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MALAYSIA'S NATIONAL INNOVATION SYSTEM

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C O N T E N T S

T A B L E S

MALAYSIA'S NATIONAL INNOVATION SYSTEM

1. Introduction

THE notion of national innovation systems (NIS) - elements of which is traceable to Frederich List's (1885) industrial policy argument to create dynamic comparative advantage - is now gaining attention as an important framework to conceptualize the development of innovative capability and its support of productive activities. Dynamic national innovation systems have helped nations transform comparative and competitive advantages (Gerschenkron, 1962; Kaldor, 1979; Porter, 1990). Given the qualitative attributes of the term technology, pioneering works in this field have deliberately left such a system open with several agents (including organizations) playing important interactive and mutually supportive roles to develop nations' productive capacity (Lundvall, 1985; Freeman, 1987; Nelson, 1985; Dosi, 1984). Innovations, broadly defined, include both the rarely achieved path breaking inventions and the commonly recorded developments by which firms introduce new manufacturing designs and processes, including minor improvements that are not entirely new to the universe. Firms typically move from acquiring existing technologies that have been accummulated cumulatively, often importing them, before moving up the stages of adapting, developing and finally innovating new processes and designs. Thus, involvement in research and development (R&D) comes at the end of a sequential learning process (Pavitt, 1984). The potential capacity of a national innovation system to stimulate innovations will depend on the effective development of key supportive organizations and effective institutional coordination between them and firms. Proponents of NIS assume the Schumpeterian notion that firms' actively shape the technology frontier, and therefore differ from the Marshallian position that firms operate as passive recipients of new technology.

This essay is divided into two main sections, *viz.* one, a conceptual framework for national innovations systems; and two, an assessment of Malaysia's national innovation system based on the framework adopted earlier. Drawing on the theoretical literature related to NIS, and its comparative assessment based on similar works on other economies, the first part identifies key agents and their coordinational roles. The second part dissects Malaysia's national innovation system critically based on the framework adopted in part one, and examines potential weaknesses in its institutional set up and coordinational mechanisms. Although it is not a theoretical effort to demonstrate the relevance of such a concept, implicit deductions could be made from the exercise.

2. The National Innovation Framework

PUT simply the NIS refers to directly - the innovating agents, and indirectly - the enabling environment that stimulates innovations. For closer examination it is important to identify its indirect and direct agents and the coordinational relationships between them. Direct agents are generally firms, and their relative gains or losses are influenced by their capacity to generate cheaper and better products and services than their competitors. Indirect agents refer to support organizations that constitute the enabling environment. The key enabling agents, e.g. human capital generators, funding organizations, transport and marketing networks, research and development institutes, incentives structures and regulatory frameworks - set the parameters within which firms tap their inputs and operate. Indirect organizations themselves are conditioned by other organizations (e.g. cultural institutions) and firms so that the whole nations' organizations and peoples could be linked into a tightly interwoven network that is referred to as the NIS. It is an open system that enjoys interrationships with foreign organizations and firms. The prime difference between the NIS and other national systems (e.g. economic, security and welfare) is that it generates innovations and its direct or frontal agents are primarily firms. NISs generally interlock between one another so that knowledge and innovations generated flow across the universe. Firms in even the most developed NIS access knowledge and innovations from other NISs. When national capacities are underdeveloped, competitive firms often access foreign sources. When foreign domestic firms are involved, a large proportion of inputs (especially technology inputs) are sourced from abroad. With any system, synergies are maximized when a systematic, cohesive and dynamic structure evolves to coordinate effectively relationships within and between institutions and firms to meet existing and future demands. For the system to be dynamic it must be flexible and receptive to change. Both - indirect and direct agents - generate innovations. A nation's competitiveness, however, manifests from innovations generated in the latter.

Since the NIS encompasses a myriad of complex agents and organizations - all of which are inter-connected - in a society, it is difficult if not impossible to assess it in *toto*. Thus, we limit our assessment to key institutions. Human resource provides the critical mass to drive scientific inquiries and technical change for its vital role in manning support institutions and firms. Schooling and other modes of learning - both general and technical schooling - referred to as pre-employment education is critical in providing the educational base for employment and receptiveness to absorbing instructions and in-firm training. Subsequent attention is then placed on in-firm training, and work related training designed to raise workers productivity. Given the broad-based nature of pre-employment training - from primary to tertiary education - few if any firms involved in manufacturing actually directly fund such programmes. Government's participation is economically justified when

social returns exceed private returns. Private firms' involvement is often determined by government incentives. Particularly in the initial stages, due to lumpy and risky investments, underdeveloped markets (especially arising from demand contraints), public investment in education tend to be much larger. Private institutions' role only tend to rise as economies mature.

Firms' investment in human resource development is stronger in enterprise training - which is undertaken in-firm or in specialized organizations. The incidence of government failure is higher here due to information asymmetry problems and conflicting interests. The government, however, often stimulates such training by intervening to remove market imperfections as in Korea and Singapore. When firms negotiate the technology trajectory moving from wholly externally sourced technologies to the remaining three technology phases - original equipment manufacturing (OEM), original design manufacturing (ODM) and original brand manufacturing (OBM) - only then will there emerge and expand demand for R&D technologists and scientists. Until then, the primary focus of human resource will be on absorbing staff for production activities (Pavitt, 1984). While external educational organizations generate R&D technologists and scientists, firms generally utilize them in specific areas to meet their objectives either through contract research, or employing them directly. Most employees engaged in R&D, however, are developed through firms, and participate largely in product and process development rather than basic research. The Japanese success in catching up with the United States, *inter alia*, reveal substantial participation in process development (Best, 1990; 1995) - a significant share being generated by personnel not officially classified as R&D scientists or technologists.

The direction of savings and finance for innovators and agents supporting them is also critical. The classical Keynesian argument that links savings with investment can only stimulate growth if directed productively (Rasiah, 1995c; You, 1995). Hence, the savings and investment structure - not just their relative shares - is critical so that related organizations service effectively agents supporting innovations. The East Asian experience interestingly show a strong link between corporate savings and investment. Also, a strong positive relationship between profits and investment has ensured continued symbiotic relationship between high returns and investment into profitable sectors (Akuyz and Gore, 1994; Rodrick, 1994). Japan, Korea and Taiwan regulated the financial sectors tightly so that prioritized institutions and firms obtained subsidized loans at rates substantially below curb market rates. Intervention to direct resources to potentially productive targets that take into account information asymmetries (including scale economies and complementarities) has been critical in late industrializers (Amsden, 1989; Chang, 1994; Rasiah, 1996).

Investments in R&D is not the most critical factor in generating competiveness and even innovations. The share of governments' and firms

investments in R&D has been very small across economies - irrespective of their level of development (see Nelson, 1993). Nevertheless, R&D investments are an important component of the national innovation system. Especially applied R&D is critical to generate inventions. Firms hardly participate in basic research which is an important part of the innovation puzzle - because its relationship with firm-level monetary gains tend to be relatively negligible.

Cultural institutions have often been used to explain the success of particular communities in motivating and directing accummulation oriented technical change; e.g. the protestant ethic and the spirit of capitalism in the rise of Europe (Weber, 1930), and the pursuit of knowledge and accummulation of similar Confucian ethics in the East Asian expansion. As Johnson (1982), Dore (1986: 250)and Chang (1994: 87-88) have argued, the functional equivalent of cultures can be adapted and adopted under different settings. Within the NIS framework, ethics are important, but do not necessarily manifest in spiritual religions. More importantly, cultures are interpreted dynamically so that changes necessary for the elevation of scientific and technical knowledge and physical accummulation introduced.

Unlike European capitalism, the latter phase as exemplified by the East Asian experiences, shifts emphasis from individual to collectivist work ethics. These collaborative relationships which grew with the guilds system in Europe are re-emerging in new settings in Europe and North America (Best, 1990). Important in such teamwork-based innovations, is the organization of the labour process, including industrial relations so that interlocking and group-working characteristics emerges to tap the innovative potential of the whole labour force. In such a system unit costs and processes become the subject of control - not labour costs or workers (see Best, 1990; Lazonick, 1989).

Most innovations are realized in firms - through new products and processes. While indirect agents that support firms operations are vital, firms eventually generate most of the appropriable innovations. Using innovative capacities - both their own formal R&D and non-R&D facilities, and capabilities generated from support institutions - firms appropriate innovations. A significant amount of innovations emerge in the production floor where learning enhances product and process improvement capacities. Incremental engineering through even minor improvements have been vital in late industrialization (Rosenberg, 1982). Being the prime direct generators of products and services, effective coordination between them and supporting institutions is critical to maximize synergies.

Governments generally lack business orientation and as such face a high risk of failure. Markets too generally fail when generating effective price signals in underveloped structures, and when scale economies and complementarities are involved (Kaldor, 1979). Hence, in addition to

investing in basic and some applied research institutions, and human resource development programmes, governments also actively create the enabling environment to stimulate indirect agents and firms' participation in innovative activities. By prioritizing investment, human resource development, research activities and other supporting activities, strategic and complementary industries have been developed in these economies successfully. The latter has been far more significant in stimulating innovative activities in Japan, Korea and Taiwan. Direct government involvement as a share of overall R&D activities has traditionally been small irrespective of development levels (see Nelson, 1993). Nonetheless, smooth coordination between government, other support institutions and firms - including helping to solve market failures - have been critical in stimulating competitive innovative activities. In addition, latecomers' have generally absorbed and adapted foreign technologies through both formal and informal relationships with foreign firms. The correct mix and orientation of indirect and direct agents can stimulate greater absorption of technology by local firms from foreign firms. Proactive governance to stimulate transfers through technology transfer agreements (TTAs) have been a critical pillar in Japan's, Korea's and Taiwan's success in technology acummulation (Johnson, 1982; Amsden, 1989; Wade, 1990).

3. Malaysia's Innovative Capacity

THE institutional mechanisms for capitalist growth in Malaya emerged during colonialism. The stagnationist production relations that characterized pre-colonial history in the country hardly offered any dynamism for innovations (Jomo, 1986; Rasiah, 1995: Chapter 2). Colonial production was, however, largely geared towards the primary sectors. Tremendous leaps were recorded in tin mining and smelting, and rubber cultivation and processing, through - both incremental improvements in production and research. Rubber cultivation (especially high yielding varieties and processing) in particular benefited immensely from formal research (Lim, 1967).

Expansion in the primary sectors helped create the basic enabling environment for manufacturing to evolve. Railways, roads, wage labour, health and education, effective demand, administrative structure, and law and order - funded by revenue extracted from primary sectors - grew substantially in the colonial period. Primary processing, consumer and support manufacturing industries began to emerge as a consequence (Rasiah, 1995a). The government's pursuance of a generally *laisez faire* approach to industrialization limited the large scale development of modern manufacturing. Hence, although the infrastructure that emerged from growth in primary sectors stimulated modern manufacturing, the colonial state's preoccupation with primary sectors - to serve generally its own interests and that of British capitalists - deprived the potential for large scale manufacturing growth.

The institutional capacities that emerged during colonial rule, were sustained in independent Malaysia. Rubber and tin, and later palm oil continued to be the main revenue generators until 1980. Tin's significance faded sharply since 1980 (Jomo, 1990). Rubber's contribution declined gradually, while palm oil has continued to be important. Oil has become the most significant primary commodity from the late 1970s. R&D activities has continued strongly in rubber, oil palm and petroleum activities. Of the three, only the first two - both in-firm and research institutes such as the Rubber Research Institute (RRI) and Palm Oil Research Institute of Malaysia (PORIM) - show participation at the technology frontier. Oil palm research has generated broader spinoffs as downstream activities into manufacturing has developed strongly (Chantasmary, 1994). R&D in petroleum activities is still confined to process technology activities - generated largely from spin-offs from the foreign ventures of Shell and Exxon.[1]

Primary sectors' significance in the national economy has, however, shrunk relatively from the 1970s, but especially the late 1980s. Tin and rubber have faced absolute declines from the 1980s. Only petroleum and palm oil have continued to remain major primary exports of the country. The biggest growth, however, has been recorded in manufacturing which overtook primary commodities as the major export since the late 1980s. Its share in GDP stagnated in 1960 and 1965 at 9.0 per cent (World Bank, 1985) but has grown rapidly from 13.9 per cent in 1970 to 31.6 per cent in 1994 (see Table 2). Manufacturing even overtook agriculture in employment generation, contributing 24.6 per cent to the national total compared to 19.9 per cent by the latter.

Table 1: Sectoral Employment, Output and Export, Selected Sectors, 1970-94

	Employment			Output			Export		
	1970	1980	1994	1970	1980	1994	1970	1980	1993
Agriculture	na	39.7	19.9	29.0	22.9	14.6	63	na	21
Mining and Quarrying	na	1.7	0.5	13.7	10.1	7.5	30	na	14
Manufacture	na	15.6	24.6	13.9	19.6	31.6	7	na	65

Note: na -- not available.
Source: Maiaysia (1991; 1995); World Bank (1995: 191).

[1] Interviews conducted in 1995.

Table 2: Manufacturing Export Structure, Malaysia, 1968-94 (%)

	1968	1973	1980	1985	1990	1994
Food, beverage and tobacco	27	22	8	6	4	3
Textiles, clothing and footwear	3	9	13	10	9	5
Wood	7	11	7	3	3	5
Rubber	18	15	1	1	3	2
Chemicals	6	5	3	5	4	4
Petroeleum manufactures	na	na	3	8	3	2
Non-metal minerals	3	3	1	1	2	1
Iron, steel and other metals	26	23	4	3	4	3
Electric/electronics and machinery	3	8	48	52	57	64
Transport equipment	2	3	4	5	4	5
Other manufacture	na	na	8	6	8	6
Total	100	100	100	100	100	100

Source: Malaysia (1995: Statistical Table 3.5); Rasiah (1995: Table 5.3)

Manufacturing has also undergone significant levels of structural change. The share of capital goods in manufacturing exports rose from 5.8 per cent in 1968 to 69.0 per cent in 1994 (Table 2). Electric/electronics has expanded the most; its export share rising from 0.7 per cent in 1968 to 64.6 per cent in 1994. Capital goods output has risen from 5.5 per cent in 1968 to 34.8 per cent in 1990 (see Rasiah, 1995: Table 5.3). The electric/electronics industry's share in employment and output rose from 2.0 per cent and 8.0 per cent respectively in 1968 to 30.2 per cent and 25.4 per cent respectively in 1990.

Unfortunately, the rapid growth of the manufacturing sector has not been reflected in several performance indicators. Burgeoning trade imbalances, high import shares in domestic demand and heavy concentration of production in narrowly defined segments of product chains has threatened to restrict further structural change. As shown in Table 3, manufactured imports in domestic demand has continued to rise, and the manufactured trade balance has remained negative. A significant share of profits realized by foreign firms have been repatriated back as factor payments abroad. The overall current account balance has worsened. The economy is now at the crossroads where supply-side resources such as labour and infrastructural support services have been exhausted. In fact the over-reliance on labour-

intensive foreign capital in the face of supply constraints has attracted foreign labour substitution thereby slowing down the transition to higher skill and technology stages of production.

Table 3: Trade Performance Ratios and Balance of Payments, Malaysia, 1973-94

	1973	1979	1985	1992
Manufacturing				
Imports/domestic demand*	0.407	0.358	0.339	0.611@
Goods trade balance**	-0.436	-0.189	-0.224	-0.182@
Overall economy (RM mil.)				
Current account balance+	-727#	-1991	-5434	-6419
Investment income++	-1187#	2033	-1522	-4400

Notes: * -- domestic demand measured as, output+imports-exports; ** -- measured as, [exports-imports]/[exports+imports]; + -- comprises goods, transfers and service accounts; ++ -- net flow of undistributed profits; # -- 1975; @ -- 1991.
Source: Rasiah (1995; 1995a); *Bank Negara* (1988; 1993)

Table 4: Educational Enrolment, Selected Economies, 1970-92

	% of age group enrolled in educational institutions					
	Primary		Secondary		Tertiary	
	1970	1992	1970	1992	1970	1992
Japan	99	102	86	na	31	32
United States	na	104	na	na	56	76
Sweden	94	101	86	91	31	34
Germany	na	107	na	na	27	36
France	117	106	74	101	26	46
Canada	101	107	65	104	42	99
United Kingdom	104	104	73	86	20	28
Korea	103	105	42	90	16	42
Turkey	110	112	27	60	6	15
Brazil	82	106	26	39	12	12
Malaysia	87	93	34	58	4	7
Thailand	83	97	17	33	13	19
Indonesia	80	115	16	38	4	10
Jamaica	119	106	46	62	7	9
Kenya	58	95	9	29	1	2
Bangladesh	54	77	na	19	3	4

Source: World Bank (1995: 216-217)

To understand better the limitations of the existing mechanisms of technical change, it is pertinent to examine the nature and structure of the direct and indirect agents of innovation in the national economy. This task is undertaken using the framework introduced in Section 2. Only key agents are assessed here. Also, given data constraints the firm level assessment of direct agents is generally limited to electronics firms.

Rasiah and Osman (1995: Table 1) reported labour supply and workers' quality as the prime deficiencies confronting manufacturing firms in Malaysia. Indeed, serious shortages have been reflected in the high wage premium enjoyed by skilled occupational categories (World Bank, 1995). The sector is, thus, gripped by serious shortages in the critical mass of employees that drive innovations - both minor and major changes in technology. All 231 firms interviewed in 1995 revealed skilled workers as their biggest problem.[2] The critical nature of this problem becomes clear when comparisons are made across economies. Malaysia's participation rates in education fall short of Korea and the developed economies - especially at the tertiary level (see Table 4). Shortages in the supply of technical graduates has been more serious. It had only 2 per cent secondary students enrolled in technical fields compared to 19 per cent in Korea (Table 5). Even Indonesia - which is less developed than Malaysia - enjoyed a 12 per cent share of secondary students in technical education. Systematic government promotion of technical education in Taiwan led to the transformation of the ratio of vocational high school (VHS) graduates to academic high school (AHS) graduates from 1:1.7 in 1950 to 1:1 in 1975 and 2:1 in 1988 (Lee, 1994: 5-6).

Participation in R&D activities have not been very significant. As shown in Table 6, Malaysia only had 4 R&D scientists and technologists per 10000 people compared to 22 in Korea in 1988-90. Investment in R&D in 1992 was only 0.4 per cent of GNP compared to 2.1 per cent in Korea. These figures were even higher in the more industrialized economies. Malaysia's relatively low R&D endowments places it at the bottom of the technology trajectory. We noted in section 2 that the depth and width of R&D participation is generally a function of the structure and levels of development of an economy. Malaysia's economic structure is not very different from that of Taiwan and Korea, but remains laggard in terms of R&D endowments. In current price terms, the economy does not face serious demand constraints. Serious labour shortages in West Malaysia attest to that. Except for a handful of firms, the available evidence does not suggest serious supply constraints either. As noted below, most firms do not participate in R&D activities and therefore do not invest in such activities or seek R&D scientists and technologists.

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[2] This unweighted sample had firms from all industries at the 3 digit standard industrial classification (SIC) level, located in all states except for Kelantan, Terengganu, Perlis and the federal territory of Labuan.

Table 5: Public Education and Technical Orientation, Selected Economies

	Public Education (as % of GNP)		Secondary technical enrolment (as % of all levels)	Tertiary natural and applied enrolment (as % of total tertiary)	Science graduates (as % of total graduates)
	1960	1990	1988-91	1990-91	1988-90
Japan	(4.9)	3.7(5.0)	28	26	26
United States	(5.3)	5.5(7.0)	na	14	15
Sweden	5.9	6.5(6.5)	73	43	26
Germany	(2.4)	4.0(5.4)	80	42	32
France	(3.6)	5.4(6.0)	54	31	27
Canada	(4.6)	(7.4)	na	14	16
United Kingdom	3.4	5.3	20	39	26
Korea	2.0	3.6	19	42	29
Turkey	2.6	na	25	33	36
Brazil	1.9	4.6	na	31	19
Malaysia	2.9	6.9	2	30	28
Thailand	2.3	3.8	19	22	18
Indonesia	2.5	na	12.0	na	11
Jamaica	2.3	6.1	4	35	19
Kenya	4.6	6.8	2	32	24
Bangladesh	0.6	2.0	1	27	16

Source: UNDP (1995: 158-159, 192-193)

Why then should there be more emphasis on R&D activities? Two major reasons can be forwarded. First, given the risks and long term nature of returns associated with R&D activities, the *status quo* reflected in current R&D supply-demand conditions cannot be the yardstick of planning. Especially for local firms in a developing economy such as Malaysia, demand has to be created to shake them in the Hirschmanian sense (Hirschman, 1957). Second, foreign firms involved in leading edge products generally access home-site NISs for their R&D activities. For example, electronics firms retain their key innovation related stages at home-sites. Reliance on external NISs to enhance Malaysia's NIS can be beneficial. Successful latecomers have strongly accessed such technology transmission channels. However, continued reliance on external technology sources without significant levels of transfer has contributed little to the strengthening of Malaysia's NIS. As we discuss below, institutional weaknesses in the country has restricted technology transfer capacity in the country. Hence, major export-oriented firms' critical stages in their value added chain has continued to remain at foreign sites.

Table 6: Research and Development Statistics

	Scientists and technologists per 1000 people 1986-90	R&D scientists and technologists per 10000 people 1986-89	R&D expenditure as % of GNP 1987-92
Japan	110	60	2.8
United States	55	na	2.9
Sweden	262	62	2.8
Germany	86	47	2.9
France	83	51	2.3
Canada	174	34	1.4
United Kingdom	90	na	2.3
Korea	46	22	2.1
Turkey	26	4	na
Brazil	30	na	0.6
Malaysia	na	4	0.4
Thailand	1	2	0.2
Indonesia	12	na	na
Jamaica	6	0	na
Kenya	1	na	na
Bangladesh	1	na	na

Note: na - not available.
Source: UNDP (1995); MASTIC (1994)

The organization of savings and investment in Malaysia reveals a fairly strong nexus between savings and investment as the participation of corporate savings has been substantial (see Table 7). Malaysia has traditionally enjoyed high savings levels - 27 per cent in 1960 and 38 per cent in 1993 (World Bank, 1985; 1995). Domestic investment rose from 14 per cent in 1960 to 33 per cent in 1993. Its resource balance remained positive - 4 per cent in 1960 and 5 per cent in 1993. Its financial environment, thus, has been stable. It has also managed to attract significant amounts of foreign direct investment - which accounted for 24 per cent of gross domestic investment in 1994 (UNCTAD, 1995). The manufacturing sector also generated 41.1 per cent of its direct loans from external sources in 1991 (MIDA, 1992). While these evidence does not allow clear deductions on the productivity of investments, the high participation of corporate investment and external loans suggests high returns to investment. Have incentives and investment been coordinated and directed towards innovative activities? Has the regulatory framework in the economy stimulated innovations? These are difficult questions to answer as the latter is difficult to define and trace. The evidence

Table 7: Technology Transfer Agreements by Industry, Malaysia, 1975-93

	75-77	78-80	81-83	84-86	87-89	90-92	1993
Electric/electronic	31	55	50	53	106	124	69
Chemical	7	38	41	48	74	64	20
Transport equip.	9	22	34	52	20	62	25
Fabricated metal	16	29	43	34	45	33	11
Food	13	24	40	24	45	12	11
Rubber	7	15	23	22	48	26	5
Non-metallic mineral	8	13	29	31	26	26	5
Basic metal	8	15	28	7	8	13	5
Textile and garment	15	12	12	14	12	20	3
Plastic	3	8	9	11	8	17	11
Wood	11	9	5	10	1	11	4
Paper	0	0	0	7	4	10	3
Others	16	43	42	25	61	48	13
Total	144	283	356	338	458	460	185

Source: MIDA (unpublished data)

Efforts have been taken from the inception of Malaysia Incorporated in 1983 to improve government-business coordination. Government officials were sent to Japan and Korea to understand better their operations. Also, consultative committees were formed between the private and private sectors. The MTDC - formed in 1992 - has begun commercializing R&D and advancing technology (Malaysia, 1994: 117). By the end of 1993, it had invested RM16 million in 12 firms (Malaysia, 1994a: 300, 303). A broader collaborative umbrella, the Malaysia Industry-Government Group of High Technology (MIGHT) was launched in 1993 to promote technology prospecting, mechanisms to identify new markets, businesses and investment opportunities for R&D and technology development. While it may be too early to assess their roles, a few flaws can be identified. First, insufficient effort has been taken to involve the private sector as officials representing the latter in consultative committees, have themselves been appointed as advisors following their retirement from public service. Second, little effective participation of government officials in the private sector actually took place as their roles have not been clearly defined. Third, most of the public sector

officials seconded to the private sector have generally been limited to parastatals. Even here, not many have involved in the business and technical aspects of production. Mistrust of government officials - a consequence of the political economy of ethnic relations (see Jomo, 1986; Rasiah, 1996a) - and weak understanding of technology and business by government officials fettered effective coordination between the public and private sectors. Besides, several officials merely moved to privatized institutions to improve their employment benefits.

To stimulate the growth of SMIs, three important programmes were introduced. First, the umbrella concept of marketing (UCM) emerged in 1984. The remaining two - subcontract exchange (SEP) and anchor company (ACP) programmes - were introduced in 1986 and 1992 respectively (Vijaya Letchumi, 1993). Besta Distribution, Guthrie Furniture and Guthrie Malaysia Exchange Programme were the pioneers of the UCM - acting as marketing support organizations for *Bumiputera* SMIs. Bumiputera equity as been strongly emphasized in ACPs involving state-sponsored firms such as Proton. The SEP generally acted as a platform for matching foreign transnationals with local SMIs. SMIs - including those engaged under the three programmes above - have been encouraged to access the ITAF. The ITAF was launched in 1990 to facilitate feasibility studies, product development and designing, productivity and market development (Malaysia, 1994).

Despite active promotion and assistance from complementing institutions (e.g. SIRIM, *Bank Pembangunan* and MATRADE), SMIs have yet to develop effective support capacities (Anuwar Ali, 1992; Rasiah and Anuwar Ali, 1995). Production linkages have been strongest in state-sponsored anchor firms due to captive rents offered by government controlled managements. Even here, linkages have grown superficially with local enterprises. For example, Proton was reported to have sourced 80 per cent of its components locally in 1995. As interviews suggest - that figure could dip below 30 per cent if imports by local supplier firms are taken into account.[6]

Five important reasons account for the general weakness of SMI support mechanisms. First, a significant number of SMIs have been start-ups begun largely to boost *Bumiputera* participation in industry. Their lack of entrepreneurial experience has often led to poor management. Second, captive rents offered by state-sponsored anchor firms have not been tied to time bound performance standards. Hence, there has been little pressure or competition to improve efficiency, and poor performers have continued to be supported by the anchor firms at the expense of their own competitiveness. Third, the 30 per cent domestic sourcing condition for firms applying for pioneer status and investment tax allowance have been redundant with strategic industries, and thus has carried serious loopholes. Fourth, the 30 per cent domestic sourcing condition has not discriminated against foreign owned firms. Thus, several transnationals meet the domestic content requirement by purchasing from their

[6] Interviews by the author in 1994.

subsidiaries - inputs partially processed or assembled - operating in Malaysia. Fifth, *quasi* government participation in learning spin-off process so as to match the right SMIs with transnationals - including by stimulating potentially capable SMIs - has not been strong. Only in Penang - where a combination of relative political autonomy enjoyed by the Chinese dominated state government who have collaborated effectively with trasnationals and Chinese-owned SMIs - have relatively strong government-business relationships led to the growth of competitive production linkages. Much of such linkages have generally emerged in the electronics, machine tools and plastics industries where, *inter alia*, the inherent need for flexibility has strengthened production linkages between foreign and local firms (Rasiah, 1994). From 45 firms in 1989, the number of such support firms rose to 250 in 1993.[7] As with the PSDC noted earlier, the Penang Development Corporation has been an important intermediary stimulating such developments.

The mechanisms of labour relations in the production process reveal generally weak workers' participation in innovative activities. Rasiah and Osman's (1995) study of 2200 firms shows a generally significant relationship between unions and training. Draconian regulatory mechanisms have limited unions to bargain only minimal working conditions and wages (Jomo and Todd, 1994; Rasiah, 1995b). Innovative activities are still limited to the different management levels in most industries. Workers generally perform only executional tasks. Employee relations until the mid-1980s have in general been hierarchical with strict job definitions and labour control. In several industries - including garments, rubber products, furniture and beverages - such an orthodox division of labour has continued.

From the mid-1980s, however, total employee participation emerged in some export-oriented high-technology industries. Particularly in semiconductor assembly and test, state of the art process techniques such as total productive management (TPM), total quality management (TQM), statistical process control (SPC), just in time (JIT) and quality control circles (QCCs) have helped transform considerably organizational structures from elongated and strictly demarcated to interlocking and flatter (Rasiah, 1995a).[8] The success achieved in these firms has spilled over to a number of firms in other industries. The lack of either a nation-wide framework as in Sweden and Germany or firm-level framework as in Japan - industrial relations linking unions with training and innovation has, however, debilitated the participation of employees in innovative activities on a national scale.

Campaigns to instill entrepreneurship and work discipline cultural attributes on a national scale has become particularly significant since Mahathir came to power in 1981. The clean, efficient and trustworthy slogan became one of the earliest motto of the Mahathir government - followed by

[7] Traced by the author in the respective years. The actual number can only be more.
[8] See Rasiah (1987) for an account of the factors that stimulated the introduction of such process techniques.

the introduction of Malaysia Incorporated in 1983. Efforts to raise participation in science and technical fields, and pursuit of competitive strategies has become conspicious only from the late 1980s. The national excellence and quality awards, young scientist of the year, and MASTIC's creation to accummulate and disseminate science and technology information across the economy have been examples of nationally coordinated programmes to raise awareness and participation in innovative activities. Many of the institutions involved in such information generation, spread and promotional activities have been introduced only in the 1990s. Information asymmetry problems still plague the manufacturing sector strongly.

Finally, have innovative activities become significant in Malaysia's manufacturing sector? Private sector expenditure on R&D activities only accounted for 0.17 per cent GNP in 1992 (MASTIC, 1994). From the discussion earlier, two major reasons can explain why the extent of innovative activities in the country have been far less than its industrial structure equivalent, *viz.*, first, foreign firms generally access much of their innovative knowhow generated from their plants located in home-site NISs, and second, weaknesses in domestic supporting institutional mechanisms has reduced the absorptive capacity of local firms. Table 8 shows R&D expenditure in selected industries in Malaysia in 1992. It can be seen that the electric/electronics shows the highest amount of investment in R&D activities followed by transport equipment. The former is dominated by foreign firms' while the latter wholly by one local firm - state-sponsored Proton. More state-sponsored local firms have entered into R&D activities in automobiles following their launching from 1994.

Table 8: R&D Expenditure in Selected Industries, Malaysia, 1992 (RM Million)

Industry	Local*	Foreign#	Total
Electric/electronics	9.7	102.7	112.4
Transport equipment	82.0	0.0	82.0
Food	14.8	1.3	16.1
Rubber	1.2	1.4	2.7
Textiles	0.4	0.4	0.9
Chemicals	1.9	11.7	13.5
Total	123.7	122.6	246.3

Note: * - local ownership exceeding 50 per cent; # - foreign ownership exceeding 50 per cent.
Source: MASTIC, *1992 National Survey of Research and Development*, 1994

Rasiah's (1995d) survey of 82 electronics firms in 1993 (29.3 per cent of firms in the industry) showed that 9 firms participated in formal R&D activities. Only one firm participated in new product development - local owned Sapura. Despite its breakthrough in certain products - e.g. developing the world's first voice activited telephone - it is still far from the technology frontier. The remaining firms - all foreign controlled - have involved in either product extension, customization or redesigning. Twenty one firms participated in process R&D formally. Eighteen of these firms were foreign controlled. A higher share of firms - 73 of the 82 - reported incremental innovations. Most of these firms do not have any formal R&D activities. Foreign controlled firms accounted for 64 of the firms that reported generating minor innovations. Although few firms have been involved directly in formal R&D operations, the incidence of minor innovations in the industry - especially foreign firms - has been high. Two major reasons explain such a tendency. First, export-oriented electronics are involved in highly competitive markets where products and processes have changed rapidly - thereby requiring quick responses from firms in all stages of production. Second, the labour force in Malaysia has been developed over 20-25 years so that they are now better equipped to absorb, generate and apply innovations. However, no electronics firm - including foreign firm - has involved in blue sky research in Malaysia. The most sophisticated designing activities undertaken in foreign firms have generally been limited to second or third order technologies - to improve performance and more uses of maturing products. For example, local engineers redesign 386 microprocessors in Intel and 256 DRAM chips in Hitachi.

4. Conclusions

THE paper presented a conceptual framework for examining Malaysia's NIS, and assessed critically the direct and indirect agents supporting innovations. Although inexhaustive, the assessment does reveal some of the more salient features of Malaysia's NIS.

Malaysia obviously does not reveal a typical industrial structure when its innovative capacity and structural composition of output and exports are compared. That the country has been able to export high technology products has largely been a consequence of foreign firms' participation. Foreign firms have generally accessed external NIS for much of their innovative support. Much of their innovation activities undertaken in Malaysia have been confined to minor process improvements, regional customization and redesigning of mature products. Local firms have generally participated in production activities with little innovative capacity. The few local firms that have developed their innovative faculties, are still far from the technology frontier. Only in resource-based agricultural activities have local firms shaped the technology frontier.

Recognizing such a reality, the government has embarked on gigantic programme to strengthen Malaysia's NIS. We, however, contend that existing institutions and coordination mechanisms have not been organized adequately to generate knowledge and innovations effectively. For an economy which enjoys substantial resources and savings, it does not suffer from funding problems. It, however, requires effective governing of the development of absorptive capacity and technology transfer. This will inevitably mean strengthening the enabling environment so that the direct and indirect agents and their interactions are coordinated effectively to quicken knowledge and innovation generation for productive use.

References

Akuyz Y. and Gore C. (1994) "The Investment-Profit Nexus in East Asian Industrialization" (forthcoming in *World Development*, 1996, 24(3).

Amsden, A. (1989) *Asia's Next Giant*, New York: Oxford University Press.

Anuwar Ali (1992) *Malaysian Industrialization: The Quest for Technology*, Kuala Lumpur: Oxford University Press.

Best M. (1990) *New Competition*, Cambridge: Harvard University Press.

Best, M. (1995) "Technology Diffusion and Regional Manufacturing Strategies", 1995 *Sir Charles Carter Lecture*, Belfast, Ireland, May 12.

Chang H. J. (1994) *Political Economy of Industrial Policy*, London: Macmillan.

Chantasmary, M. (1994) "Impact of Trade AFTA on the Palm Oil Industry in Malaysia" report submitted to the Thailand Development Research Institute, Bangkok.

Dosi, G. (1984) *Technical Change and Industrial Transformation*, London: Macmillan.

Freeman, C. (1987) *Technology Policy and Economic Policy: Lessons from Japan*, London: Frances Pinter.

Gerschenkron, A. (1962) *Historical Backwardness in Historical Perspective*, Cambridge: Harvard University Press

Hischman, A. (1957) *Strategy of Economic Development*, New Haven: Yale University Press.

Johnson, C. (1982) *MITI and the Japanese Miracle*, Stanford: Stanford University Press.

Jomo K.S. (1986) *Question of Class*, Kuala Lumpur: Oxford University Press

Jomo K.S. and Todd, P. (1994) *Trade Unions in Peninsular Malaysia*, Kuala Lumpur: Oxford University Press.

Kaldor, N. (1979) "Equilibrium Theory and Growth Theory", Boskin, M.J. (ed), *Economics of Human Welfare: Essays in Honour of Tibor Scitovsky*, New York: Academic Press.

Landau, D.F., Schinasi, G.J., Cassard, M., Ng. V.K. and Spencer, M.G. (1995) "Effects of Capital Flows on the Domestic Financial Sectors in APEC Developing Countries", Khan, M.S. and Reinhart, C. .M. (eds). "Capital Flows in the APEC Region", *Occasional Paper 122*, Washington D.C.: International Monetary Fund.

Lazonick, W. (1989) "Business Organization and Competitive Advantage: Capitalist Transformation in the Twentieth Century", paper presented at the conference, The Process of Technological Change", New School for Social Research, New York.

Lee J.S. (1994) "The Role of the State in Economic Restructuring and Development: The Case of Taiwan", *Occasional Paper Series* no. 9403, Chung-Hua Institution for Economic Research, Taipei.

List, F. (1885) *The National System of Political Economy*, London: Longman.

Lim C.Y. (1967) *Economic Development of Modern Malaya*, Kuala Lumpur: Oxford University Press.

Lundvall, B.E. (1985) " Product Innovation and User-Producer Interaction", *Industrial Development Research Series*, Vol. 31, Aolborg: Aolborg University Press.

Malaysia (1991) *Second Outline Perspective*, Kuala Lumpur: Government Printers.

Malaysia (1994) *Ministry of International Trade and Industry Report*, Kuala Lumpur: Government Printers.

Malaysia (1994a) *Mid-term Review of Sixth Malaysia Plan*, Kuala Lumpur: Government Printers.

Malaysia (1995) *Economic Report 1995/96*, Kuala Lumpur: Government Printers.

MIDA (1992) *Statistics on the Manufacturing Sector*, Kuala Lumpur: Malaysian Industrial Development Authority.

MASTIC (1994) *1992 National Survey of Research and Development*, Kuala Lumpur: Malaysian Science and Technology Information Centre.

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