The National Innovation Systems of Singapore and Malaysia

Trevor Monroe

Self-Study with Professor Samphantharak

4/07/06
Executive Summary

Technological development has been an important component of economic development in Singapore and Malaysia. Beginning in the seventies, both countries initiated economic transformation by successfully attracting foreign direct investment into their high-tech manufacturing sectors. By the eighties these countries developed into high-tech export platforms as foreign multinationals not only helped to stimulate economic growth but also provided benefits in the form of technology and knowledge spillovers. As both economies continue to grow more knowledge intensive, public policy is placing a greater emphasis on developing the infrastructure and human capital necessary to support domestic innovative capacity.

Introduction

In recent decades, as economic activity in both Singapore and Malaysia has grown more knowledge intensive, greater attention is being given towards the economic role of innovation. Because the ability to innovate will play a more prominent role in driving future economic growth, the national governments of both Singapore and Malaysia have accelerated policy efforts aimed at strengthening their national innovation systems. These efforts include the introduction of broad measures to improve performance in areas like R&D, education, entrepreneurial activity and knowledge flows—all of which are key determinants for innovative activity.

This paper will analyze the development of these national innovation systems beginning with a brief introduction of the role of innovation and an examination of the
elements that comprise national innovation systems. The paper will incorporate analytic approaches from institutional thought and economic geography in order to assess the evolution of each country’s National Innovation System (NIS) and the role it will play in supporting future economic growth and development. Following this analysis will be a section that compares and contrast key determinants that drive innovative performance in each country and identify commonalities and differences.

Innovation and National Innovation Systems

Product, process and organizational innovation are the types of innovation with the most relevant applications towards economic development. Innovation in these areas is considered an interactive process that involves the novel application of economically valuable information across various sections of a production network or value chain. The most important determinants of these types of innovation include; industry R&D, university research, highly skilled labor, and network and firm characteristics.

Studies have accumulated from fields of economic geography and institutional perspectives that are particularly useful in helping to better understand and explain the relationship between innovation and economic activity. These two approaches often share commonalities and overlap, with scholars from both approaches emphasizing how geographic, cultural, firm characteristics and institutional factors shape innovative capability and economic development.
While there is no one definition of a national innovation system, most definitions reflect the web of interactions within the system involving the flow of technology and information among society, firms, universities and government institutes. According to the OECD, which is undertaking a major assessment of national innovation systems, the innovative performance of a country depends to a large extent on how these various actors relate to each other as elements of a collective system of knowledge creation and with respect to the technologies they use. These relationships often take the form of joint research, personnel exchanges, cross-patenting, purchase of equipment and a variety of other channels.

From a geographic perspective innovation theory generally supports the idea that innovative activity is greater in areas with larger amounts of knowledge generating inputs, or clusters, which are systems of interconnected firms and institutions that play an important role competition. Consequentially, innovational advantages often arise in areas with highly specialized clusters of related skills, technologies, and infrastructure, especially when these clusters are difficult to duplicate. These systems represent planned interactive enterprises that rely on close university-industry co-operation, where large and smaller firms establish network relationship with other firms, universities, research institutes, and government agencies based on public-private partnerships. According to the OECD (1999), the concept of clusters is closely linked to firms networking but it goes beyond that as it captures all forms of knowledge sharing and exchange within a specific locality.

The smooth operation of innovation systems depends on the fluidity of knowledge flows – among enterprises, universities and research institutions. It is widely recognized that knowledge, in the form of human capital and technology, are key drivers of
economic growth. This includes both *tacit knowledge*, or know-how exchanged through informal channels, and *codified knowledge*, or information codified in publications, patents and other sources. The mechanisms that engender these knowledge flows include joint industry research, public/private sector partnerships, technology diffusion and movement of personnel. Investments in knowledge, such as in research and development, education and training, and innovative work approaches are widely considered to be key to economic growth.

The formation of a national innovation system and the institutional channels for the exchange of information can also be thought of as an approach to reducing uncertainty. Being part of a network enables a firm to exploit developments in a technology and solve problems by sharing experiences with those dealing with similar technologies. High-tech and Science clusters that have demonstrated high levels of innovative success have accumulated information that also facilitates the next round of innovation, since the ability to innovate successfully is often a function of the technological levels already achieved.

As economic activity grows more knowledge intensive it is generally accompanied or preceded by the growth of institutions involved in the production and diffusion of knowledge. The regionalization and globalization of economic activity has prompted central and local policy makers to take steps to establish and strengthen institutional linkages between firms, research institutions, and universities at the local, regional and international levels that facilitate greater exchange of *tacit* and *codified* knowledge.

**Singapore’s National Innovation System**
Overview

As a newly industrialized country that is among the world’s highest in per capita income, Singapore has been highly successful in its pursuit of rapid economic growth. Singapore’s industrial policy has involved the pursuit of an upgrade strategy in its technology and manufacturing sectors. In the first decade following independence growth was largely propelled through labor-intensive industries with foreign multinationals leading the success of Singapore’s technological manufacturing sector. This has culminated in about three-quarters of Singapore’s manufacturing output in coming from MNCs, and more than sixty percent of equity in its manufacturing sector being foreign. Today Singapore is one of the world’s most important international hubs for business, transport, finance, and communications--knowledge intensive service and manufacturing sectors that have become the key drivers for its economic growth.

Economic Development Path

Wong has categorized Singapore’s overall economic development path in four phases; 1) the industrial take-off phase (from 1965-mid 1970s) which was characterized by high dependence on technology transfer from foreign MNCs, 2) local technological deepening (mid-1970s to late-1980s) characterized by rapid growth of local process technology capabilities brought by upgraded MNC operations in Singapore and the development of local supporting industries, 3) applied R&D expansion (late 1980s to late 1990s) characterized by rapid expansion of applied R&D activities by global MNCs along with the establishment and growth of new public R&D institutions geared to support MNC product and process innovation activities, and 4) the shift towards high
technology entrepreneurship and basic R&D (1990s onwards) characterized by an emerging emphasis on indigenous technological innovation capabilities, the formation of local high tech start-ups and shift towards science-based industries, particularly life-science.

Singapore, unlike many other Asian Tigers, placed a much higher dependence upon MNCs rather than local firms to lead its development in technological capability. Therefore rather than indigenous R&D, Singapore primarily relied upon MNCs to produce the knowledge spillovers and technology transfers necessary to develop its national technological capability. From a historical perspective, Singapore’s NIS can thus be described as transforming from one that emphasized technology adoption, particularly the assimilation and diffusion of technology by leveraging inward MNC investments, to a more balanced approach that places more of an emphasis on indigenous innovation capability and the creation of local high technology firms.

In an effort to establish Singapore as a regional R&D and innovation hub the state intensified policy action beginning in the 1990s to strengthen its national innovation system. In order to encourage foreign MNCs to locate R&D activities in Singapore, the government began to establish research institutes in IT, microelectronics and life sciences. Towards the end of the nineties, policy efforts grew more pronounced to produce a national innovation system that would support and compel a higher amount of indigenous innovation activity.

The primary institutions that have evolved to support the ICT industry include the Ministry of Communication & Information Technology (MCIT), the Infocomm Development Authority (IDA), the Media Development Authority (MDA) and the
National Science and Technology Board (NSTB). The NSTB was established to help coordinate efforts to attract private sector R&D and to channel resources to construct R&D supporting infrastructure.

1996, the state followed with a more locally targeted plan with the Innovation Program, which had the objective to develop a wide base of indigenous creative capabilities within Singapore. Recent policy initiatives, like the "Intelligent Nation" initiative continue to place a pronounced effort upon improving innovative performance by enhancing knowledge flows. Starting in 2006 the IDA is rolling out the ten year “Intelligent Nation” plan to drive the use of ICT throughout Singapore.

Up until recently, most of the R&D undertaken in Singapore has generally focused on applied rather than basic research. The applied research that did take place tended to be government-extracted, often taking the form of joint public-private collaborations in order to solve production problems. Government labs in Singapore operated on two parallel tracks: they provided services to multinationals to keep them in Singapore; and they undertook independent research to promote their own objectives.\textsuperscript{vi} Overall, the government placed emphasis on the generation of “an original commercial outcome”, which presented the labs with strong incentives to undertake applied research. The Singapore Government enticed foreign firms to perform more local R&D by criteria that related to the bottom line. Arguably, this dampened investment in more basic research, where market results were less certain and harder to achieve.\textsuperscript{vii}
In order to conduct basic research, which in turn helps to spur innovative scientific activity, larger amounts of human capital and R&D investment is required relative to applied research. Singapore’s government is undertaking measures to address this by offering more postgraduate scholarships in the sciences with renewed emphasis on basic research in the government-funded research institutes and in the local universities.

The government is also making concerted efforts to attract foreign talent to Singapore to supplement the local talent pool. As reflected in figure 1, R&D spending has for the most part has steadily risen in recent years, while figure relates that the share of researchers per million are increasing while the share of technicians per million have maintained a steady level.

*Science and High-Tech Clusters*

Singapore is a small city-state that has enjoyed the economic advantages of
location dating back centuries. In line with economic geography theory location factors have positively influenced economic development in Singapore. Singapore has leveraged these advantages in order to drive to technological development and relying on locational advantages to become a regional hub for R&D.

In 1980, seeking to emulate the success of science and high-tech clusters like Silicon Valley and Route 128, the government established the Singapore Science Park (SSP). The SSP has since been an integral part of the technology policy that underpins Singapore’s economic growth strategy. The primary reason to develop the SSP was to provide and upgrade local infrastructure to attract MNCs and new industries that favor locations with proximity to research institutions. Additionally the SSP was conceived to serve as an incubator for high-tech industries and be the locus for R&D in Singapore, with the primary emphasis being on applied industrial R&D rather than basic scientific R&D.

Building upon the success of SSP, the One-North Science Habitat is the government’s recent bold initiative to encourage the next wave of economic growth arising from a state of the art cluster. The One-North project reflects the governments commitment to establish Singapore as a regional and global center for R&D. One-North is a 200-hectare development that will integrate the existing science park facilities and other research centers into a mammoth science and technology district. Conceptualized in 2000, the project is estimated to cost S$15 billion, or about US$8.6 billion, over 15 years. It is envisaged to create the ambience of a multifaceted research community, with schools, public transport, and other amenities. It will provide a wider focal point for R&D and entrepreneurial activities in the biosciences and information technology sectors.
One of the main objectives of the One-North initiative is to attract and develop novel R&D arrangements that foster innovation through new forms of business interaction, through “dynamic planning” in a dense technological metropolis. “Dynamic Planning” is a novel design concept that is a product of current innovative thinking. The concept is to generate self-evolving industrial structures by incorporating design principles that promote the vertical and horizontal integration of tenants. In the process of transforming themselves through the integrated use of space and the “cross-fertilization of research ideas, organizations involved in different sectors and technological activities should be able to combine their different capabilities into new ones. This arrangement is an example of organizational innovation albeit between firms rather than within a single firm, that is intended to be instrumental towards producing innovative process and product outcomes.

**Malaysia’s National Innovation System**

*Overview*

In the 1970s Malaysia began its transition into a middle-income country by gradually broadening its economic activities. In the following decades it transitioned from an economy primarily focused on the production of raw materials, like rubber, tin and palm oil into one of the world leading electronics exporters.\(^ix\) The sector was the primary driver of export growth during the transition period and is currently Malaysia’s leading industrial sector in terms of investment, value added, exports and employment.\(^x\)
Malaysia’s NIS

Policies to develop and strengthen Malaysia’s NIS are orchestrated around Vision 2020, which serves as the nation’s roadmap for economic development. The key institutions in Malaysia that are related to ICT are the Malaysia Science, Technology, and Innovation Ministry, the National Information Technology Council of Malaysia (NITC), the Ministry of Information, Ministry of Science Technology and the Environment, and the Malaysian Development Corporation (MDC).

The National Information Technology Council of Malaysia (NITC), which was established in 1994, functions as the primary advisor to the government on ICT matters. Chaired by the prime minister of Malaysia, the council comprises representatives from the public, private and community sectors. The MDC is actually a private entity that was formed by the government to act as a catalyst for the ICT industry. The MDC operates through provisions that involve fiscal incentives for setting up ICT companies. The MDC’s most important operation is the Multimedia Super Corridor (MSC), the country’s most prominent science and high-tech cluster.

The Multimedia Super Corridor (MSC) is a prominent initiative being taken by Malaysia to develop a world-class IT industry. The MSC is Malaysia’s flagship science and high-tech research project. The MSC encompasses Kuala Lumpur and five other key infrastructural projects that are Petronas Twin Towers, Putrajaya, the new government administrative capital, Cyberjaya an ‘intelligent’ research and development city, Technology Park Malaysia; and Kuala Lumpur Tower.
Beginning in the 1990s the Malaysian government intensified efforts to position Malaysia as a global hub for ICT by introducing a series of development plans focused on developing ICT infrastructure and institutions. Altogether the government has planned eight flagship MSC projects aiming to attract leading companies to establish research and development facilities. A bill of guarantees and incentives have been provided for MSC-status enterprises, among which are an estimated 1,000 foreign technology manufacturers, data centers and communication-related companies.\textsuperscript{x}\textsuperscript{i}

Recently the government has introduced major initiatives to help improve the performance of knowledge flows throughout society and the economy. With the MSC NET LEAP program, which began in 2004 and is scheduled through 2010, the MSC initiative is being expanded to serve the national ICT need. This expansion will culminate in a series of networked cyber cities and cyber centers to be created in phases. The hub for this network is the Central Incubator at Multimedia University, which offers seminars and training in topics like courting venture capital, business plan development, accounting, and marketing. Another key initiative towards enhancing knowledge flows is the ‘My Malaysia, My MSC’ campaign which was recently launched in January 2005 as part of the 'MSC Net Leap' program. ‘My Malaysia, My MSC’ aims to spread MSC benefits and value propositions nationwide, narrowing the digital divide, and reaching both industry and general society.

As shown in Figure 3, the Malaysian government is steadily increasing investment into R&D as a percentage of GDP. Under the 8th Malaysia Plan (2001-2005), significant allocations have been made to increase knowledge flows. These include the expansion of the MSC flagship project to include a network of cyber cities, the
The government’s Malaysia Science, Technology and Innovation Ministry (MSTIM) recently set up an ICT Policy Division with five sub-units, tasked to formulate the national policy on ICT. The first unit is the guiding NITC Secretariat. The others are the Policy and Strategic Unit, IC Tech Studies Unit, Assessment and Monitoring Unit and ICT Acculturation Unit. In addition to formulating national policies on ICT, the division is also responsible for planning ICT programs for the masses, and programs designed to bridge the digital divide, as well as those for specific target groups. Its tasks also include ICT industry promotions, coordination of new development of ICT applications, and providing guidance and advice to the local sector.

The government is implementing policy measures to address the need for skilled workers. Instrumental to this effort was the establishment of the ICT Development Institute. As shown in figure 4, Malaysia’s share of researchers per million have grown substantially in recent years, while the share of technicians per million has also displayed...
modest gains. The government has also been undertaking the necessary investments into education. With the Smart Schools project, schools in Malaysia will now be ICT enriched to transform them into a “smart environment” which should pay dividends in a knowledge-based economy.

Figure 4

Comparison of Singapore and Malaysia NIS

Singapore and Malaysia have pronounced differences in their countries endowment factors. Singapore is a small city-state with a service orientated knowledge based economy, while Malaysia has abundant natural capital and a huge population base, with a less sophisticated service economy but still steadily growing more knowledge intensive. However, while Singapore is well ahead of Malaysia in terms of the sophistication of its knowledge based economic activities and therefore growing more dependent upon innovation to drive economic growth, both of these countries have converged in their approach to developing national innovation systems. This can be
witnessed in the overall pattern of active government policy to enhance economic role of innovation and to improve the performance of their national innovation systems in each respective country.

The policy approach in each country to the development of their national innovation systems shares many commonalities. Both countries have sought to lead economic and technological development with strategies designed to attract foreign multinationals. Both governments have successfully developed science and high-tech parks in order to 1) raise the level of technological sophistication of local industries, through the promotion of industrial R&D; 2) promote foreign investments, especially in higher value-added activities; and 3) accelerate the transition from a labor intensive to a
knowledge-intensive economy. Additionally, Singapore and Malaysia have taken proactive approaches to promote knowledge flows throughout their economies and throughout regional and global linkages with initiatives are underway in both countries that facilitate the penetration of ICT across business, government and society at local, regional and international levels.

The major difference between Singapore and Malaysia with respect to economic and innovative activity involves the types of areas where research and economic activity tends to focus. In general Singapore’s national innovation system is well ahead of Malaysia with respect to technological development and scientific capabilities. While both countries are growing ever more knowledge intensive in their economic activities, Singapore generally has higher capabilities to focus in more value added or sophisticated and technically complex areas.

Malaysia benefits from its proximity to Singapore particularly in the SSD industry. As figure 6 displays, this is particularly evident in the percentage of high-tech exports where Malaysia will continue to capture more and more high tech manufacturing jobs from Singapore. Additionally, the more basic research and innovation undertaken in Singapore is certain generate more spillover effects for Malaysia. Malaysia’s strategy to develop strengthen its own national innovation system will help to harness improvements in Singapore’s innovative performance in order to promotes its own future economic development.
Both Singapore and Malaysia have bought into theories from economic geography that location does matter. Both countries have flagship areas, the MSC in Malaysia and the SSP and One North Science Habitat in Singapore where the government has subsidized the creation of high-tech science parks in order to drive economic development. These countries are following policy prescriptions to develop strong national innovation systems support the key drivers of innovation in order to spur economic development.

Conclusion
The structural development of the National Innovation Systems in both Singapore and Malaysia share many similarities. Initially, both countries relied upon foreign multinationals to drive technological development and innovative activity. Public policy in both countries is now beginning to emphasize indigenous talent development in order to capture more economic and technological spillovers domestically. Initiatives in both countries are being introduced that seek to enhance innovative capabilities by forging local, regional, and international channels that facilitate flows of knowledge and information. These initiatives, which are in line with principles from economic geography, strive “to connect with creative talent wherever it resides and build relationships that enable all parties to innovate more rapidly and to get better faster by working with each other”\textsuperscript{iii}. In both Singapore and Malaysia the next phase of economic growth will be more reliant upon the performance of their respective national innovation systems.
Bibliography


x http://www.businessmonitor.com/cgi-bin/request.pl Business Monitor Online

xi http://www.businessmonitor.com/cgi-bin/request.pl Business Monitor Online

xii Koh

xiii http://www.businessweek.com/innovate/content/feb2006/id20060216_568704.htm