

**The Singapore Model Of Industrial Policy:  
Past Evolution And Current Thinking**

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## I. Introduction

Singapore has achieved substantial economic and social progress since political independence in 1965. Per capita income reached S\$41,513 (US\$24,560) in 2004, one of the highest in Asia. The UNDP ranks Singapore 21<sup>st</sup> in per capita GDP and 25<sup>th</sup> in the Human Development Index in 2003<sup>1</sup> The World Competitiveness Yearbook 2005<sup>2</sup> ranks Singapore as the third most competitive economy in the world. The Global Competitiveness Report 2004-2005<sup>3</sup> ranks Singapore 7<sup>th</sup> in growth competitiveness and 10<sup>th</sup> in business competitiveness.

The Singapore economy has progressed through different stages of development, from being labour abundant and capital scarce to labour scarce and capital abundant. Its industrial structure has progressed from labour-intensive export manufacturing to capital- and technology- intensive manufacturing and high value added services. Singapore has become an export manufacturing base, regional headquarters of foreign multinational corporations, a financial centre, and a trading, transportation and telecommunications hub. However, Singapore can no longer compete in the regional and global economy on cost and efficiency alone and has to advance to the stage of innovation and creativity to remain competitive.

The economic success of Singapore has been used by neoclassical economists to support the role of the market, with minimal price distortions, openness to international trade, investment and technology flows, macroeconomic stability from fiscal and monetary prudence, and high savings and investment. On the other hand, the revisionists argue that Singapore demonstrates the success of government intervention in the economy to create national competitive advantage through selective industrial policy. Singapore conforms to the characteristics described by neoclassical economists, but with strong pro-market government intervention and industrial policy.

Singapore's proactive industrial policy has often been negatively compared with the *laissez faire* approach of Hong Kong, China, since both are highly successful city-state economies. However, initial conditions for industrialization were different. Hong Kong, China's entrepot traders had developed experience and expertise in marketing the manufactures of mainland People's Republic of China (PRC) and could be used to launch export manufacturing, while Singapore's entrepot traders had experience and expertise only in marketing the primary produce of Southeast Asia. Also, Hong Kong, China enjoyed an influx of Chinese industrialists and industrial capital fleeing communist PRC in the late 1940s and early 1950s, resulting in a transplant to Hong Kong, China of mainland capital, expertise, industrial production and export. In contrast, government and foreign direct investment played a crucial role in launching Singapore's industrialization drive.

The paper is structured as follows. Section II summarizes Singapore's economic performance. Section III examines the evolving industrial strategy. Section IV examines major policies and performances. Section V concludes.

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<sup>1</sup> See Human Development Report 2005.

<sup>2</sup> Published by the International Institute for Management Development (IMD).

<sup>3</sup> Published by the World Economic Forum.

## II. Economic Performance

### GDP Growth and Structure

**Table 1** presents some indicators of Singapore's economic performance. Singapore enjoyed an average annual GDP growth rate of 8% and a per capita GNI growth rate of 8.7% during the four decades from 1965 to 2004. GDP growth rates have been volatile for the export-led and foreign direct investment-based economy. Double-digit growth rates were registered annually between 1966 and 1973, driven mainly by high growth in exports of manufactures and exports of financial services. Negative growth was experienced in 1964, 1985 and 2001. The Asian financial crisis in 1997 and a maturing economy dampened economic growth in subsequent years, but the economy managed to bounce back with a growth rate of 8.4% in 2004, slowing down to about 5% in 2005. High growth has been accompanied by a fall in the unemployment rate from double-digit in the early 1960s to 1.7% in 1990 and 5.3% in 2004, and an inflation rate that averaged 2.9% a year for the whole period. The strength of the Singapore economy is seen in its high savings and investment rates and appreciating exchange rate. Vis-à-vis the US dollar, the Singapore dollar has moved from a ratio of 1:3 to 1:1.69.

**Table 2** shows Singapore's economic structure. Since the 1960s, both manufacturing and services have been the pillars of the economy, while agriculture has been minuscule. Manufacturing share of GDP rose from under 15% in the early 1960s to over 25% in the past decade. Unlike in Hong Kong, China, there has been no substantial industrial hollowing out in Singapore. The share of services declined from 70.8% in 1965 to 60.4% in 1980 and fluctuated between 62-64% in subsequent years. Among service sectors, the share of trade has been declining, while the share of financial services and business services rose rapidly during 1965-1985, while the share of transport and communications remained relatively unchanged.

The employment structure shows the growing sophistication of the economy. Manufacturing sector showed a declining share in employment as the sector restructured away from labour-intensive industries and operation. The occupational distribution of employment shows the growing importance of the top-most occupational category of professional, technical, and managerial workers, whose share rose from 10.3% in 1970 to 42.6% by 2004.

Of the factor resources that gave Singapore its competitive advantages, only its strategic geographical location at the crossroads of international shipping and in a time zone straddling Europe and the Pacific, is an inherited factor. All others are created factors. The initial competitive advantage conferred by Singapore's geographical location and natural harbour were buttressed by the free trade policy pursued by the colonial government and continued after political independence and by investment in world-class transportation and telecommunications infrastructure, facilities and services. Extensive air, sea and telecommunications networks link Singapore with major cities and ports in the region and around the world.

The quality of economic management and political governance is also a significant factor in Singapore's economic success. Policies pursued since the mid-1960s created a strong macroeconomic environment characterized by high savings and investment and low

inflation. The high savings rate reflects compulsory savings under the Central Provident Fund as well as public sector budgetary and operating surpluses. The low-inflation environment reflects prudent monetary and fiscal policies, a free trade policy that ensures access to world goods at world prices. Economic openness has contributed to economic efficiency and helped overcome the constraints of a small domestic market and poor resource base. Political stability and probity and competence of the political leadership and bureaucracy are well known. Full employment and the CPF provide a social safety net for workers. In addition, subsidized public housing enables 85% of the population to enjoy home ownership. Policy and practice have enabled Singapore to achieve social cohesion despite a multi-racial, multi-cultural and multi-religious population.

The lack of natural resources turned out to be a blessing in disguise, as it forced Singapore to focus on its human resources. To provide an industrial workforce, Singapore revamped the educational system in the 1960s to emphasise technical and vocational education and established specialized industrial training institutes to turn out qualified technicians and craftsmen. The Skills Development Fund was established in the 1970s to support training to upgrade worker skills. Tertiary education expanded since the early 1980s to provide professionals and managers in science, engineering, business and computing. To augment the small domestic labour pool, in recent years Singapore has been actively recruiting foreign talent for both the public and private sectors. English is the language of instruction in schools and universities and the language of government and business, facilitating the operations of foreign MNCs in Singapore and linking Singapore effectively with the global economy.

#### **Total Factor Productivity <sup>4</sup>**

Studies on total factor productivity (TFP) growth in Singapore, either for the whole economy or for the manufacturing sector generally found low TFP growth, though some studies have highlighted improved TFP performance in the more recent period.

- Young (1992, 1995) estimated TFP growth for a number of East Asian economies between 1966-90. TFP growth for Singapore was only 0.2%, as compared to 1.7% for the Republic of Korea, 2.3% for Hong Kong, China, and 3.5% for Taipei, China. Young attributed Singapore's poor TFP growth performance to the compulsory national savings being used by the government for physical capital accumulation.
- Rao and Lee (1995) examined the growth experiences of Singapore during 1966-73, 1976-84, and 1987-94. During the restructuring and transition phase of 1976-84, TFP contribution to growth at aggregate level was only 7% as compared to 15% and 36% for the other two periods. The capital input component in output growth decreased from an average of 66% between 1966-73 and 1976-84 to 42% during 1987-94. The contribution of TFP to growth in manufacturing output increased from -5% during 1976-84 to 32% during 1987-94, while for the services sector, the contribution of TFP increased from 10% to 27% during the same period.
- Collins and Bosworth (1996) provided a comparative study on TFP growth for the period 1960-92. The growth in output per worker in Singapore improved from 4.3% for 1973-84 to 6% for 1984-1994. While the contribution of physical capital to growth

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<sup>4</sup> TFP estimation is highly sensitive to the specification of the production function and its underlying assumptions. The main limitations in TFP measurements are in model specifications and data inputs, such as the valuation of capital, choice of capital deflators, depreciation methods and capacity utilisation. In addition, a production functional form does not necessarily explain the underlying technology trends in the economy.

remained high in Singapore during 1960-93, the contribution of TFP to output growth rose to 50% during 1984-94 and overtook physical capital as the key driver of growth. High physical capital input to growth during 1960-73 and 1973-84 was accompanied by correspondingly low TFP growth.

- Wong and Gan (1994) analysed the TFP contribution of 27 manufacturing firms in Singapore between 1981-85 and 1986-90. The average annual rate of growth of manufacturing output during 1981-85 was 1.3% as compared to 12.0% during 1986-90. Capital and energy inputs were the main contributors to manufacturing growth in 1981-85 while the contributions of other inputs were largely negative. During 1986-90, materials and TFP became the two main contributors to TFP growth.
- Tye (1998) estimated TFP growth for 18 manufacturing industries in Singapore between 1970-1995. With overall manufacturing output that grew at an average annual rate of 8.03%, input components such as material, energy, capital, labour and TFP contributed 2.84%, 2.45%, 2.09%, 1.92% and -1.27% to output growth respectively. The oil crisis in the 1970s had a negative repercussion on economic growth as energy and material inputs which were largely imported became more expensive. In addition, the wage adjustment in 1979-81 coincided with the decline in labour productivity.
- Lall et al (1996) attributed Singapore's low TFP growth to possible data problem, in particular, errors in estimating the capital stock and real GDP, and the low level of indigenous R&D activity. R&D activities were mainly carried out by foreign MNCs in their home countries and were significantly affected by home country characteristics.

Singapore's Department of Statistics estimates the annual multifactor productivity using a translog production function and assuming constant returns to scale and competitive markets for labour and capital. In the first half of 1980s, high capital input to output growth (more than 90%) was mainly attributed to heavy investment in buildings. Capital deepening during certain periods reflects the economic development process and official policy to invest in industrial and transportation infrastructure in anticipation of demand growth in the future. Labour input in output growth is usually lower than that of capital inputs and showed more fluctuations. During the 1986-2000 period, TFP growth has been the main driver to output growth. **Table 3** shows the multifactor productivity growth estimates for 1992-2004. Output growth during this period has been highly volatile. The contributions of labour inputs have been low. The contributions of capital inputs have been high and positive. MFP growth shows wide annual fluctuations.

### **III. Evolving Industrial Strategy and Industrial Structure**

The key elements of Singapore's industrial strategy are strong government policy intervention, initially to jump start industrialisation and increasingly to restructure the economy and encourage specific types of activities; reliance on a free trade and foreign direct investment; investment in physical infrastructure and human capital to ease supply constraints; stable macroeconomic environment and industrial relations; and liberal use of fiscal incentives to lower the tax burden on business.

Since the early 1960s the Singapore economy has transformed from a regional entrepot into an export-manufacturing platform and a services hub and is now shifting towards a knowledge-based economy. The different phases are described below.

### **(1) Pre-1960: Entrepot and Military Base**

In colonial Singapore, the economic pillars were entrepot trade<sup>5</sup> and the British military base. The initial advantages of a strategic geographical location, a natural deepwater harbour, and free port policy and administrative and legal framework under British colonial rule, were reinforced over subsequent decades by the development of transportation and telecommunications infrastructure, and commercial and financial services and expertise. As primary commodities dominated the entrepot trade in the pre-1960 period, Singapore's economic fortune rose and dipped with the changing world prices and demands for primary commodities. By the late 1950s, Singapore's prospects as the regional entrepot had become adversely affected by policies of neighbouring countries to develop competing ports and direct trading. The second economic pillar was also in danger, when Britain announced in the late 1960s the phased closure of its military base in Singapore.

### **(2) 1960-65: Import Substituting Industrialisation**

The Singapore government initiated the industrialization drive in 1960. With entrepot and military base services contributing to Singapore's high per capita income, manufacturing remained underdeveloped and accounted for less than 12% of GDP. Manufacturing activities were confined to entrepot-related processing of primary commodities, military-base-related engineering services, and industries producing bulky and perishable consumer goods and services enjoying natural protection from import competition.

In the late 1950s and early 1960s, the conventional wisdom amongst international development agencies and economic consultants was to recommend import substitution, and this was the strategy recommended to Singapore in several reports.<sup>6</sup> In the transition period from British colonial rule to self government in 1959, an Industrial Promotion Board was established to promote manufacturing by the private sector. Industrial estates were planned. When neighbouring Malaya introduced the pioneer tax holiday legislation in 1958, Singapore followed suit in 1959 and the Shell corporation became the first recipient of Singapore's pioneer status tax holiday.

Between self-government in 1959 and political independence in August 1965, the Singapore government adopted an import substitution strategy of industrialization. The objective was to provide a new economic pillar to entrepot trade and to create jobs for the rapidly growing labour force. The unemployment rate had reached double-digit. As Singapore was preparing to join the Federation of Malaysia in September 1963, import substitution was considered a viable strategy as there would be the Malaysian common market. Tariffs began to be introduced in 1960 and accelerated in 1963 to conform with Malayan tariffs. Import quotas were also introduced.

The industrial blueprint adopted by Singapore in the early 1960s was based on the UN Industrial Survey Mission (1963), headed by Albert Winsemius. The terms of the Mission were to draw up a list of economically feasible industries in shipbuilding and repair, metal engineering, chemicals and electrical equipment and appliances; prepare an outline plan for development of industrial estates; and advise on the necessary economic, organisational and operational measures for promoting manufacturing industries. The terms of reference was extended to include advice on economic policies

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<sup>5</sup> Historically, the entrepot function was largely one of importing manufactures from the western industrial countries for breaking of bulk and distribution to the Southeast Asian region and the collecting of primary produce from the region for sorting, grading, processing and re-export to the western industrial countries.

<sup>6</sup> These included two World Bank reports in 1955 and 1963 and a 1960 report by a Canadian consultant.

and organization; and an overall industrial programme covering formulation of a plan for industrial estates, to financing and identification of specific industries. The Report recommended the Singapore government to continue import protection for selected industries and giving preference to the local manufacturing industry in the government's building programme. The Report foresaw the government having to participate directly to operate certain industries, if neither foreign enterprises nor local manufacturers were forthcoming. But it noted that in the long run, government participation might adversely affect the investment climate. It also recommended the establishment of the Economic Development Board with multi-functions in addition to investment promotion.

Singapore faced several drawbacks as it tried to jump-start industrialization. It had a small economy ---581 sq km land area, 1.6 million population, S\$2 billion GDP. The emergence of industries was handicapped by lack of natural resources, lack of scale economies with a small and unprotected domestic market, and high prevailing wage rates from entrepot and military base activities. It had no competitive advantage in resource-based industries, industries catering to a large domestic market, or labour intensive industries. But Singapore had an advantage over other developing countries trying to industrialize from an agrarian background. It already had well developed transportation, communications, commercial and financial infrastructure and a sizeable literate population and commercial and financial expertise.

Industrial growth in the 1960-65 period was modest. The industrial climate was adversely affected by political uncertainties and industrial unrest, as well as Indonesian economic confrontation.<sup>7</sup> However, the infrastructural and policy groundwork was laid for an accelerated industrial growth in later years. Initially industrialization focused on processing industries related to the entrepot trade --- such as petroleum refining, wood and rubber processing, and food processing ---- and labour intensive industries such as garments manufacturing, electronics assembly, and ship-repairing and oil rig construction.

### ***(3) Export Oriented Industrialization***

With political independence in August 1965 and the loss of the potential Malaysian common market, Singapore's industrial strategy switched from import substitution to export-orientation. Industrial growth averaged 18.1% a year during 1965-73. With the dearth of domestic industrial entrepreneurs and the lack of industrial technology, Singapore opted for FDI. Quantitative restrictions were eliminated and tariffs were progressively phased out in the ensuing years to reach a maximum ad valorem rate of 5% by end-1970s. As of 2004, only 6 tariff lines on alcohol products remain and are subject to specific rates of duty.<sup>8</sup> Singapore has reverted to a free trade regime.

To improve the investment climate, strict labour measures were introduced. The Trade Development Board (TDB) was established in 1983 to help local enterprises develop export markets. Tax incentives were given to encourage exporting. The EDB changed its promotional stance and marketed Singapore as an export production platform for MNCs. This was the beginning of Singapore's electronics industry. Singapore enjoyed a first mover advantage as it was one of few developing countries that had actively promoted

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<sup>7</sup> Merger with Malaysia in September 1963 led to economic confrontation by Indonesia that seriously affected the entrepot trade and led to GDP contraction in 1964. Separation from Malaysia and political independence in August 1965 ended Indonesia's economic confrontation and the resumption of entrepot trade

<sup>8</sup> These specific rates have been removed under several bilateral free trade area agreements.

inward FDI and MNC investments. Singapore also benefited when Hong Kong, China and Taipei, China investors established garment factories in Singapore to circumvent quota restrictions imposed on their home-base exports. By the 1970s, Singapore was also able to benefit from the oil exploration boom in Southeast Asia.

By the early 1970s, Singapore was experiencing labour shortage and began to import foreign workers. In 1972 the National Trades Union Congress (NTUC) was formed to foster industrial peace and the tripartite National Wages Council was formed to provide for orderly wage increases. In the 1974-79 period, industrial growth decelerated, following the impact of the first oil shock in 1973 and the ensuing global recession. Growth of Singapore's manufacturing plummeted in 1974 and turned negative in 1975, followed by recovery in 1976-80.

#### **(4) 1979-1990: Industrial Upgrading**

With economic recovery, Singapore again faced labour shortage and wage pressures. Faced with growing competition from low-cost manufacturing bases emerging in Southeast Asia, Singapore launched restructuring policies to shift the economy towards high-tech manufacturing. Measures included a three-year wage correction policy, encouraging companies were encouraged to automate, mechanize and computerize their operations, and intensified manpower development through education and training. In 1985 the Singapore economy was hit by a recession caused by both a fall in external demand and loss of cost competitiveness caused by high operating and wage costs and slump in domestic construction. The high wage policy that supported industrial restructuring and the generous CPF contribution rates turned excessive as economic growth began to slow. Counter-recessionary measures included reductions in labour remuneration, currency devaluation, and reductions in government user rates and charges. These improved Singapore's competitiveness and together with a recovery in external demand led to a rebound in Singapore's GDP. Economic restructuring resumed.

In 1985 the government had convened the Economic Committee to review progress of the economy and identify new directions for future growth. The 1986 **Economic Committee Report (ECR)** focused on both counter-recessionary short-term measures and longer term measures. For the longer term, the ECR argued that Singapore needed to find a new niche as its existing niche as an offshore production base would have eroded by the 1990s. It recommended the shift to an international business centre and attract foreign MNCs to establish operational HQs to undertake product development, manage treasury activities, and provide administrative, technical and management services. Singapore should also become an exporter of services, not just in tourism and banking, and in offshore-based activities.

Industrial upgrading during this period was evident from the increasing capital intensity per worker and value added per worker and the increasing technical sophistication of industrial operations and products. For example, in the electronics industry, Singapore shifted from labour-intensive sub-assembly to production of disk drives and computers. Singapore also became a regional services hub in trade, finance, and transport and communications.

#### **(5) 1991 Strategic Economic Plan: Manufacturing and Services as Twin Engines**

Once recovery from the 1985-86 recession was assured, the government began to plan for the longer term. The **1991 Strategic Economic Plan (SEP)** prepared Singapore for a changed economic landscape 20-30 years down the road. The SEP called for

promoting and developing Singapore as a “total business centre” and developing high tech and high value added manufacturing and services as twin engines of growth. Strategies were grouped under *Manufacturing 2000* and *International Business Hub 2000* programmes with EDB as the implementing agency.

The ***Manufacturing 2000 Programme*** affirmed the continuing role of manufacturing as a mainstay of the economy. The strategic goal was to sustain manufacturing at 25% of GDP and 20% of national employment. Policymakers wanted to avoid the rapid industrial hollowing out that was occurring in Hong Kong, China as industries relocated in droves to the Pearl River Delta. The model for Singapore’s continued role as a manufacturing base was value-chain analysis, which saw modern manufacturing and services as integrated and complementary activities. Industrial capability is an essential component of any advanced economy, providing the foundation for building advanced capabilities in science and technology, logistics and operations management. The key element of Manufacturing 2000 was the development of *industry clusters*, particularly in chemicals, shipbuilding and repair, electronics, and biomedical sciences. The strategy was to upgrade capabilities across the value chain in each industry cluster, including product and process development, production, engineering and strategic marketing. Based on detailed analysis of the value chain for various industries, the plan identified gaps in existing industry clusters and formulated initiatives and strategies to close them. The EDB established the *Cluster Development Fund* and *Co-investment Programme* to co-invest with foreign MNCs and local enterprises in joint ventures and strategic projects.

The ***International Business Hub 2000 Programme*** focused on strategies to develop Singapore as a services hub, particularly in business and finance, logistics and distribution, and communications and information. The basis for the hub strategy was the notion that key economic activities such as finance, shipping, air transport, telecommunications and information are becoming concentrated in a few strategic nodes around the world. Each node acts as a hub providing services to the extended hinterland and linking it with the rest of the world. Singapore seeks to position itself as a node in the Asia Pacific and to secure the first-mover advantage. Its competitive advantage as a services hub arises from its strategic location and in developed physical infrastructure and human resources as well as its minimal restrictions on the movement of goods, services and factors of production and its reputation of law and order and public governance. Singapore has been providing trading, transshipment, storage, breaking of bulk, grading and processing, and financing since the 19<sup>th</sup> century as the entrepot of Southeast Asia. As the region’s economies industrialised, the entrepot trade shifted from intermediation in primary products of Southeast Asia for western manufactures to intermediation in trade in manufactures and intra-industry trade. Because of its advantageous location for time sensitive shipments, Singapore became the hub for distribution and transshipment in the region. It also became a host to over 5,000 MNCs, many with divisions performing regional HQ functions. Singapore also emerged as a regional financial centre with the establishment of the offshore Asian Dollar Market in the early 1970s collecting offshore funds for offshore lending. The assets of the ACU peaked at US\$557.2 billion in 1997 before the outbreak of the Asian financial crisis. Over the years, the strategy has been to establish Singapore as a risk management centre with active foreign exchange trading, money market operations, and trading in capital and market instruments, equities and futures.

### **(6) 1998 Committee on Singapore's Competitiveness Report**

In May 1997, before the onset of the Asian financial crisis, the Singapore government had established the *Committee on Singapore's Competitiveness* to assess Singapore's economic competitiveness over the next decade and to recommend strategies and policies. The main committee, 5 industry subcommittees and a panel of resource persons, involved over 100 individuals in the public, private and academic sectors. As with the 1986 Economic Committee Report, the **Competitiveness Report** released in November 1998 contained both short term measures for economic recovery and longer-term measures to transform Singapore into an advanced and globally competitive knowledge-based economy. The main recommendations of the Report are outlined below:

#### **(6a) Maintain manufacturing and services as twin engines**

This strategy re-affirms the strong linkages between the two sectors and Singapore's need for a broad economic base to reduce vulnerability. Also, Singapore needs to balance the global orientation of export manufacturing with the regional orientation of exportable services. For example, Singapore's exportable services were more adversely affected by the 1997-98 Asian financial crisis than its exports of manufactures because services exports were more dependent on regional demand. Manufacturing makes a large contribution to Singapore's GDP, employment and foreign exchange earnings, as well as to technological progress, productivity improvement, and entrepreneurship. As Singapore loses cost competitiveness, it seeks to become a location where foreign MNCs and local enterprises produce high value added products and provide manufacturing-related and HQ services to the region. It also seeks to move along the value chain into R&D, design, logistics, marketing and sales.

**The Competitiveness Report** made strategic recommendations to develop the manufacturing and services sectors. Following on the recommendations, the EDB launched **Industry 21**, a 10-year plan to develop Singapore into a global hub of knowledge-driven industries in manufacturing and traded services with emphasis on technology, innovation, and capabilities. I21 encourages MNCs to locate more of their key knowledge-intensive activities in Singapore and encourages local companies to embrace more knowledge intensive activities and become world-class players. I21 has 5 broad strategies ---diversifying among and within industry clusters for a balanced and robust mix of industries and markets; building up world-class capabilities and global coverage; promoting innovation; developing local talent and attracting foreign talent; and creating a business-friendly environment and world-class infrastructure. **I21** has 5 other programmes to support the manufacturing and service sectors ---the World Class Companies /Promising Local Enterprises Programme; the International Business Programme; the Innovation Programme; the Resources Development Programme; and the Co-investment Programme. Paralleling the EDB's work, the Trade Development Board is promoting and marketing Singapore's total trade capabilities through its trade regulation, facilitation and promotion functions.

#### **(6b) Outward investment and regionalisation to complement the domestic economy as a source of growth**

Singapore began the outward investment drive in 1993, pushed by increasing land and labour constraints at home and pulled by a booming Asia. Outward investments would enable Singapore's growing capital resources to earn higher rates of return, bring spillover benefits from increased trade flows through Singapore, consolidate Singapore's

HQ functions, develop domestic technology, know-how and R&D, and tap foreign expertise.

The government's role in facilitating outward investments in the region is to provide basic infrastructure, sign bilateral agreements with countries that interest Singapore's private sector, encourage government-linked companies (GLCs, or state-owned enterprises) to partner with private sector companies in large scale projects, disburse various regionalisation financial schemes to assist companies venturing abroad, and establish bilateral councils to network and exchanging business information. The EDB facilitates the efforts of Singapore companies through tax incentives and grants, risk-sharing partnerships, and other broad-based support mechanisms, including the Overseas Enterprise Incentive and the INTECH scheme, which trains Singapore managers for overseas postings. Singapore government initiatives also include promoting ASEAN growth triangles and overseas industrial parks.<sup>9</sup> In recent years, the government's investment arm, Temasek Holdings, have been aggressively investing abroad. As shown in **Table 4**, Singapore's outward direct investment stock reached S\$153.5 billion by 2003 or 63% of the size of the inward FDI stock. Outward investments are concentrated in financial and insurance services (55.7% of total in 2003), followed by manufacturing (20.8%). They are undertaken by foreign MNCs based in Singapore, Singapore GLCs and the Singaporean private sector, with the largest share to Asia (49.3%), mainly PRC, Hong Kong, China, Malaysia and Indonesia.

#### **(6c) Nurture and strengthen domestic enterprises**

Singapore's longstanding free trade policy did not protect domestic manufacturers. From the mid-1960s, Singapore's industrial strategy focused on foreign MNCs.<sup>10</sup> EDB efforts to mainstream local enterprises include developing a local supporting industry to service the MNCs, particularly in the electronics industry, and the Local Industry Upgrading Programme (LIUP). By and large, local entrepreneurs have only a marginal role in export manufacturing and have limited capacity to venture abroad. Except for a handful of large GLCs, the bulk of domestic enterprises are small and medium enterprises (SMEs) comprising over 90% of business establishments, but employing only half the workforce, and contributing to one third of value added. The local SMEs in Singapore lacked the vibrancy of local SMEs in Hong Kong, China and Taipei, China. Some attribute this to the crowding out effect of the dominant GLCs and foreign MNCs in the competition for resources and markets as well as the regulatory regime that discourages non-conforming behaviour and creativity.

The 1988 **SME Master Plan** marked the first coordinated national effort to upgrade SMEs and promote entrepreneurship. A decade later, SMEs remained a problem in Singapore. Of particular concern were SMEs concentrated in the services sector serving the domestic market (in commerce, construction and real estate, and community, personal and social services) with low productivity, small scale operations and shielded from international competition. The Singapore government increasingly realized that building local enterprises is important, for sustainable development and economic depth and resilience. In the knowledge-based economy, SMEs are a source of entrepreneurship and innovation. SMEs are also needed to partner MNCs in supporting

<sup>9</sup> These include Batamindo Industrial Park, Bintan Industrial Estate, International Tech Park in Bangalore, Vietnam Singapore Training Centre and Vietnam Singapore Industrial Park.

<sup>10</sup> Local entrepreneurs did not enjoy a protected domestic market nor a local-content policy on FDI imposed in many countries. There was no concerted effort to develop local enterprise as an engine of growth, only as providing supporting products and services to MNCs.

industries and beyond. This realization has come about decades later than the other Asian NIEs of Hong Kong, China, the Republic of Korea and Taipei, China. The 2000 **SME 21 Report** further updated efforts to build up capability of SMEs. The 10-year plan specifies 3 strategic goals --- nurture innovative high growth SMEs with capacity to compete globally on a sustained basis so that a steady stream of Singapore's SMEs reach world class status; enhance the productivity of SMEs and improve land and labour resource utilisation by restructuring, revitalising and upgrading SMEs in the domestic service sector, particularly retail trade; create a knowledge-based, pro-enterprise environment that inculcates the appropriate mindset for business, encourages entrepreneurship and innovation, and eliminates barriers to organisational growth.. SME 21 is jointly implemented by the government, chambers of commerce, industry associations, and the private sector.

**(6d) Develop local and foreign manpower:**

Up to the 1980s, the pool of human talent in Singapore remained limited, reflecting a small population base as well as the legacy of educational neglect during colonial rule and more urgent priorities in the immediate post-independence years. The 1990 population census showed 61% of non-student population had not completed secondary education and only 14% had upper secondary or tertiary education. Near 40% of the workforce was still without secondary education, and about 40% of them were aged 40 or younger. By 1998, the skills profile of the workforce had improved considerably, with 34% skilled, 28% semiskilled and 38% unskilled. The **Competitiveness Report** recommends a 2-pronged manpower strategy --- to upgrade the domestic workforce and to augment it with foreign workers. The **Manpower 21 Report** lays out the blueprint for manpower development. (see later section on Human Resource Policy)

**(6e) Leverage on science, technology and innovation as competitive tools:**

Singapore has depended heavily on foreign MNCs to introduce advanced and sophisticated technology and know-how. However, it has reached a development stage where it must also develop its own science, technology and innovation capabilities. Serious efforts to develop such capabilities began with the launching of the 1991 **National Technology Plan** with strategies for developing technology infrastructure, encouraging private sector R&D activities and a human resource plan to complement the science, technology and innovation needs. The next 1996 the National Science and Technology Plan continued the core strategies and sought to increase R&D resources and efforts. In 1995, the **Innovation Programme** was launched to enhance innovation awareness, introduce new innovation systems and practices in companies, expand innovation infrastructure, and launch a national innovation framework for action.

Despite a decade of such efforts, Singapore's R&D thrusts remain modest in absolute terms, reflecting the economy's small size and strong services orientation. R&D expenditures and manpower in Singapore are small in absolute size and their shares of GDP and total employment are still behind the Republic of Korea and Taipei, China and many advanced industrial countries. The **Competitiveness Report** made several recommendations to improve Singapore's science, technology and innovation position and recommends that Singapore should become an IT hub. **Technopreneurship 21 (T21)** was announced in April 1999 to boost development of technopreneurs and it recommends strategies to promote start-ups and harness new products, services and markets through entrepreneurship and applied research. The **ICT21 Master Plan** has 3 strategic thrusts ---to develop ICT as a major growth sector; to leverage on ICT to boost competitiveness of key economic sectors; and to prepare Singapore for the information

society of the future. In January 2000 the government unveiled a programme for liberalization of the telecomms sector ---it accelerated by 2 years the timetable for full competition in the sector to 1 April 2000 and lifted the existing 49% direct and indirect foreign equity limits for public telecomms service licences. This was followed by measures to support ICT development, including changes to the legal and policy environment, assistance to promising local enterprises and SMEs, development of a strong broadband network and introduction of an ICT manpower development programme.

**(7) 2003 Economic Review Committee Report: Towards a Dynamic Global City**

The Economic Review Committee (ERC) was formed in December 2001 against the backdrop of a significantly changed regional and world environment., with slowdown in developed economies, economic rise of PRC, uncertainties in Southeast Asia, and a maturing Singapore economy. The ERC's task was to fundamentally review Singapore's development strategy and formulate strategies to upgrade, transform and revitalize the economy. There were seven sub-committees and numerous working groups involving more than 1,000 persons. As with earlier reports, the ERC report contains more immediate measures to recover from the 2001 recession and longer-term strategies to restructure the economy. For the longer term, the ERC aims to remake Singapore into a globalized, creative, entrepreneurial and diversified economy powered by manufacturing and services, with local companies complementing MNCs, and new start-ups co-existing with traditional businesses.

The Singapore manufacturing sector has been restructuring as it loses comparative and competitive advantages in labour intensive products and processes. The ERC Report recommends that Singapore identifies and develops niche areas and new manufacturing clusters through technology, market and enterprise development. Singapore has to move beyond manufacturing and become an innovative creator of products and businesses, through strengthening inter-linkages between industry, R&D and intellectual property protection. Singapore should also promote cooperation and co-development of products and processes between research institutes and local enterprises to bridge the gap between research and commercialisation. In a recent update<sup>11</sup>, the government reiterated that manufacturing will remain important to Singapore, as it diversifies Singapore's economic base and increases resilience against cyclical fluctuations in the global economy, and creates many spin-offs in other sectors of the economy. Singapore will improve supply chain management, strengthen industry clusters, intensify technology and innovation development and improve skills. Singapore will also look beyond the traditional catchment area for manufacturing FDI to include PRC, India and the Middle East. Singapore will also build connectivity by expanding the network of FTAs, investment guarantee agreements, double taxation agreements, and mutual recognition agreements to facilitate access to markets. With the trend towards outsourcing, Singapore will strengthen the enterprise eco-system to provide manufacturers with good linkages within and across clusters.

The ERC Report also notes Singapore's competitive advantages as a services hub in Asia --- strategic geographical location; well developed physical infrastructure; expertise in commerce, finance, port and airport management, hotel management and engineering consultancy; well educated and English-speaking workforce; conducive legal environment; minimal restrictions on movement of goods, services, people and capital;

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<sup>11</sup> As reported in the Business Times on 19 October 2005.

minimal restrictions on right of establishment of foreign firms; and political, social and economic stability. The Report recommends that Singapore further upgrades trading and logistics, information technology, financial services and tourism to remain competitive. At the same time, Singapore should focus on becoming a regional hub in new areas such as healthcare, education and creative industries. The strategies include removing regulatory impediments, and developing land and manpower resources for services.

### ***Priority industries and industry clusters***

**Table 5** shows the growth of Singapore's manufacturing sector during 1965-2004. There is growing sophistication as measured by value added per worker and net fixed assets per worker. There is also growing export-orientation, as the sector's export/total sales ratio rose from 32.5% in 1965 to over 60% since the 1980s. The growing sophistication is also seen in the composition of industries in 2004, as shown in **Table 6**.

The composition of industries underwent marked transformation in response to industrial promotion policies, changing factor endowment and dynamic comparative advantage. In 1960, value added by the 3 leading manufacturing industries, printing and publishing, food manufacturing, and beverages accounted for 42.8% of total manufacturing value added, but their share fell to 16.7% by 1969 to only 10.0% by 1985. The new leading industries were petroleum refining, transport equipment and oilrigs, and electronic products and components. In 1971 they accounted for 43.6% of total manufacturing value added. In 1985 they accounted for 44.9% but electronic products and components had replaced petroleum refining as the leading industry with a value added share rising from 9.4% to 27.1%, while the petroleum refining industry's value added share fell from 20.6% to 8.2%. As at 2004, the leading industry clusters are electronics, chemicals, precision and transport engineering, and biomedical manufacturing.

Singapore's industrial strategy is all about finding niches and creating opportunities **Industry 21** (I21) identified electronics, chemicals, engineering, life sciences, education and healthcare, headquarters, communications and media, and logistics as industry clusters to be nurtured:

- A world-class electronics hub in Singapore by attracting global leaders with the latest product-design, manufacturing, and applications in semiconductors, infocomms products, data storage, and key modules and global leaders in the management of new products, applications and markets.
- A chemicals industry cluster, to make Singapore a world-class petroleum and petrochemicals hub based at Jurong Island with S\$40 billion of capital investment targeted by 2010. Ten chemical plants came on-stream in 1999. The IT master plan for Jurong Island adds a e-business dimension to the chemicals cluster.
- A life science cluster with world-class capabilities in pharmaceuticals, medical devices, biotechnology, agri-biotech products, and food intermediates. Singapore is already a manufacturing hub for pharmaceutical bulk actives. The goals are to have biotechnology manufacturing output double by 2005, and 15 world-class companies, and a regional centre for clinical trials and drug development by 2010. The EDB invests in R&D and manpower development and nurture start-up companies through co-investment and venture capital in 3 dedicated investment funds.<sup>12</sup> More activities are also seen in R&D, product and process development, clinical trials and manufacturing.

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<sup>12</sup> Singapore Bio-Innovations, Pharmbio Growth Fund, and Life Sciences Investments.

- Nurture engineering to generate growth potential for existing industry clusters and to improve the possibilities for creating new industries by developing multi-disciplinary capabilities and state-of-the-art technologies. The target is to nurture 5 new industries and attract 20 global engineering centres and 50 manufacturing HQs.
- Position Singapore as world-class education and healthcare hub, with emphasis on attracting world-class universities, executive learning centres, corporate training centres, and distance learning providers. To date, MIT, INSEAD, Wharton, Chicago Graduate School of Business, Georgia Tech, and John Hopkins have set up teaching and research facilities in Singapore. For the healthcare service cluster the plan envisions Singapore as the place for timely reliable clinical trials and analysis. The strong cluster of education and healthcare companies will also support the life sciences industry.
- Build the infocomms and media cluster into a global hub in Asia for the digital economy offering a wide range of initiatives and developments in telecommunications, IT, media, e-commerce and the Internet. The telecomms sector has been liberalized and more competition introduced into the local broadcast and print media industries. Parallel with efforts to strengthen the telecomms infrastructure is the active promotion of software development, Internet builders, application service providers, portals and intermediaries.
- Build on Singapore's reputation as the premier location for MNCs to attract them to base regional and business HQs.
- Nurture a logistics and supply-chain management cluster, to develop Singapore into a leading integrated logistics hub for the Asia Pacific region. The strategy is to build up supply chain capabilities by getting third party logistics players, cargo airlines, value added distributors, and manufacturers locate their supply chain centres for Asia in Singapore. These companies provide world-class logistics services, and enhance manufacturers' global supply chains. A Free Trade Zone Logistics Park has been established at Changi Airport and a Chemical Logistics Hub on Jurong Island.

A brief survey of major industry clusters is given below to demonstrate the successful exploitation of opportunities as well as missed opportunities.

***Electronics cluster:*** The largest industry cluster is electronics. FDI has been crucial in the development of this cluster. In the late 1960s, an investment mission to the US to promote Singapore as a location and leverage on the emerging trend of US MNCs seeking export platforms in East Asia to offset rising costs at home, led to an influx of US MNCs engaged in semiconductor assemblies for export. This influx was followed by similar investments from Japan and Europe. Singapore offered low cost, easily trainable young female labour, well developed physical infrastructure and generous investment incentives. Investments in consumer electronics and industrial electronics followed. Over the next decade, the Singapore industry underwent rapid structural change and upgrading in response to global competition, technological change and shortening product cycles, as well as domestic labour shortages and rising wages. MNC responses to the changing Singapore labour market have been two-fold: process and product upgrading of Singapore operations into automated manufacturing, higher-end products, product design, and R&D and/or relocation of labour intensive operations and mature and lower-end product lines to countries with abundant low-wage labour.

By the mid-1980s, there was rapid growth in production of computers and data processing equipment, computer peripherals and disk drives, and telecommunications

equipment. In the 1990s, Singapore invested heavily in semiconductor manufacturing, design, and development --- wafer fabs, IC-design houses, test and assembly facilities, and supporting industries. With the high capital intensity, co-investment by EDB was seen as necessary. By 2004, the electronics cluster produced S\$69 billion worth of output. There has been a shrinkage of the industry in terms of number of establishments and total employment, as many labour intensive operations relocated out of Singapore, remaining firms upgraded and reduced employment, and new firms were more capital intensive. Trade data show domestic exports reached S\$34.1 billion for office machines and S\$17.0 billion for electronic parts and components in 2002. The cluster continues to attract the largest investment commitments in manufacturing as the EDB actively promotes investments to manufacture high value-added products, carry out R&D, create and manage intellectual property and manage regional operations.

***Chemicals cluster (including petroleum refining):*** The second largest industry cluster is chemicals. Petroleum refineries were established in the 1960s and 1970s, using imported crude from the Middle East and leveraging on Singapore's role as a bunkering centre, its established entrepot trade in petroleum, and its proximity to Asia Pacific markets. When new refineries in the Middle East and in neighbouring countries came on-stream in the 1980s, Singapore upgraded its refinery operations and also developed a petrochemical complex using feedstock from the refineries. The three Singapore petroleum refineries ---- Shell, Exxon and Mobil ---- produced naphtha, which could be cracked into ethylene, the building block of a whole host of downstream petrochemical products. Political stability was the sine qua non for locating capital-intensive industries with a long payback period.

With the lack of land for the facilities a major constraint, EDB spent S\$4 billion to build Jurong Island, a 3,200 hectare offshore chemical complex with world class infrastructure and capabilities. The chemical complex produced S\$22 billion worth of goods in 2003. The Singapore location provides communications, logistics and financial infrastructure as well as connectivity to global markets to effectively and efficiently manage their Asian businesses.

***Shipbuilding, shiprepair and oil rig cluster:*** This originated with the conversion of the British naval dockyards to commercial use. This and the legacy of engineering skills from the British naval base and the role of Singapore as a major port-of-call provided the initial locational conditions. A supertanker took 24 to 36 hours to de-gas itself after dropping off its cargo of crude oil at a Japanese refinery. This was the time a supertanker leaving Japan for the Middle East needed to reach Singapore, where repairs and maintenance can be done to prepare it for uplifting its next cargo in the Arabian Gulf. Singapore's geographical location at the tip of the Asian continent between the Indian and the Pacific Oceans provided the niche to establish a thriving ship-repair industry. At its peak, the Singapore shipbuilding and shiprepairing employed more than 20,000 workers in Singapore. These activities declined with waterfront shortages and rising labour costs in Singapore in the 1980s, resulting in major relocation of activities to elsewhere in the region. Ngiam Tong Dow, a retired senior civil servant revealed recently: "We refused to change in the earlier phase of ship-repair when the Arabian Gulf States invited us to help them establish ship-repair yards. They pointed out to us that we were using hardy Indian and Bangladeshi workers to do the heavy work in ship-repair. It might be better for our yards to employ them for work in the Gulf States directly. Our lack of foresight led to a decline in the ship-repair industry because we were too Singapore-centric. We have to be infinitely more flexible in future if we are to exploit the current

burgeoning oil-rig and exploration industry.”<sup>13</sup> The skills learnt in repairing supertankers enabled Singapore to advance into the construction of oilrigs for the major oil exploration companies. A boom in petroleum exploration in Southeast Asian waters in the 1970s led to the growth of oil rig construction. Keppel and Sembawang, which followed Jurong Shipyard in ship-repair, are now among the world's largest oil-rig builders. The challenge for Singapore is to find and maintain its niche in this industry against construction giants in PRC, India, the Republic of Korea and Japan and strategic alliances and mergers and acquisitions are on the cards.

**Biomedical sciences cluster:** The newest industry cluster is biomedical sciences, comprising the pharmaceutical, medical technology, biotechnology and healthcare services industries. The EDB and A\*Star (Singapore's agency for science and technology research) are targeting Singapore as a biomedical hub, with biomedical companies locating their manufacturing, R&D, clinical development and HQ activities. Specialised and integrated infrastructural complexes, including research and training institutes, have been developed to support the clusters. Foreign MNCs are encouraged to leverage on Singapore's rapidly growing scientific research base and intellectual property protection to develop and testbed new products and processes.

A\*STAR is overseeing the growth of this cluster. The main challenge is to turn Singapore into a centre of biomedical innovation, moving upstream from drug manufacturing to inventing and testing them. A\*Star has embarked on a vigorous PhD programme to educate and train the best and brightest students in the hard sciences to enable Singapore to be part of cutting-edge science such as stem-cell research. The government is investing nearly S\$2 billion to make Singapore a global centre of excellence in several fields, including cancer and regenerative medicine. The Biopolis is a state-of-the-art campus that clusters five public research institutes --- specialising in genomics, nanotech and other cutting-edge disciplines ---together with facilities for big drug firms and biotech research. Recently, Novartis moved its new research institute for tropical diseases into Biopolis, attracted to Singapore by its combination of rich-world facilities and proximity to poor-world afflictions, such as malaria and dengue. Eli Lilly has also set up a research centre in Singapore, as have some biotech firms, such as Paradigm Therapeutics, a British drug-discovery company. Singapore is attracting stem-cell firms too, in part due to its liberal bioethical regulations.

As with Singapore's earlier efforts to develop manufacturing industries in the 1960s and to develop the chemical complex in the 1980s, efforts to develop the biomedical complex has drawn its share of sceptics. The *Economist* (12 August 2005) notes that Singapore is a long way from the drug manufacturing centres of US and EU and has little tradition of academic research in biomedicine and few private investors schooled in the risks of biotech. Ngiam Tong Dow<sup>14</sup> questions Singapore's push for the hard sciences as it will be competing with countries with abundant human talents and resources, such as the US, Russia, EU, PRC and India. Boston Consulting<sup>15</sup> notes that while Singapore is still the location of choice for some drugs and biotech companies investing in life sciences R&D, Singapore needs to try harder if it wants to keep its lead. Singapore needs to accelerate investments and incentives for people to come to Singapore to make those

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<sup>13</sup> A recent commentary, as reported in the Straits Times on 24 October 2005.

<sup>14</sup> As reported in Straits Times on 24 October 2005.

<sup>15</sup> As reported in Business Times on 20 October 2005.

investments. In comparison to PRC and India, Singapore does not have the talent pool and domestic market.

EDB's response<sup>16</sup> is that comparison between Singapore, PRC and India may not be valid. Singapore aims to be a home-base away from home for international pharmaceutical and biotech companies, similar to the situation it has achieved in the electronics and chemicals manufacturing sectors. Southeast Asia is probably a bigger market for pharmaceuticals than PRC and Singapore is a logical springboard into this market. Singapore's strategy is to nurture a small quantity of quality companies. Singapore will continue to play a pivotal role in life sciences over the next 5-10 years amid a changing pharmaceutical landscape in Asia. By then, the reasons for investing in R&D in Asia will be driven by cost factors rather than market accessibility and PRC and India may not continue to enjoy a cost advantage. Singapore hopes to attract R&D investments in the same way it has successfully attracted investments into manufacturing.

### **Export Structure**

**Table 7** shows the growing sophistication of Singapore's domestic exports. Major domestic exports in 2004 are machinery and transport equipment, mineral fuels (primarily refined petroleum products) and chemicals.

The share of machinery and transport equipment in total domestic exports rose from 10.7% in 1970 to 25.5% in 1980 and reached a peak of 68.8% in 1995, before falling to 49.4% in 2004. In absolute terms, exports declined from a peak of S\$85.9 billion in 2000 to S\$68.7 billion in the following year and recovering to S\$82.3 billion only in 2004. This decline reflects the global electronics downcycle as well as the closure, down-sizing and relocation of electronic factories in recent years. Within the machinery and transport equipment group, the leading exports in 2004 were electronic valves, data processing machines, and parts and components for data processing machines as well as communications equipment. There is an active production network and rapid growth in intra-industry and intra-firm trade in East Asia.

The share of mineral fuels has been declining from 43.2% in 1970 to 20.2% in 2004 and comprised mainly refined petroleum products using imported crude. In contrast, the share of chemicals has risen from 2.4% in 1970 to 17.2%. The largest exports within the group are organic chemicals, followed by plastics, and medical and pharmaceutical products.

## **IV. Major Policies and Performances**

### **Foreign Investment Policy**

Effective harnessing of FDI has been an important factor in Singapore's economic competitiveness. FDI played a particularly crucial role in Singapore's pursuit of export manufacturing and development of its financial centre. Singapore's success in attracting FDI despite its lack of natural resources and small domestic market may be attributed to the holistic policy approach --- providing both an efficient and secure business environment, comfortable living, and attractive investment incentives. As shown in **Table 4**, by 2004, the inward stock stood at S\$244.4 billion. Singapore has one of the highest

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<sup>16</sup> As reported in Business Times on 20 October 2005.

inward FDI penetrations in the world, with a ratio of inward FDI stock to GDP of 135% in 2003. Sectorally, the largest concentrations of inward FDI stock are in manufacturing (37.6% of total in 2003) and in financial and insurance services (34.0%). Singapore is host to over 5,000 foreign MNCs that use the city-state as a base for their global and regional operations. The EU is the major investor in Singapore, mainly from the Netherlands, UK and Switzerland, followed by the US and Japan. Together these 3 sources of investments accounted for 63.4% of total inward FDI stock

### ***Singapore's Competitive Advantages***

Dunning's OLI conceptual framework is useful in explaining FDI. (Dunning 1993).<sup>17</sup> Economies hosting FDI have locational (L) advantages, which vary with the motivation of the investing firm. For resource-seeking investments, it is the possession of specific natural resources, labour, skills, technology or physical infrastructure. For market-seeking investments, it is the size and growth potential of the host market, including preferential access to markets in regional trading arrangements. For efficiency-seeking investments, it is the host economy's competitiveness and efficiency in producing for the export market. Increasingly capability of integrating into global and regional production networks and supply chains has become an important locational advantage as MNCs locate different parts of the production processes and service functions across the globe to take advantage of the differences in costs, resources, logistics and markets (UNCTAD 2002).<sup>18</sup>

Although some of Singapore's inward FDI includes resource-seeking and market-seeking investments, all are efficiency-seeking as they produce for export. In the 1960s and 1970s, geographical location was an advantage in the establishment of the petroleum refineries and the financial centre, while a large pool of trainable, low-wage labour was an important resource for labour intensive manufacturing. For market-seeking investments, government policies have helped overcome the small domestic market size with extensive regional and global transportation networks and regional and bilateral trading arrangements. Efficiency-seeking investments emphasise cost and productivity, which include labour and other production costs, procurement and distribution costs, efficiency for "just-in-time" manufacturing, and efficient transportation and logistics. Singapore is well integrated into the MNC international production systems and global supply chains.

Singapore's success in attracting FDI reflects the government's holistic approach to maximise its locational attractions, as well as policy consistency over time and policy

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<sup>17</sup> Firms invest abroad because of ownership (O) advantages, which can be financial assets, knowledge and technologies, brand names, organisation and management and marketing skills and distribution networks. A firm with these assets can reap rents in foreign markets through overseas production by subsidiaries and joint ventures, or enter into licensing, franchising, management, marketing and turnkey contracts. Firms may prefer FDI so as to internalise (I) the benefits of exploiting the ownership-specific advantage in particular locations, such as to reap monopoly rents or because markets for assets and production inputs may be imperfect or non-existent.

<sup>18</sup> Three forces are driving the growth of international production systems --- policy liberalisation that opens up national markets to FDI and other non-equity arrangements; rapid technological change which forces firms to tap world markets and share the costs and risks, while falling transport and communication costs makes it economical to integrate distant operations; and increasing competition that results in unexpected forms of relocation to new sites, with new ownership and contractual arrangements and involving new activities.

coherence, which provides predictability for investors, and effective policy implementation. Components of that strategy are outlined below.

**First mover advantage:** Singapore as the pioneer in the MNC-led growth model enjoys some advantages. With growing volume of investments made in Singapore, relocations are more difficult and unlikely for capital intensive MNCs --- the petroleum sector is an example of such locked-in MNC investments. At the same time, there are also instances where MNCs have been pushed out of Singapore as competitive costs change --- product lines are transferred out, leaving Singapore to be the technical support centre for trouble shooting purposes and for technical training and possibly some testing and R&D functions. But these MNCs have also enhanced their operations in Singapore in line with their global operations as well as in response to the EDB's efforts to promote industrial upgrading. Singapore tries to make itself the nerve centre for OHQs, IPOs, Approved International Traders and Approved Oil Traders, always mindful that the profit-making MNCs seek the best locations.

**EDB and investment promotion:** The EDB was established in 1961 to spearhead Singapore's industrialisation and FDI drive on the recommendations of the Winsemius Report. Initial core functions of EDB include investment promotion, development of industrial estates, and industrial financing, but only investment promotion was retained and other functions hived to new public sector agencies. The EDB is reputed to be one of the most effective investment promotion agencies in the world. "Professionalism, dedication and leadership all played a role in this success" (Hughes 1993, p15).

The EDB works closely with an International Advisory Council (which includes the global heads of leading MNCs) which advises on international and regional strategies, and with various business networks.<sup>19</sup> It maintains a network of overseas promotion offices in North America, Western Europe and Asia and targets sectors, activities and firms for investment promotion in line with the government's overall economic and industrial strategies. It functions as an effective one-stop investment centre, able to assist investors to come into production in Singapore in a matter of weeks. The EDB is able to offer investors land and factory sites location in industrial estates and parks, tax holiday incentives, and training subsidies.

Notably, the EDB focuses not only on pre-investment but also post-investment services, keeping existing investors satisfied so that they are encouraged to stay, reinvest and expand. The EDB has nurtured and managed its relationship with the MNCs, follow them throughout their stay in Singapore and even around the region. Investor satisfaction is evident from the high proportion of Singapore FDI's commitments each year comprising of reinvestment and expansion investments.

**Conducive business environment:** Singapore's core locational attractions are the underlying political, social, legal, and macroeconomic policy and institutional frameworks. In a relatively turbulent region, Singapore has been an oasis of political and social stability. Industrial peace has prevailed since the early 1970s. The political leadership and bureaucracy are noted for integrity, probity and competence, contributing to a positive business environment and low business transaction costs. Singapore has one of

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<sup>19</sup> The 2003 Council includes the Chairman of Agilent Technologies Inc, Chairman of Asahi Glass Co. Ltd, Chairman of BASF Aktiengesellschaft, Board member of DaimlerChrysler AG, and CEO of Exel plc.

the best managed economies in East Asia, as high growth has been accompanied by low inflation rates and stable exchange rates. Macroeconomic stability protected the asset values of foreign investors and contributed to cost predictability. Singapore has a transparent legal and regulatory framework readily understood by the international investment community and with a strong enforcement record. In particular, as it moves towards a high-tech and knowledge-based economy, it has put in place a strong intellectual property protection regime. Labour and skills bottlenecks have been overcome with imported foreign workers and skills training. Singapore has successfully planned its infrastructure availability and provides one of the best physical infrastructure for business, including industrial estates and science parks; world class sea and air transportation and telecommunications; and water and power supplies. From the mid-1980s, emphasis has been placed on developing a network of reliable and competent local suppliers for the electronics, chemicals, engineering and precision industries.

**Minimal FDI restrictions and generous tax incentives:** Singapore has maintained an FDI policy regime since the mid-1960s characterised by the lack of restrictions and generous use of tax incentives.<sup>20</sup> Unlike policies in most host developing countries, there is general absence of entry and ownership restrictions and performance requirements. Foreign investors are generally accorded right of establishment and national treatment (except for selected services), and are represented on various national advisory and policymaking councils and committees together with their local counterparts.<sup>21</sup> Singapore's tax incentives are not the core locational attraction for FDI, but are an important "icing on the cake". Singapore makes extensive use of the tax incentive, in part to compensate for locational disadvantages such as high cost of land and labour and a small domestic market, and in part to attract FDI into targeted sectors and activities that would promote Singapore's dynamic comparative advantage. First introduced in 1959 for pioneer industries and companies, the tax incentives cover industrial expansion, use of foreign technology, skills development, industrial upgrading, innovation and R&D, and a growing range of service activities. There are also investment allowances to encourage capital investment and reinvestment and co-investments by the EDB and other government agencies for targeted capital-intensive strategic investments.

The literature on investment incentives is highly critical of the use of the tax incentive --- tax incentives are ineffective in attracting investments, distort resource allocation, and lead to loss of tax revenue; in addition, developing host economies compete unnecessarily with each other and raise the extent and cost of subsidies.<sup>22</sup> It is impossible to estimate the quantity of FDI inflows into Singapore that would have occurred in the absence of tax incentives. However, data are available on companies that have received the pioneer tax holiday at some time or other. **Table 8** shows data on manufacturing establishments in receipt of the pioneer tax holiday. By 2003, although they accounted for only 4.1% of total manufacturing establishments, they accounted for

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<sup>20</sup> **UNCTAD (1996)** noted the increasing use of investment incentives by host country governments to encourage inward FDI. In the developed countries the financial incentives are more common, while in developing countries, except for subsidies for infrastructure in industrial estates and export processing zones, tax holidays and other fiscal measures that do not require direct payments of scarce public funds are more common.

<sup>21</sup> Representatives of foreign MNCs sit on various advisory and policy-making bodies, including the Economic Development Board, the National Wages Council, and the universities, polytechnics and research institutes.

<sup>22</sup> See for example, Hughes (1969,1993), Guisinger (1985).

73.5% of manufacturing output, 66.5% of manufacturing value added and 37.7% of manufacturing employment. With the proliferation of tax incentives over the years and the progressive reduction in the overall corporate income tax, the government should seriously consider the case for a low uniform corporate income tax. Singapore's corporate tax rate has been falling progressively from 40% in the 1960s to 20% currently and in the process, the margin of preference provided by the tax incentive has fallen dramatically. Investors, local and MNCs alike, may prefer a simple and lower uniform low tax rate, as tax incentives are both selective and temporary.

In the 1960s and 1970s, capital inflow from FDI helped to close the savings-investment gap and finance net imports of goods and services. By the mid-1980s, the national savings rate exceeded 40% of GNP and Singapore had become a net capital exporter. Nonetheless Singapore continues to rely heavily on FDI for other resources, in particular, technological and managerial know-how, and links to global production and distribution networks. The contribution of FDI to the Singapore economy can be gauged from the rapid growth and competitiveness of export manufacturing, and the rapid growth of Singapore as a financial centre. FDI contributes to the level and growth of exports and their diversification and technological and skill content. With the growth of international production systems and supplier networks, new forms of export competitiveness geared to international production systems enable host developing economies to enter technologically intensive activities and produce internationally branded products that they could not otherwise undertake. In addition, local firms benefit from arm's length licensing and OEM contractual arrangements.

**Chia (2005)** found that in 2001, foreign firms (defined in the manufacturing census as those with at least 50% foreign equity) accounted for 78.7% of manufacturing output, 71.9% of manufacturing value added, 48.5% of manufacturing employment, and 88.0% of manufacturing direct exports. The 100%-foreign firms alone accounted for 72.0% of manufacturing output, 66.6% of manufacturing value added, 42.1% of manufacturing employment, and 83.3% of manufacturing direct exports. The 100%-local firms accounted for 41.2% of employment, but only 15.0% of manufacturing output, 19.9% of value added, and 7.0% of direct exports. Technology transfer and spillover effects of FDI are more difficult to measure. Spillover effects from joint ventures between foreign MNCs and local firms have not been substantial since joint ventures have not proliferated. The MNCs' local sourcing contributed significantly to technological development of local firms, through exposure to their procedures and technologies in the buyer-supplier relationship. More recently, through the Industry Cluster Development strategy, EDB has facilitated joint ventures and technology alliances between Singapore firms and major MNCs in several high-tech industries, including semiconductor wafer fabrication and chemicals. In 2002, R&D by foreign MNCs amounted to S\$1.1 billion, accounting for 52.9% of private sector GERD and 32.5% of national GERD. The bulk of the GERD by MNCs is in experimental development (60.4%), with applied research accounting for 34.5% and basic research for only 5.1%.

#### ***Government-MNC Partnership***

Singapore's partnership with MNCs over the past 40 years has been harmonious and mutually beneficial.

Attracting FDI became a policy priority since the mid-1960s, at a time when the conventional wisdom among newly independent developing countries was to follow the Dependency School ideology of being hostile to FDI and MNCs. Singapore's FDI strategy

was motivated by pragmatism rather than ideology. FDI provided finance, technology, management, marketing and integration into global production networks and supply chains in a package. The first mover advantage enabled Singapore to leapfrog into export manufacturing in the 1960s. The Singapore government viewed the process of transforming domestic trading entrepreneurs into industrial entrepreneurs with international marketing capability as being too slow and uncertain. However, after decades of industrialisation, Singapore remains heavily dependent on inward FDI, even though it is increasingly engaged in outward FDI. Some explanations are posited. First, industrial restructuring has been very rapid for the small island nation, so that Singapore is continually in the "infant industry" mode and competitiveness can be more readily achieved by importing the necessary resources. Second, for the major part of the period, Singapore failed to develop a vibrant domestic entrepreneurial class with technological and international marketing capabilities. Third, while inward investments are generally from countries more advanced than Singapore, outward investments are generally to countries less advanced than Singapore.

The Singapore public and private sectors have maintained a favourable stance towards FDI and foreign MNCs in Singapore. Several factors explain the lack of xenophobia.

- Singapore has always been an open economy and society. These reflect a favourable British colonial heritage, a multi-ethnic, multi-lingual and multi-religious population largely of immigrant origin, an open trade policy, and lack of an indigenous industrial lobby group.
- Singapore had little choice. The EDB is conscious of Singapore's lack of resources and domestic market for the MNCs and compensates for it in other ways such as infrastructure, manpower and skills development and an attractive tax package.
- MNCs in Singapore are engaged in export-oriented activities and not in import substitution that crowd out domestic entrepreneurs or in resource development that raises issues of exploitation. MNCs which have chosen to locate in Singapore have had to ensure their competitiveness by transferring relevant product lines and technologies. Singapore's successful export-oriented industrialization rode on both the technological and expansionist paths of MNCs in the electrical-electronics, oil and petrochemicals industries.
- Singapore's business environment and macroeconomic and microeconomic policies give little room for MNC dissatisfaction ---- an efficient, transparent and honest policy making elite; excellent physical infrastructure and industrial facilities; low tax rates; clean, secure and comfortable living environment. The industrial relations climate is peaceful and there are no labour relations problems with MNCs being highlighted by the media. MNCs are represented in the tripartite National Wages Council. The MNCs participate actively in Singapore's planning and decision-making process. The EDB regularly seeks the views and ideas of CEOs of MNCs. Through various global strategy workshops and committees, the EDB seeks to integrate its own plans into those of the MNCs along their globalisation route.
- The EDB partners MNCs through co-investments in key industrial projects, and in industrial training. The latter includes joint training centres set up in the 1970s<sup>23</sup> to produce skilled craftsmen in tools and die making, precision machining, CNC machining, CAD/CAM and advanced metrology. The EDB also facilitated linkage

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<sup>23</sup> In collaboration with India's Tata, Germany's Brown Boveri and Netherland's Philips. In 1993 the Tata and Brown Boveri centres were restructured and integrated into a single Precision Engineering Institute providing precision engineering manpower and technical services to the tool and die industry. In the same year, EDB transferred the institutes to the Nanyang Polytechnic and the Institute of Technical Education.

between MNCs and local suppliers through the Local Industry Upgrading Programme (LIUP) established in 1986.<sup>24</sup> EDB also partners the MNCs when the latter relocated offshore. When relocating their labour intensive operations abroad, MNCs are encouraged to retain some of their more advanced functions and operations in Singapore. MNCs have 2 attractions to use Singapore as beach head for the region --- access to factors of production at competitive rates on a region-wide basis; and access to Singapore's well developed and efficient infrastructure.

## Human Resource Policies

Singapore had double-digit unemployment rates in the late 1950s and first half of the 1960s as growth in labour supply from rapid population growth exceeded the capacity of the stagnating entrepot trade to create jobs. Rapid economic growth during 1966-73 as well as falling birth rates led to disappearance of the labour surplus and the emergence of labour scarcity, and Singapore became increasingly dependent on foreign labour. Economic restructuring led to large job retrenchments and rising unemployment in recent years and together with slower economic growth, unemployment rates began to rise again (see **Table 9**). At the same time, Singapore continued to depend heavily on foreign labour because of skills and job mismatches.

Sectorally, manufacturing employment grew rapidly to account for 30% of total employment by 1980. As manufacturing became increasingly capital and technology intensive, its role in employment declined. Thereafter employment in the services sectors grew faster, particularly in commerce, finance, business services and transport and communications. Also, in tandem with the needs of the economy, the share of professional, technical, administrative and managerial occupations rose rapidly, while clerical and production workers declined. Singapore government intervention in the labour market has been extensive, covering policies affecting the demand and supply of labour, skills development, wages and industrial relations.

On labour demand, the government has encouraged economic restructuring by promoting investment in high value added and high tech manufacturing, and high value added services. The high wage policy of 1979-81 was specifically aimed at discouraging labour intensive manufacturing. The government has also encouraged relocation of labour intensive operations to neighbouring countries. However, labour intensive firms in the non-tradable sector cannot relocate overseas and became increasingly dependent on imported foreign labour. Foreigners currently account for 25% of Singapore's workforce. The Ministry of Trade and Industry (MTI) has shown that the contribution of foreign workers (on employment and work permits) to GDP is 30.7% between 1986-2000.

On labour supply, the government has been promoting female labour force participation, encouraging the elderly to remain in the workforce, and importing foreign labour. Female labour force participation rates have been increasing dramatically with modernization, rising levels of education and job opportunities for women, and rising wages in the labour market and this trend will continue. Labour force participation rates are high among younger women. The government is using tax incentives, provision of childcare

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<sup>24</sup> The participating MNCs provide assistance to their local vendor firms to help them improve their operational efficiency, develop new technical capabilities and become more competitive. LIUP benefits the participating MNCs with access to high-quality, cost-competitive products on a timely basis

facilities, and flexible work arrangements to encourage females to remain economically active.<sup>25</sup> Labour force participation is relatively low among older women because of low educational attainments and little work experience and low wages. Mandatory retirement at age 55, enforced since colonial times was changed by the Retirement Age Act in April 1993 that prohibits employers from dismissing workers below age 60 on the basis of age. The retirement wage was subsequently raised to age 62. One problem associated with employment of older workers today is that many of them have relatively little education and needs extensive retraining as well as job redesigning. Singapore has one of the most rapidly ageing populations in Asia. With longer life expectancy, a longer working life is necessary to keep in control the social burden of the aged for the household and society. The labour movement is currently in the forefront in encouraging employers to employ older workers and re-designing jobs to be physically less demanding, and persuading older workers to undergo training and retraining.

Since the early 1970s, Singapore has become increasingly dependent on foreign labour at both ends of the skills spectrum, from the highly qualified professionals and management executives to the unskilled housemaids and cleaners. Foreign labour is allowed into Singapore on employment-passes, S-passes and work permits.<sup>26</sup> The government actively promotes the skills inflow, including talent scouting at foreign universities, attracting bright foreign students to study in Singapore universities, offer of permanent residence and citizenship, and improving the living environment for expatriates. In contrast, government policy tries to restrict inflows of unskilled and semi-skilled workers to foster economic restructuring. In April 1987 the foreign worker levy scheme was introduced, to reduce the wage gap between foreign workers and domestic workers, with the objective of encouraging employers to use more capital and skill intensive methods of production. Two other labour levies (covering both foreign and domestic workers) were also introduced in the 1970s ---- a 4% levy on employers to contribute to Skills Development Fund, and a 2% payroll tax.

Prior to 1972, wages in Singapore were mainly negotiated on the basis of bargaining strength of unions and management. Rising wage expectations in the face of full employment led to the establishment in 1972 of the National Wages Council (NWC), a tripartite body with representation from employers, unions and government to ensure orderly wage increases. Although not mandatory, the NWC quantitative wage guidelines were influential in determining annual wage adjustments in the public and private sectors. During the 1972-85 period the wage cost to the employer consisted of the worker's basic wage, annual increment or bonus, the NWC guideline on supplementary wage increments, and the employer's CPF contribution rate. By 1985, high wage costs had contributed to the high cost of doing business in Singapore and, in conjunction with several other factors, led to a recession. NWC quantitative guidelines were discontinued and replaced by qualitative guidelines and a flexible wage system, a wage restraint policy was implemented, and the employers' CPF contribution rate was cut from 25% to 10% in 1986 to foster economic recovery. Labour market flexibility has enabled Singapore to ride the ups and downs of changes in global demand.

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<sup>25</sup> The government faces the policy dilemma of encouraging women to join and stay in the workforce and encouraging them to have children.

<sup>26</sup> Employment passes are issued to foreigners who hold acceptable degrees, professional qualifications or specialist skills with monthly basic salary of about S\$2,500. S-passes were introduced in July 2004 to increase the flexibility and responsiveness of the foreign manpower framework to industry needs for skilled manpower at the middle level earning a monthly basic salary of more than S\$1,800. Work permits are issued to unskilled and semi-skilled foreign workers with a monthly basic salary of not more than S\$1,800.

Human capital investment encompassing the rapid expansion of primary, secondary, vocational and technical education began in earnest only after self government in 1959 to meet the requirements of nation building and the manpower needs of the rapidly industrialising and post-industrial economy. Rapid expansion of tertiary education took place only from the 1980s with the strong demand for polytechnic and university education. Enrolment rates for all courses at the tertiary level have risen, but more particularly in the disciplines that were more “marketable”, that is, engineering, computer science and business studies. In the early 1990s the government targeted that 20% and 40% of each age cohort should be university and polytechnic graduates respectively. By the end of 1990s, 60% of the relevant age cohorts were receiving polytechnic and university education. Tertiary enrolment in polytechnics and universities in 2004 reached 122,144 students. In the current shift towards the knowledge-based economy, greater emphasis is given to science-based education and to changes in educational curriculum and methodology to inculcate self-learning, independent and critical thinking and creativity and innovation.

As the Singapore economy moves up the technological ladder, not only do new entrants into the labour market have to be better educated, existing labour force participants also require skills upgrading. The Skills Development Fund was established in October 1979 with the primary objective of encouraging employers to invest in the skills upgrading of their workers. The Fund is financed through the Skills Development Levy imposed on employers. The original levy rate of 2% was imposed on the payroll of workers earning not more than S\$750 per month. This was increased to 4% in 1980 and subsequently revised downwards to 1% in the wake of the 1985-86 recession. The wage ceiling has been successively raised and reached S\$2000 in September 2005. All funds collected from employers go into a common pool from which grants for approved training programmes and courses are disbursed upon application by firms. Firms can recoup their levy payments only if they train, raising the incentive for those firms that have a predominantly low-skilled labour force. In 2003, the SDF committed an annual amount of S\$93.2 million to train some 562 thousand workers in productivity and quality-related skills, computer-related skills, technical production and engineering skills, technical service skills, management and supervisory skills, and trade and craft skills.

The Manpower Development Assistance Scheme (MDAS) was set up in April 2000 and the Lifelong Learning Endowment Fund (LLF) in March 2001. The MDAS is targeted at industry-wide initiatives aimed at enhancing the employability of lower educated workers and developing the manpower needed for strategic industries. The LLF is to enhance the employment and employability of Singaporeans through initiatives that promote and facilitate the acquisition of skills. Besides employer-based training, LLF can be used to support individual-based or community-based training. Economic restructuring and corporate rationalization in recent years have led to massive job redesigns and retrenchments and rise in structural unemployment. There is growing national and individual concerns over the unemployability of retrenched and ageing workers. This led to the establishment of the Workforce Development Agency (WDA) in September 2003 to act as a catalyst of workforce development, by developing a comprehensive, market-driven and performance-based adult continuing education and training framework.

The ***Manpower 21 Report*** lays out the blueprint for manpower development. It recommends the following manpower strategies:

- Improved manpower information: Integrated manpower planning; a National Manpower Council to oversee national manpower strategies and targets; an enhanced Manpower Information System to provide relevant and timely labour market information.
- Lifelong learning for lifelong employment: A comprehensive in-employment education and training framework --- National Skills Recognition System to define and recognise skill competencies; enhancement of the Skills Development Fund and tax incentives for employers and workers; network of One-stop Career Centres to provide training and career information and counselling. University education must equip students with problem-solving skills, invest in high-tech cutting-edge research, and develop programmes for continuing education and worker training. The education system and curriculum in both schools and universities are undergoing major revamps to encourage greater creativity among students.
- Foreign workers: EDB facilitates the entry of professionals, technicians and skilled personnel and undertakes recruitment missions abroad. Singapore has an Internet site for recruiting international talent, developing programmes to enable talents to work in overseas operations of Singapore companies.
- Transform the work environment: Recommends flexible work arrangements and job re-design to keep pace with nature of knowledge-based work and to increase participation rates of women and elderly; advocates adopting best practices in human resource management and development and improving safety and health at the workplace.

Singapore faces 4 manpower challenges ---develop expertise, innovation and entrepreneurial capabilities that will enhance competitiveness and enable Singapore to stay ahead in the rapidly changing economic environment; support growth industries with the appropriate quality and quantity of manpower resources; minimise structural unemployment; ensure that Singapore workers can be engaged in meaningful jobs in which they realize and develop their capabilities to the fullest and achieve a good quality of life.

### **Local Enterprise, Innovation and Research and Development**

Unlike the other Asian NIEs of Hong Kong, China, the Republic of Korea, and Taipei, China, Singapore chose to depend on foreign MNCs to spearhead its industrialization drive and neglected the development of domestic enterprises in the early phases. After decades of industrialisation, Singapore's numerous domestic enterprises continue to play a marginalized role as the corporate scene became dominated by MNCs and GLCs. Hence Singapore faces an uphill task to develop a vibrant local enterprise community to match those of the other NIEs.

The **1988 SME Master Plan** marked the first coordinated national effort to upgrade small and medium enterprises (SMEs) and promote domestic entrepreneurship. A plethora of SME assistance schemes were hatched and implemented, including --- the Local Industry Upgrading Programme (LIUP), to help local enterprises achieve greater efficiency through the transfer of management skills and technological know-how from MNCs and large local companies; the EDB-Joint Venture Matching Service to help SMEs seek strategic alliance with foreign organizations for growth; the Business Development Scheme to encourage SMEs to seek business opportunities overseas for marketing arrangements, technological tie-ups and other business partnerships; and the Small

Industry Technical Assistance Scheme to help SMEs improve their productivity and technological standards through grants to defray part of the costs of approved upgrading projects; and the Promising Local Enterprise Program (PLE) that aims to build 100 local companies with at least S\$100 million sales turnover in ten years.

Further efforts in support of SMEs are found in the **SME 21 Report** which outlines three strategic goals for SMEs --- nurture innovative high growth world class SMEs able to compete in the global marketplace; enhance the productivity of SMEs; create a knowledge-based pro-enterprise environment. A multi-agency SME 21 Implementation Committee was formed, led by the Singapore Productivity and Standards Board (later renamed to Spring Singapore), with participation from the government, chambers of commerce, industry associations and private business. Spring Singapore administers a series of assistance schemes for local enterprises

The **Technopreneurship 21** (T21) initiative was announced in April 1999 specifically to boost development of “technopreneurs”. It recommends strategies to promote start-ups and harness new products, services and markets through entrepreneurship and applied research. The T21 has 4 broad thrusts:

- Pro-enterprise environment: Specific measures to create an environment favourable to enterprise include adopting a qualified employee stock option scheme to encourage equity ownership, revising bankruptcy laws to promote responsible risk-taking, allowing high tech start-ups to tender for government projects, relaxing work pass and long term social visit pass rules to facilitate foreigners starting techno businesses in Singapore and allowing technopreneurs to use their residential premises as offices.
- Conducive physical environment: A science hub will be developed in the Buona Vista area. The integrated development will encompass industrial R&D, commercial, social, recreational and residential uses.
- Venture investment infrastructure: To build up Singapore’s venture investment infrastructure, a US\$1 billion **Technopreneurship Investment Fund** (TIF) was established to co-invest with the private sector to provide seed money for technopreneur start-ups, draw venture capital into Singapore and develop strategic linkages and networks with other top-tier venture capital companies worldwide. The TIF is co-managed by the National Science and Technology Board (NSTB) and the Government of Singapore Investment Corporation (Special Investment). NSTB also initiated 2 other venture co-investment programmes (Business Angel Fund and Venture Investment Support for Start Ups) to stimulate early-stage investments in promising start-up companies. Under the Technopreneurship Investment Incentive scheme, companies and individuals are allowed tax deductions on losses from selling qualifying shares or liquidating investments in approved start-ups.
- Education: Effective in 2003, the universities (National University of Singapore and Nanyang Technological University) will supplement the GCE A level exams with a reasoning test, project work and extra-curricular activities in determining admission, to reinforce and complement ongoing reorientation of the education system to ensure that the next generation of graduates will be able to contribute effectively to the growth of the knowledge-based economy.

The National Science and Technology Board (NSTB) is building a knowledge infrastructure to facilitate technology development. The 13 research institutes and centres supported by NSTB have achieved economic impact by developing technologies

jointly with industry, by training R&D manpower, and by transferring know-how to industry. To date, these research institutes and centres have spun off a total of 35 high tech start-ups.

In 1992, the National Computer Board released its **IT2000 Report** which envisioned Singapore as an Intelligent Island with an advanced National Information Infrastructure connecting computers in virtually every home, office, school, public library, community club, factory and workplace and linking government, business, and people in cyberspace. The major thrusts of IT2000 were intensified development of ICT-related manpower, improved quality of life, improved personal and community communications, and competitive advantage using NII.

The 1998 **Competitiveness Report** recommends that as IT is a key technology and to become an IT hub, Singapore should initially focus on the following areas:

- Communications and media: Singapore's educated multi-lingual, multicultural background gives it a competitive edge as the content gateway to both East and West. Singapore should attract creative talents from around the world and improve enforcement of IPR protection. Singapore ONE can be used to jump-start the local multimedia and broadband industries.
- IT innovation: Singapore should position itself as a test bed where new and innovative products and services are created, customised and tested before export. E-commerce is expected to present tremendous business opportunities and impact on such sectors as logistics, transportation and financial services. The government is already setting up the infrastructure to establish Singapore as an e-commerce hub.

From the early 1990s, the Singapore government has been pushing R&D with an array of institutional, infrastructure and manpower support and financial and fiscal incentives. The **1991 National Technology Plan** represented the first concentrated effort at innovation and R&D, with emphasis on private sector participation. Specific targets were for total national expenditure on R&D to reach 2% of GDP by 1995, minimum 50% private sector share, and ratio of RSE of 40 per 10,000 by 1995; a S\$2 billion R&D Fund to support industry driven R&D; provision of grants and fiscal incentives to encourage more R&D by private sector; assistance in developing and recruiting R&D manpower domestically and overseas; support and funding for research centres and institutes capable of training the manpower or providing the technological support to enable companies to undertake their own R&D; assistance for commercialisation and infrastructural support. R&D expenditures and priorities would be focused on the following--- microelectronics, electronics systems, manufacturing technology, materials technology, energy, water, environment and resources, biotechnology, food agro-technology and medical services. Since 1991, a plethora of R&D assistance schemes have been introduced.<sup>27</sup>

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<sup>27</sup> Including the following: Product Development Assistance Scheme (PDAS) to encourage local companies to develop new products and processes; Research Incentive Scheme for Companies (RISC); Research and Development Assistance Scheme (RDAS) provides assistance to private sector companies in undertaking R&D projects either on their own, or in collaboration with public research institutions and tertiary institutions; Foreign Researchers Recruitment Programme to supplement and complement local R&D manpower resources; Researcher Exchange (REX) Local programme supports collaborative R&D projects between private companies and public research institutes or tertiary institutions; Technology Assistance Centre (TAC) as a one-stop hub to provide "techno-preneurs" with business and funding advice, technical links to research institutes and to facilitate linkages with commercial, business and financial sectors; Innovation Centre located in Singapore Science Park to provide the space for technology incubation units, technopreneurs as

The second National Technology Plan (1996) had a budget allocation doubled to S\$4 billion and emphasised the development of science in addition to technology. The third National Science and Technology Plan (2001) has an even higher budget allocation of S\$7 billion, with a larger proportion earmarked for long-term strategic and basic research. Also, new policy initiatives were announced in 1998 under Industry21, Manpower21 and Technopreneurship21. Reflecting the government emphasis on the life sciences as a new growth sector, a US\$1 billion Life Sciences Fund was announced in 2000 to accelerate the funding of R&D and technology commercialisation in the life sciences. The National Survey of R&D Expenditures in Singapore record rising R&D activities during 1993-2004. The number of organisations engaging in R&D have been rising, National gross expenditures on R&D (GERD) rose to 2.25% of GDP. The number of research scientists and engineers (RSE) per 10,000 of the labour force rose to 86.7 as the government encourages local graduates to enter R&D careers and attracts foreign scientists and engineers to Singapore. In 2004, private sector R&D spending jumped 24.4% to S\$2.6 billion, while public sector R&D spending edged up 9.6% to S\$1.5 billion. Enterprises in the manufacturing sector accounted for 63.7% of private R&D spending, with the bulk from the electronics sector, followed by precision engineering. The presence of a sizeable and vibrant pool of local R&D personnel helps attract foreign talent. And the availability of R&D personnel has become a key factor in Singapore's ability to attract MNCs to transfer new processes and high tech product lines

**Toh and Choo (2003)** in their assessment of the economic contributions of R&D concluded that R&D has yielded high economic returns as a long term investment in Singapore. R&D has also played a key enabling role in the growth of Singapore's manufacturing industries. As Singapore continues its development into the knowledge-based economy, R&D will become even more important for both manufacturing and services. There is therefore an economic imperative to continue to promote R&D in Singapore.

Singapore has been pumping huge investments into R&D to develop this sector as a growth engine for the economy. Despite the quantum leap, Singapore's R&D efforts remain modest in absolute terms, reflecting the small size of the economy and its strong services orientation. Even in relative terms, as measured by the RSE and GERD ratios, Singapore is way behind the Republic of Korea and Taipei, China. Private sector business economists argue that Singapore has a long way to go to play catch-up. They believe that the Singapore government will have to offer the right incentives to attract more private sector R&D investments. If Singapore succeeds in attracting top R&D players from around the world to locate in Singapore, the government would not even need to invest on R&D. Being a small country, Singapore is also faced with a shortage of R&D talent. The Singapore universities produce fewer PhD graduates than many other countries. So they are urging the government to address this problem quickly to meet the increasing demand for R&D positions.

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well as technology-based start-ups; Technology Development Fund focuses on promoting and nurturing technology based start up companies having high growth potential (S\$50 million equity fund); Manpower Upgrading for Science and Technology (MUST) programme supports the continuous upgrading and training of RSEs and technopreneurial talent; internationalisation to expand R&D space through tapping technological capabilities and manpower resources overseas.

Recognising the uphill task facing Singapore, the Ministerial Committee on Research and Development (MCRD) has reviewed the R&D strategies and directions for Singapore and concluded that there is an urgent need for bold reforms to transform Singapore into an R&D driven innovative knowledge-based economy. Singapore needs to refocus its research and innovation agenda and MCRD recommends that national R&D efforts should be driven by 5 key strategic thrusts:<sup>28</sup>

- Provide more resources for R&D: Singapore's national expenditure on R&D was 2.15% of GDP in 2003 and lags significantly behind other leading innovation countries. Singapore must intensify R&D efforts significantly and achieve national R&D spending of at least 3% of GDP within the next 5 years.
- Focus on selected areas of economic importance: Singapore needs to focus on a small number of strategic areas to develop a critical mass of research capabilities in industries where it can be economically competitive. Existing key clusters are electronics, chemicals and marine engineering and biomedical sciences. A vibrant research environment will help identify emerging growth areas, such as in environment and water technologies, and interactive and digital media.
- Balance between investigator-led and mission-oriented research in selected strategic areas: Mission-oriented research would continue to have a significant role and would be closely integrated with industry development and investment promotion strategies. For this, the budget for A\*Star is raised from \$4 billion for FY2001-5 to S\$5.4 billion for FY2006-2010. Basic investigator-led research is broadly aligned with the long-term strategic interests of Singapore. For this, the Ministry of Education's Academic Research Fund is raised from S\$550 million for FY2001-2005 to S\$1.05 billion for FY2006-2010.
- Encourage more private sector R&D: Economic promotion agencies, particularly the EDB, will have a critical role to facilitate and catalyse private investments in research and innovation. Incentive packages will be reviewed to better attract more global R&D centres and activities to Singapore, supported by a high quality support framework, including a strong base of scientific and research manpower and sophisticated intellectual property protection regulations. The aim is to have two-thirds of R&D, mainly development, performed by the private sector and one-third of R&D, mainly research, performed by the public sector agencies.
- Strengthen the nexus between R&D and business: Universities and research institutes must improve on their ability to commercialise their research results and have closer collaboration with industry. Also promote technology innovation in local enterprises through stronger co-funding frameworks between public and private sectors. In particular, polytechnics with strong applied research and downstream capabilities and industry networks could be encouraged to link with industry associations to collaborate on R&D initiatives.

To operationalize these key strategic thrusts, MCRD recommends that a high level Research, Innovation and Enterprise Council (RIEC) be established to advise the Singapore government on national research, innovation and enterprise strategies. To support the work of the RIEC, a National Research Foundation would be established with key responsibilities to implement the strategic thrusts and to fund longer-term research in strategic areas. The NRF will be provided with funding of S\$5 billion for FY2006-2010. This, together with the increased budget for A\*Star and the Academic

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<sup>28</sup> See speech by outgoing Singapore Deputy Prime Minister and incoming chairman of National Research Foundation, Dr Tony Tan, on 11 August 2005, as reported in the Straits Times.

Research Fund, will more than double the total public sector R&D budget from just under S\$5 billion for FY2001-2005 to almost S\$12 billion for FY2006-2010.

## V. Conclusion

On the eve of political independence in August 1965, sceptics questioned and believers worried over the future of the small city-state and its political and economic viability. The Singapore nation-state and economy has not collapsed and its political and economic successes have far exceeded expectations.

On the economic front, Singapore has achieved high and sustained growth to result in a per capita income and standard of living among the highest in Asia and the world. Singapore has overcome its physical constraint by adopting the region and world as its economic hinterland, through policies that foster free trade and free flow of investments. It has leveraged on its geographical advantage and developed an infrastructure that links it efficiently with the world. Without natural resources, it has accumulated huge financial resources, human resources, modern economic and social institutions. Singapore has considerably improved its national balance sheet in the past 40 years.

Former Prime Minister and current Senior Minister, Goh Chok Tong noted that innovative policies in anticipation of future trends and to meet the challenges and opportunities of a changing external environment have characterized Singapore's continuing economic success.<sup>29</sup>

- When Stamford Raffles landed in Singapore in 1819, he saw the potential of turning the swampy island into a "great commercial emporium" and, in a clear break from prevailing mercantilist practices, decided to make Singapore a free port. In just 40 years, Singapore recorded an annual trade of 10 million pounds sterling.
- In the 1960s and 1970s, when it was fashionable to be anti-colonial and anti-MNC, newly-independent Singapore welcomed Western MNCs and became the first and strong advocate of an open, MNC-based economy. The Singapore Economic Development Board pioneered the "one-stop shop" concept to service foreign investors. While Singapore has grown in partnership with MNCs over the past 40 years, this economic model is no longer unique as it has been widely adopted elsewhere since.
- The new economic strategy that Singapore has embarked on for the 21<sup>st</sup> century comprises three critical aspects. First, Singapore has sought to overcome its geographical constraints through innovative policies to enlarge its economic space, to turn Singapore into a global city serving the region and the world with a large pool of foreign talent and enterprises from all over the world. In recent years, Singapore was among the first to push for bilateral FTAs.<sup>30</sup> Second, to maximize human potential through education, to underpin the drive towards innovation. The Singapore education system has been extremely successful in producing competent and disciplined workers, but is being revamped to nurture a spirit of enquiry, innovation and enterprise. Third, Singapore is committing more resources to intensify R&D

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<sup>29</sup> Goh Chok Tong's speech on Powering Growth through Innovation on 27 September 2005.

<sup>30</sup> The government is of the view that FTAs would not only give momentum to the Doha Round but also secure outcomes for signatory economies that go beyond concessions in the WTO. To date, Singapore has concluded 11 FTAs, including with major economies like the US, India, Japan, South Korea and Australia, and is negotiating 10 more.

efforts. A Research, Innovation and Enterprise Council (RIEC), chaired by the Prime Minister, is being established. A National Research Foundation is also being formed. The government will help companies link up with public research institutes, as well as encourage more private sector players to base R&D activities in Singapore. The aim is to nurture more Asian innovations with a global focus.

Singapore continues to anticipate trends as it views its future. Accelerated globalization and technological change, together with the rapid economic development of Southeast Asia and the economic rise of PRC and India, are pressuring the Singapore economy to restructure and reinvent itself so as to remain competitive. The free trade and free investment model which gave Singapore a competitive edge is being increasingly emulated by countries in the region. With rising land prices, wages and business costs, the cost advantage of Singapore is rapidly eroding. The phase of investment-driven growth has ended and Singapore must depend increasingly on innovation-driven growth. Singapore has to accelerate the development of three capabilities --- produce a more educated and skilled workforce; produce more dynamic and innovative domestic entrepreneurs; and produce more indigenous innovations and R&D to strengthen core capabilities. Domestic capabilities, where inadequate, have to be enhanced and leveraged by accessing international skills, talents, entrepreneurship and innovations.

Are there lessons from Singapore's development experience and development and industrial strategies? Singapore's export-led and FDI-led industrialization has lost its uniqueness as countries in the East Asian region, including PRC, followed suit. However, countries should also learn from the experiences of the Republic of Korea and Taipei, China in fostering a dynamic and vibrant domestic entrepreneurship. Other characteristics of the Singapore development experience are worthy of study by other developing economies ----- the vision, competence and probity of its political leadership and bureaucracy; promote economic efficiency through exposures to global competition; emphasis on human resource development and infrastructure development to support the private sector; consistency and coherence of its FDI policies; maintaining social cohesion through its ethnic and language policies, and ensuring the welfare of workers through policies to promote full employment, provision of social safety net through the Central Provident Fund, provision of public housing, quality education and healthcare at affordable cost.

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Table 1: Singapore - Key Indicators on Economic Performance

Year	GDP at 1995 market prices		Per capita GNI S\$	Employ- ment Number	Unem- ployment rate %	Consumer Price Index 2004=100	S\$-US\$ exchange rate	% of popula- tion living in HDB housing	Gross national savings/GDP ratio, %	Gross fixed cap. formation/GDP ratio, %
	S\$million	CAGR %								
1965	8,891.0	na	1,618	na	na	33.3	na	23	12.6	21.1
1970	16,207.2	12.8	2,825	644.2	8.2	35.4	na	36	21.2	32.5
1975	25,258.8	9.3	5,996	828.7	4.5	55.3	na	55	30.8	35.9
1980	37,958.6	8.5	9,971	1,073.4	3.5	65.7	na	74	35.6	40.7
1985	51,702.0	6.4	14,676	1,234.0	4.1	77.0	2.2002	84	46.4	42.2
1990	77,298.9	8.4	22,549	1,537.0	1.7	82.0	1.8125	87	45.5	32.3
1995	118,962.7	9.0	34,601	1,702.1	2.7	93.0	1.4174	86	51.8	33.4
2000	162,379.0	9.6	39,405	2,094.8	4.4	97.2	1.7240	86	45.3	29.8
2003	166,491.8	0.8	37,853	2,033.7	5.4	98.3	1.7422	84	44.0	24.2
2004	180,496.0	8.4	41,513	2,066.9	5.3	100.0	1.6903	84	44.4	24.0

Sources: Singapore 2005 Statistical Highlights; Singapore Yearbook of Statistics, various years;  
Economic Survey of Singapore, various years.

Table 2: Singapore - Economic Structure

Year	Percent distribution of gross value added									Percent distribution of working persons			
	Goods producing industries			Service producing industries						Professional technical & managerial occupations	Clerical, sales & service occupations	Manufac- turing sector	Financial & business services sector
	Total	Manufac- turing	Construc- tion	Total	Whole- sale & re- tail trade	Finan- cial services	Busin- ess services	Transport & commu- nications					
1965	26.2	14.4	6.2	70.8	23.7	4.4	9.4	11.5	na	na	na	na	
1970	30.9	18.6	6.9	66.1	24.5	4.9	9.3	10.9	10.3	42.8	22.0	3.5	
1975	34.2	22.3	7.9	63.0	21.6	6.9	8.8	11.0	13.5	42.6	26.2	6.1	
1980	37.3	27.3	6.3	60.4	17.2	8.2	8.7	13.6	18.0	28.1	30.1	8.0	
1985	34.0	20.9	10.2	62.1	12.8	11.0	11.0	12.8	21.7	30.1	25.5	8.9	
1990	33.0	25.5	5.3	62.9	13.7	10.7	12.0	12.9	24.2	25.7	28.9	11.3	
1995	33.9	25.0	7.1	62.6	13.5	11.1	13.4	12.1	35.9	24.1	23.7	15.4	
2000	34.6	26.6	6.3	62.0	12.7	11.3	13.7	11.7	35.8	21.2	20.8	15.4	
2003	32.2	25.5	4.9	64.2	13.9	11.7	13.6	10.9	42.2	24.0	17.9	17.1	
2004	33.8	27.7	4.3	63.0	14.3	11.3	12.7	11.0	42.6	24.2	17.3	17.5	

Source: Sources: Singapore 2005 Statistical Highlights; Singapore Yearbook of Statistics, various years;  
Economic Survey of Singapore various years.

Table 3: Multifactor Productivity Contribution to Growth in Real GDP

Year	% age change in GDP	% age contribution to growth in real GDP to		
		Capital input	Labour input	Multifactor productivity growth
1992	6.5	3.7	1.5	1.2
1993	11.6	3.9	1.5	6.2
1994	10.8	4.0	2.1	4.7
1997	6.5	3.7	1.5	1.2
1999	6.6	3.3	-0.2	3.6
2000	9.2	3.4	1.9	3.9
2001	-2.0	2.7	1.7	-6.4
2002	3.1	1.9	-0.7	1.9
2003	1.4	1.5	-0.6	0.4
2004	8.1	1.8	0.8	5.5

Source: Yearbook of Statistics, various years

Table 4: Singapore- Stock of Foreign Direct Investment

Year	Inward FDI total S\$million	Major investing countries				Major sectors	
		UK	US	Japan	Netherlands	Manufac- turing	Financial services
		% of total				% of total	
1970	1,398.3	30.3	18.4	8.2	0.8	50.0	19.1
1975	4,649.5	28.1	18.3	9.7	2.4	50.3	21.7
1980	11,201.7	26.3	22.5	11.7	1.9	56.6	16.5
1985	22,354.9	16.1	26.7	14.1	3.5	50.5	28.0
1990	53,151.5	12.1	17.8	20.6	8.0	41.4	33.9
1995	92,840.7	10.4	17.4	19.4	5.0	38.2	37.3
2000	195,023.7	4.6	16.3	15.0	15.0	36.1	35.9
2003	244,390.8	16.2	15.4	13.5	11.1	37.6	34.0
2004	na	na	na	na	na	na	na
Year	Outward FDI total S\$million	Major destination countries				Major sectors	
		China	Malaysia	Hong Kong	Indonesia	Manufac- turing	Financial services
		% of total				% of total	
1976	1,015.1	na	na	na	na	na	na
1981	1,677.7	-	60.0	10.8	2.4	na	na
1985	2,257.2	2.6	43.1	20.4	2.9	na	na
1990	13,621.7	1.8	20.5	16.6	1.7	17.6	53.6
1995	49,570.8	7.5	20.9	13.5	7.9	25.1	48.1
2000	98,291.1	16.0	9.9	8.7	5.6	25.4	48.3
2001	133,612.4	11.8	8.4	8.6	4.2	20.1	55.3
2002	148,923.4	12.1	8.9	8.0	5.2	20.9	55.1
2003	153,484.2	12.4	8.6	7.6	6.5	20.8	55.7
2004	na	na	na	na	na	na	na

Sources: Singapore 2005 Statistical Highlights; Singapore Yearbook of Statistics, various years

Table 5: Manufacturing Sector

Year	Establish- ments Number	Manufac- ring output per estab. S\$000	Manufac- ring output growth %	Remuner- ation/value added %	Exports/ total sales %	Remuner- ation per worker S\$000	Value added per worker S\$000	Net fixed assets per worker S\$000
1965	1,000	1,086	na	na	32.5	3	na	na
1970	1,747	2,227	29.1	na	39.6	3	na	na
1975	2,385	5,287	26.5	na	58.1	6	na	20
1980	3,355	9,436	20.2	35.1	62.0	9	25	26
1985	3,504	10,986	4.0	49.4	63.3	16	33	51
1990	3,703	19,264	13.1	42.3	65.6	20	46	51
1995	4,036	28,087		41.1	61.1	29	72	71
2000	4,044	39,255		31.9	60.0	36	113	123
2003	8,597	17,539	6.6	35.0	65.4	37	106	130
2004	na	na	19.5	28.2	64.8	38	134	na

Source: Singapore 2005 Statistical Highlights

Notes:

From 2005, data includes manufacturing establishments with less than 10 workers.

For 1970,1975,1980,1985, 1990, manufacturing output growth is computed over a 5-year period

Table 6: Manufacturing Industries, 2004

Code	Industry	Output S\$million	Workers Number	Output %distribution	Workers %distribution
15/16	Food, beverages, tobacco	3943.6	18756	2.19	5.31
17	Textiles, textile manufactures	247.2	1623	0.14	0.46
18	Wearing apparel	748.6	8424	0.42	2.39
19	Leather, leather products, footwear	219.3	1107	0.12	0.31
20	Wood, wood products	268.5	1618	0.15	0.46
21	Paper, paper products	850.0	4229	0.47	1.20
22	Printing, reproduction of recorded media	2688.7	18018	1.49	5.10
23	Refined petroleum products	27815.6	3067	15.44	0.87
24	Chemicals, chemical products	35952.7	19808	19.95	5.61
25	Rubber, plastic products	2597.5	19505	1.44	5.52
26	Nonmetallic mineral products	1372.7	5113	0.76	1.45
27	Basic metals	692.4	1395	0.38	0.40
28	Fabricated metal products	7060.0	37375	3.92	10.58
29	Machinery and equipment	9774.2	42404	5.42	12.01
30	Electrical machinery, apparatus	2066.4	8191	1.15	2.32
31	Electronic products, components	69460.1	90096	38.55	25.51
32	Medical, precision, optical instruments	3304.0	10494	1.83	2.97
33	Transport equipment	9317.5	50764	5.17	14.37
34	Furniture, other manufacturing industries	1180.0	10411	0.65	2.95
35	Recycling of metal, waste, scrap	622.3	728	0.35	0.21
	Total manufacturing	180181.9	353146	100.00	100.00

Source: Yearbook of Statistics, 2005

Table 7: Singapore - Composition of Exports

	1965	1970	1975	1980	1985	1990	1995	2000	2004
<b>Total exports, S\$million</b>	3004	4756	12758	41452	50179	95206	167515	237826	303476
<b>% distribution:</b>	101.32	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Food	14.51	11.56	7.18	4.84	4.37	2.87	2.12	1.27	1.07
Beverages & tobacco	1.53	1.51	0.32	0.38	0.48	1.46	1.36	0.80	0.59
Crude materials	27.28	30.07	13.28	11.34	5.38	3.06	1.44	0.70	0.63
Mineral fuels	14.35	17.30	27.05	28.87	32.79	18.17	8.27	9.70	12.24
Animal& vegetable oils	2.00	2.95	1.92	2.64	3.06	0.80	0.43	0.16	0.15
Chemicals	3.65	2.71	3.73	3.42	5.41	6.27	5.97	6.93	11.68
Manufactures	13.21	8.90	8.52	8.30	7.17	6.99	6.34	3.79	3.73
Machinery & transport	10.49	10.95	22.69	26.75	33.02	50.14	65.67	67.45	61.06
Miscell.manufactures	5.09	5.21	6.90	6.21	6.73	8.93	7.49	8.15	7.90
Miscell. Transactions	9.22	8.85	8.41	7.25	1.59	1.32	0.91	1.05	0.95
<b>Domestic exports, S\$million</b>	na	1832	7540	25805	32576	62754	98473	135938	166503
<b>% distribution:</b>	na	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Food	na	5.75	3.69	2.33	1.47	1.53	1.22	0.99	1.09
Beverages & tobacco	na	0.64	0.34	0.40	0.32	0.62	0.49	0.19	0.19
Crude materials	na	1.63	0.60	0.59	0.58	0.73	0.59	0.48	0.48
Mineral fuels	na	43.24	42.88	45.00	48.62	27.31	13.93	16.82	20.25
Animal& vegetable oils	na	2.66	0.74	1.53	1.93	0.94	0.34	0.21	0.23
Chemicals	na	2.36	2.76	2.22	4.91	5.77	5.71	7.88	17.23
Manufactures	na	9.27	6.45	5.13	3.73	3.39	2.97	2.26	2.46
Machinery & transport	na	10.78	22.37	25.45	31.11	51.55	68.80	63.15	49.41
Miscell.manufactures	na	7.89	8.86	7.31	6.81	7.75	5.41	7.41	7.93
Miscell. Transactions	na	15.76	11.32	10.06	0.51	0.42	0.54	0.60	0.71
Machinery & transport,S\$million	na	na	na	na	na	na	na	85851	82269
<b>% distribution:</b>	na	na	na	na	na	na	na	88.02	86.40
Electronic valves	na	na	na	na	na	na	na	30.91	32.45
Data processing machines	na	na	na	na	na	na	na	28.97	23.55
Parts for office & DP machines	na	na	na	na	na	na	na	15.63	15.83
Communications equipment	na	na	na	na	na	na	na	6.22	8.19
Electrical circuit apparatus	na	na	na	na	na	na	na	3.46	3.75
Electrical machinery	na	na	na	na	na	na	na	2.83	2.62

Source: Singapore Yearbook of Statistics, various years.

Table 8: Pioneer Manufacturing Establishments

Year	Establishment Number	Total output S\$million	Value added S\$million	Workers Number	Gross fixed assets S\$million	Direct exports S\$million
1993	421	56955	12906	162341	27389	39461
1998	361	83825	17005	151901	43032	59211
1999	360	92292	18073	142321	45736	65755
2000	362	116613	26783	139389	54199	75765
2001	373	94788	20425	137788	61779	67493
2002	360	99706	23943	135763	64523	68971
2003	353	110810	24660	132363	66536	78357
Pioneer share of total manufacturing, 2003						
	4.11	73.49	66.54	37.70		

Table 9: Unemployment Rate, Working Persons by Occupation, Sector and Qualifications, Education Ratios

Year	Unemployment rate	Professional, technical, managerial workers	Clerical, sales, services workers	Manufacturing sector	Financial, business services sector	Population with university qualifications	Mean years of schooling	Combined gross enrolment ratio	Entry ratio		
									Post-secondary	Poly-technic	University
	%	% of working persons				%	years	%	% of primary one cohort		
1965						na	na	69.6	11	2	3
1970	8.2	10.3	42.8	22.0	3.5	1.9	na	65.6	13	4	4
1975	4.5	13.5	42.6	26.2	6.1	na	na	64.9	17	6	5
1980	3.5	18.0	28.1	30.1	8.0	2.7	4.7	66.8	23	5	5
1985	4.1	21.7	30.1	25.5	8.9	3.6	5.7	75.9	49	14	8
1990	1.7	24.2	25.7	28.9	11.3	4.7	6.6	79.8	59	22	15
1995	2.7	35.9	24.1	23.7	15.4	7.6	7.7	85.2	68	36	19
2000	4.4	35.8	21.2	20.8	15.4	12.1	8.6	87.5	79	37	21
2003	5.4	42.2	24.0	17.9	17.1	15	8.6	87.4	82	38	22
2004	5.3	42.6	24.2	17.3	17.5	16.3	8.8	87.4	83	39	22

Sources: Singapore 2005 Statistical Highlights; Singapore Yearbook of Statistics, various years; Economic Survey of Singapore various years.

Notes:

Mean years of schooling = refer to resident non-students aged 25 and above.

Combined enrolment ratio = residents enrolled in primary, secondary and tertiary institutions divided by resident population aged 6-20 years.

Table 10 : Research and Development

Year	Organisations performing R&D					R&D manpower			R&D expenditures					Patents owned No.	
	Total	Private	Higher	Govern-	Public	Total	RSE	RSE/ 10000 labour	Total	Private	Higher	Govern-	Public		R&D
	No.	No.	No.	ment	research	No.	No.	force	\$million	\$million	\$million	\$million	\$million		expendit./ GDP ratio %
1993	436	410	6	15	5	10748	6629	40.5	998.2	618.9	157.3	106.5	115.5	1.07	
1998	604	571	6	13	14	19007	12655	65.5	2492.3	1536.1	305.8	299.8	350.5	1.81	847
1999	624	593	6	12	13	20612	13817	69.9	2656.4	1670.9	310	304.9	370.6	1.9	1077
2000	582	539	6	24	13	25220	14483	83.5	3009.5	1866	338.3	423.8	381.4	1.89	1268
2001	558	513	6	24	15	25162	15366	87.6	3232.7	2045	367	425.1	395.6	2.11	1456
2002	564	519	7	25	13	26824	15654	73.5	3404.7	2091.3	430	449.1	434.3	2.15	1739
2003	662	617	9	24	12	28825	17074	79.4	3424.5	2081.2	457.5	435.8	450.0	2.13	2314
2004						31008	18935	86.7	4061.9	2590.0	442.2	424.1	605	2.25	2570

Source: Yearbook of Statistics 2005; 2005 Survey of R&D