the financial communities argue strongly against it. The tax is already low, and so further tax breaks to technology venture capital funds is unlikely to boost investment. Hong Kong has a dynamic

financial sector with abundant capital; there is no need to stimulate the flow of funds to Hong Kong but to direct them to the start-ups. Berger and Lester identify the reduction of risks by allowing more exit options to venture investors as an important step to increase the investment in the new technology start-ups. They suggest that the Hong Kong government explore the creation of a new class of "T shares" in such companies to be traded on the stock exchange as an intermediate step toward the formation of a second stock exchange for technology companies in the long run. Furthermore, they advocate more general government involvement in boosting Hong Kong´s competitive infrastructure, which distinguishes their approach from the neo-classical position adopted in another study of the Hong Kong industries by Enright et al. (1997).

Specifically on the biotechnology industry, Berger & Lester suggest that Hong Kong concentrate on the niches it enjoy comparative advantages: Hong Kong should set the highest priority in the development and manufacturing of traditional Chinese medicine, the second priority on the manufacturing of generic phamaceuticals, and the lowest priority in new biopharmaceuticals. Firstly, HK enjoys a bilingual environment (Chinese and English), empirical knowledge of traditional Chinese medicine in the medical research and health care community, and proximity and affinity with China. These factors will pose a barrier to competition from Western pharmaceutical companies. Secondly, Hong Kong can perform local processing and marketing of generic pharmaceuticals with an educated workforce, and sophisticated management and modern manufacturing experience. Eventually, Hong Kong can transfer these technologies to China and help China become less dependent on imported materials. The least priority should be given to the R&D-driven biopharmaceuticals due to the limited bioscience base and product development, manufacturing, sales and marketing experience, little venture capital support, inadequate regulatory ability and the fierce competition from the Western firms.

**REMARK**

The debate between functional and sectoral industrial policies is relevant not only to the city-states but to the many cities and countries which are struggling with economic restructuring. The recent setback in the Asian economies is promptly taken as "evidence" to refute the active state model (Kristof,1998). The IMF, in particular, has imposed textbook free market reforms in a heavy-handed way on South Korea, Indonesia and Thailand. The most profound reform is to let the fundamentally weak businesses fail so as to allow the free flow of resources to more productive ventures. The resultant unemployment, coupled with a lack of unemployment benefits and social safety nets typically enjoyed by some Western countries, is likely to increase social turmoil (Wyszomierski, 1997). Asian governments need to distinguish appropriate state intervention in industrial upgrading from inappropriate state intervention in investing in lavish environmentally-damaging mega-projects and fostering crony capitalism. A mindless copying of the textbook recipe of free-market capitalism model will only invite economic and social chaos.

**Footnote**:

i. This is based on the personal interview with Dr. Albert Chang (Director, HKIB) in Oct. 1998.

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