

7. The Future of Singapore's National Innovation System

'Enclave' development

- Most accentuated among Asian NIEs
 - “Establishing Singapore as an offshore electronics manufacturing base for MNCs”
 - TI and National Semiconductor
 - followed by HP (1970) and SGS (1969) (later Thompson-SGS, and in 1998, ST Microelectronics)
 - NEC, Toshiba in the 1970s

The continuing dominance of MNCs

- (1) overall dominance
- (2) more important in the leading sectors
→ upgrading through inviting MNCs

Table 5 Share of Manufacturing Investment by Local and Foreign Firms, 1972-96

Year	Total Manufacturing Investment Commitment (\$mn)	Foreign	Local	%Local
1972	195.0	156.0	38.0	19.5
1973	296.0	224.0	72.0	24.3
1974	292.0	169.0	123.0	42.1
1975	306.0	247.0	60.0	19.6
1976	303.0	260.0	43.0	14.2
1977	396.0	362.0	34.0	9.4
1978	812.0	765.0	47.0	5.8
1979	944.0	823.0	120.0	12.7
1980	1413.5	1189.1	224.4	15.9
1981	1863.0	1221.4	641.6	34.4
1982	1704.5	1162.5	542.0	31.8
1983	1775.8	1269.8	506.0	28.5
1984	1824.4	1334.7	493.7	27.0
1985	1120.4	888.0	232.4	20.7
1986	1450.0	1190.6	259.4	17.9
1987	1743.0	1448.0	295.0	16.9
1988	2007.3	1657.8	349.6	17.4
1989	1956.7	1625.4	333.3	17.0
1990	2487.4	2217.9	269.5	10.8
1991	2534.0	2461.1	472.9	16.1
1992	3491.6	2733.0	758.6	21.7
1993	3925.0	3177.0	748.0	19.1
1994	5764.7	4327.5	1437.2	24.9
1995	6809.1	4852.4	1956.7	28.7
1996	8085.2	5716.3	2368.9	29.3

Source : EDB Yearbook, various years

Table 5 Indicators of Foreign MNCs' dominance in Singapore's Electronics industry

a) Foreign share of equity investment in Singapore's Electronics Industry, 1980-93

Year	Electronics Industry (%)	Total Manufacturing (%)
1980	91.0	67.1
1987	96.7	70.8
1990	93.5	69.4
1992	88.0	61.0
1994	84.8	62.6

Source: 1980 estimated from EDB cumulated investment data
1987, 1990 and 1994 Department of Statistics (1996)
1992 from EDB, cited in Chia (1997)

a) Ownership Structure of Electronics Firms, 1993

Ownership Structure	No. of firms	%
100% local	50	18.9
>50% local	62	23.5
50:50 joint venture	4	1.5
>50% foreign	16	6.1
100% foreign	132	50
Total	264	100

Source: Report on the Census of Industrial Production 1993 (unpublished)

(3) Gradual upgrading and integration into the regional economy

- HP

chip design centre (HP's first in Asia) →
wafer fab → Asia-Pacific Distribution
Centre (1988) → Network Software
Development Centre (1989)

- SGS

: "... pursuing a strategy of locating
marketing expertise around the world .."
design centre (1982) → wafer fab (1984)

“Up to the end of the 1970s, SGS and other MNCs were producing in Singapore and Malaysia as a low-cost platform for sales to the world, rather than to Asia. But in 1980 the emphasis shifted to Asia.” (Mathew & Cho 2000: 213)

(4) Less urgency in science and technology development
→ later than other E. Asian NICs in engaging in S&T policy

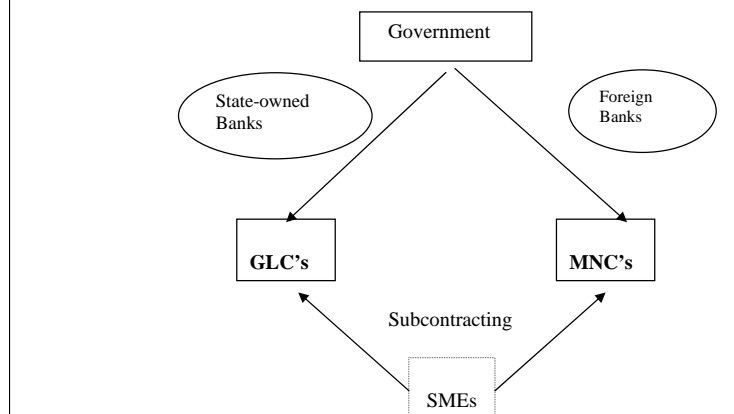
Upgrading investment in wafer fabrication by MNCs

- SGS-Thompson in 1985
- HP in 1987
- TECH Semiconductor in 1991
- Linear Technology in 1989
 - testing and design
- Siemens
 - establishing design centre in 1992
 - advanced IC packaging

The role of GLCs

- The military-related sector
- Nurturing the sector strategically important, but MNCs are not interested in
- Pioneering into the new growth sectors eg. CSM

Figure 3. Singapore's Internationalist Model



International Conditions for the Dependent Strategy

- (1) The ever-increasing role of MNCs in the world economy
 - the take-off of MNCs in the 1960s
 - increasing room to grow through utilising expanding global production networks
 - increasing 'spatial separability of production processes'
- (2) Regulatory changes in the world market

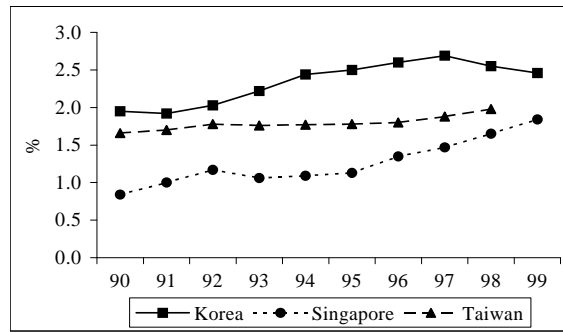
Strengths and weaknesses of the dependent model

- Strengths
 - easier in starting industrialization
 - less risky

Strengths and weaknesses of the dependent model

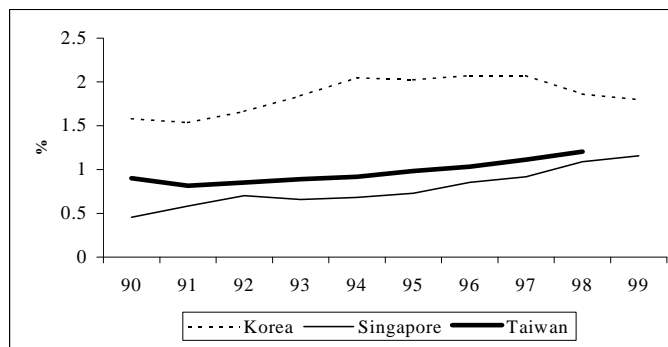
- Weaknesses
 - relative underdevelopment in local technological and marketing capability
 - the last things MNCs will part with?
 - pressing need to acquire higher-end capabilities
- : “Why do MNCs want to invest in an advanced country?”

Figure 6. Trend of GERD/GDP among Korea, Taiwan, and Singapore



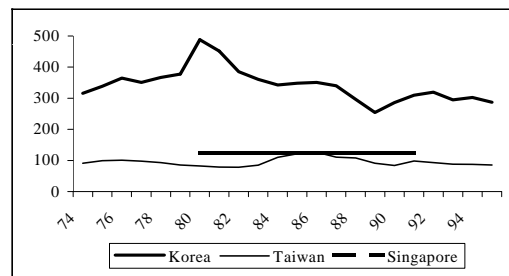
Source: STEPI website
 National Survey of R&D in Singapore
 National Statistics of Taiwan, Republic of China

Figure 7. Trend of Private R&D Expenditure to GDP ratios in Korea, Taiwan and Singapore



Source: STEPI website, NSTB, Bureau of Statistics of Taiwan

Figure 5. Debt-Equity Ratio of Manufacturing Firms in East Asia (%)



Source: BOK website, Fields (1995: 108, table 4-5),
Bank of China in Taiwan, quoted in BOK (1999a)
Singapore's figure is 123.3% on average during 1980-1991
(Demigruć-Kunt & Maksimović 1996)

Table 2. External Debt to GDP Ratios of Korea, Taiwan, and Singapore (% , Selected years)

	1976	1982	1985	1993	1996	1997
Korea	36.7	52.0	52.1	12.7	20.2	25.5
Taiwan	13.6	12.8	14.5	7.6	8.0	9.3
Singapore		22.0	22.8	9.5	10.7	16.5

Source: Economic Planning Board and Bank of Korea for Korean figures.
Taiwanese figures are calculated from External Debt of Developing countries and Joint BIS-IMF-OECD-World Bank statistics on External Debt
Singaporean figures calculated by GDP from IFS, IMF, external debt from External Debt Statistics, OECD and exchange rates from the Statistics of Singapore website

Strategic directions from the 1990s

- Cluster strategy
 - knowledge flow & fusion across sectors
- Hub strategy
- Increase in R&D investment
- Changing the 'mind-set'
 - technopreneurship and so on ...

Cluster Strategy 1

- Strategic importance of knowledge flows and fusion across sectors
- Expecting 'agglomeration effect'
 - * Strategic Economic Plan 1991
 - "the need to focus on the high value-adding activities in each major industry value chain, the major underlying supporting industries, as well as core capabilities needed to make the entire industry cluster competitive." (MTI 1991, quoted from Wong 1998)

Cluster Strategy 2

- The Case of Hard disk drive industry
→ nurturing supporting industries (disk media sputtering, cleanroom technical service, optical data storage devices) + PRI (Data Storage Institute)

Table 1. The Growth of the HDD Industry in Singapore

Year	World output (1 million units)	Singapore output (1 million units)	The share of Singapore output (%)
1986	7.8	3.8	48.9
1987	13.6	6.1	45
1988	17.7	8.6	48.6
1989	20.8	10.1	48.5
1990	23.8	14.9	62.7
1991	32.6	14.7	45.1
1992	43.9	20.8	47.4
1993	51.9	23.2	44.7
1994	64.7	32.3	49.9
1995	89.6	40.3	45
1996	105	47.4	45.1
1997	126	49.7	39.4
1998	145	52.2	36

Source: Wong (1999)

Cluster Strategy 3

- Helping MNCs' diversification into non-manufacturing activities
 - Regional marketing and sales, technical support and training, procurement, logistics and distribution, R&D
 - Motorola University corporate office for SE Asia (training)
 - HP Regional Response Centre (technical support)
 - IBM (international procurement)
 - Sony Logistics, Asia Matsushita Logistics, Apple, Compaq

Hub Strategy

- Transportation hub
 - Seaport
 - Airport
- Information hub: IT2000
- Education hub
- Bio-Med hub
- Pro-active and broadened cluster strategy

Technopreneurship

- A way to survive the erosion of cost competitiveness
- Increasing acceptance of the Silicon Valley model of high tech innovation
- Technopreneurship Investment Fund (TIF)
 - the government as VC of VCs
 - co-investment and co-management with global VC players

Reforming Education System

- Research universities
 - related with education hub
- Broad changes in curriculums

“inculcate in our people a more analytical and risk-taking mindset, on top of their strengths in science and mathematics” (Tony Tan at Singapore TechnoVenture 2000 in San Francisco, 13th March 2000)

Reforming Commercial Laws and Regulations

- Reforming bankruptcy laws to encourage tolerance to failures
- Changing laws to allow capital losses incurred by investors in startups to be tax deductible
- Reducing strict stock exchange regulations so that companies can float on the public markets without being profitable

Push for developing local high-tech Industries

- The case of the SC industry
 - an attempt at building local high-tech capabilities
- State-MNC joint venture: Taiwanese model
 - Chartered Semiconductor Manufacturing: ASIC foundry
 - Tech-Semiconductor: DRAM
 - Tri-Tech: design

Building a Bio-Med Hub

- The 'One-North' Project
 - regional 'Mecca' of bio-medical industry
 - supported by already developed research institutes and hospitals
 - supported also by IT industries
- Adding more investment to exiting multinational pharmaceutical firms

The Continuing Dominance of State-cum-MNCs System

- Again utilising a modified state-MNCs innovation system by introducing US venture capitalist in technopreneurship, and inviting MNCs in nurturing the semiconductor industry and bio-med industries
- R&D activities also relying heavily on foreign talents
- Alliance with and inviting world class universities

The Future of Singapore

- Optimistic?
 - track record of being successful despite initial skepticism
- “Singapore has done what it needs to do. It has attracted the large pharmaceuticals, and has good research ... People are talking about Singapore. There’s a feeling that something exciting is going on here” (Carl Feldman, President of Biotechnology Industry in the USA, ST 1 November 2002)

The Future of Singapore

- Pessimistic?
 - a qualitatively different challenge
 - remaining rigidities?
- “My big worry with the flagship approach [of Singapore] is that I have seldom seen life-science innovation and entrepreneurship thrive in highly-controlled, top-down, bureaucratic environments.” (Dr Gurinder Shahi, Head of BioEnterprise Asia, in ST, 26 October 2002)