

The Malaysian Semiconductor Cluster



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Microeconomics of Competitiveness

Malaysia's Historical Context

Strategically located between the Strait of Malacca and southern South China Sea, the Malay Peninsula has historically been a meeting point of cultures and trade between people traveling through China and India. Commerce between the two countries saw the establishment of trade posts along key routes in Malaysia as early as 100 BC, and the adoption of Hinduism and Buddhism from India (Al Jazeera English, 2013). By the 1400s, with the growing influence of Muslim traders along the Port of Malacca Islam became an established religion in Malaysia (World and Its People, 2008).

Under the colonial influence of the Portuguese and Dutch between the early 14th and mid-17th centuries, Malaysia became a key exporter of tin and gold to Europe, attracting Arabs, Indians, and Chinese who formed a class of powerful and wealthy, immigrant merchants (World and Its People, 2008). By the late 18th century, under British colonial administration, rubber and palm oil grew to become Malaysia's staple exports. New waves of immigrants arrived as indentured workers from India, as well as Chinese immigrants who were attracted by opportunities in tin mining (AL Jazeera, 2013; World and Its People, 2008). At the time of its independence in 1957, Malaysia was among the world's largest producers of tin, rubber, and palm oil. Today, Malaysia is an ethnically diverse country with a population of 30 million, half of whom identifying as Malay while Chinese and Indians constituting the second and third largest groups respectively (CIA World Factbook, 2015).

Economic Performance

Historical performance

Upon independence Malaysia, implemented economic policies through state mandated national plans centered on propelling growth and reducing inequalities between the Malay and Chinese communities. Core strategies included the New Economic Policy (NEP) from 1970-1990, and the National Development Policy (NDP) from 1991-2000. Under the NEP, the government encouraged industrialization to drive exports, while furthering rural development and economic empowerment for the Malay. Pro-poor policies granted plots of farmland to

ethnic Malays and created free trade zones to attract manufacturing to rural areas (EPU, 2004). Economic empowerment for ethnic Malays was implemented through the Industrial Coordination Act (ICA) which mandated 30% Malay share ownership in publically listed businesses (Menon, 2008). By 1990, the percentage of businesses owned by Malays rose to 68% from just 39% in 1969, boosting the share of Malay equity in the economy (EPU, 2004).

Large state corporations – such as HICOM (the Heavy Industry Corporation of Malaysia) – entered into partnerships with foreign companies seeking to investment in key areas of the economy. The National Car Project was one such partnership with Mitsubishi Corporation to manufacture the first Malaysian car and jumpstart the automobile industry. These initiatives benefited from distortionary market policies through government subsidies, favorable procurement provisions, and tariff protection (Menon, 2008). While the economy expanded, growth was heavily dependent on public spending leading to current account and fiscal deficits in the 1980s. Facing falling commodity prices and a global recession, in the mid-1980s Malaysia's experienced its first economic contraction of about 1% of GDP in 1986 (Menon, 2008).

The National Development Policy (NDP) shifted away from the tools of the NEP, instead emphasizing private sector investment as a driver of the economy and entrepreneurship and human development to address racial imbalances. State owned enterprises were privatized and restructured, and the Industrial Cooperation Act was relaxed allowing foreign equity ownership of 100% in some export oriented industries (Menon, 2008).

Malaysia experienced rapid economic growth during this period. GDP grew at an average rate of 6.7% between 1971 and 1990, and 7.0% between 1991 and 2000 (EPU, 2004). Per capital income levels rose from approximately \$10,000 in 1990 to approximately \$14,500 by 2000 (PPP), and poverty decreased dramatically from 49.3% in 1970 to 7% in 2000 (WDI, 2015).

Recent performance

Between 2000 and 2013 growth averaged 5% despite the dot com crisis which saw a slump in the electrical and electronics industry, and the 2009 global recession which led to a contraction in the economy (WDI,

2015). By 2012 per capital income had risen to \$22,000 (PPP), and just 1% of the population was living in poverty (WDI, 2015).

The government, however, faces several challenges in achieving its goal of becoming a high-income economy by 2020. Labor productivity and total factor productivity have been slow to recover since the global recession, barely growing at 2 percent since 2009 (EIU, 2015).

Malaysia's \$25,000 in annual output per person is lower than Japan and Singapore, two of the most competitive economies in the region.

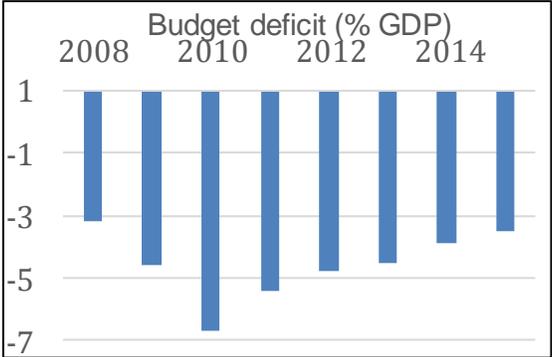
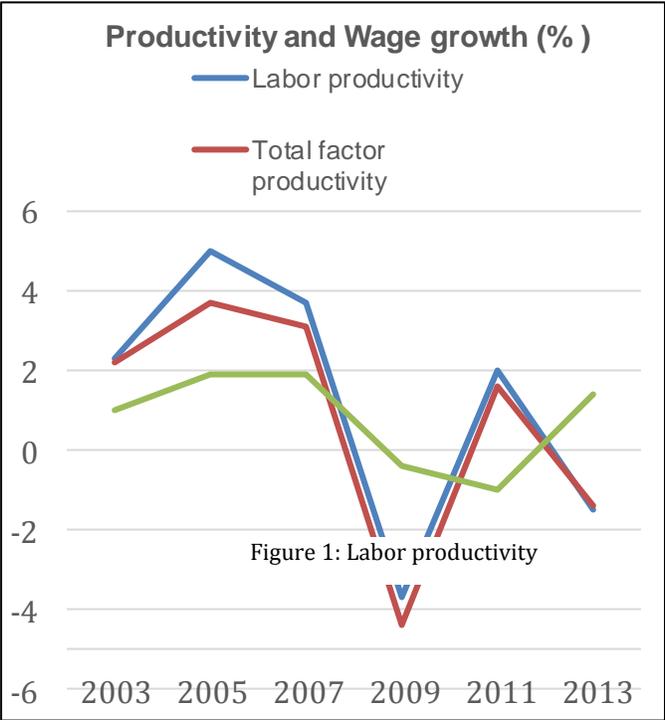


Figure 2: Deficit

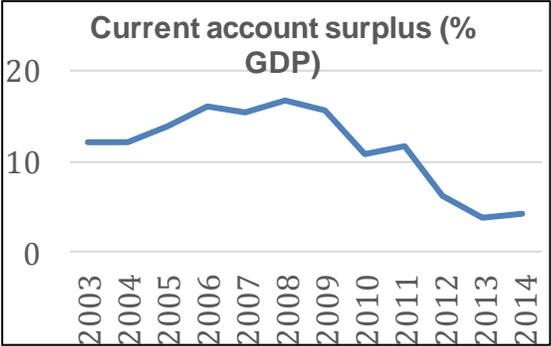


Figure 3: Current account

Furthermore, since the 2009 recession the budget has been in deficit while decreasing global demand and recent decline in commodity prices have eroded the current account surplus (EIU, 2015). Fearing a potential twin deficit situation, the government instituted policies to reduce the deficit (currently at 3.5%) through a new goods and

services tax and subsidy reforms (EIU, 2015). These measures could, however slow down growth, moving the country further away from the 2020 goal of high-income status.

Economic Composition

With 55% of GDP, the services sector accounts for the majority of economic activity, while manufacturing accounts for 26% and agriculture just 7% (EPU, 2013). As of 2013, Malaysia’s IT exports captured 5% of the global export market, significantly larger than the 1% average across other clusters. However, IT has experienced one of the biggest declines in global market share (-1.4%) across clusters since 2000. Despite policies to encourage diversification away from commodities, Malaysia’s largest exporting cluster (by sheer volume) is Oil & Gas Products, while Agricultural Products represent the third largest after IT. Other significant exporting clusters include Hospitality & Tourism, Plastics, Processed Food, Lighting & Electrical Equipment, and Construction Materials – demonstrating strong diversity in the sources of government export revenue.

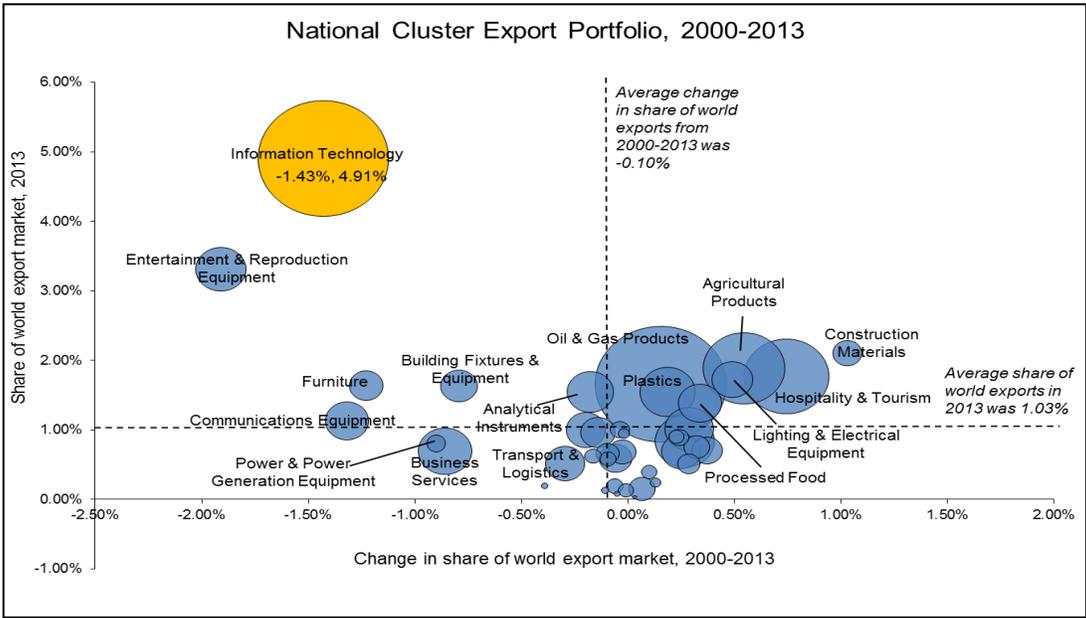


Figure 4: Cluster portfolio

Source: Michael E. Porter, International Cluster Competitiveness Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director. Prof.

Non-exporting industries have grown faster than exporting industries due to growth in domestic demand for infrastructure development, notably transportation equipment and various construction materials (EPU 2013).

SIPI Conditions

Human Development

As noted earlier, Malaysia's economic growth has been accompanied by the near eradication of poverty and steady increases in overall per capita income levels. Primary school enrollment is nearly universal and 93% of the population is literate. Consistent improvements in the quality of healthcare have seen a steady increase in life expectancy from 72.8 years in 2000 to 75 years in 2013 (HDR 2000, 2013).

However, the education sector faces challenges of low secondary and tertiary enrollment at 71% and 37% respectively (WDI 2015). Education quality is also a concern, particularly given that Malaysian students lag behind students in several competitive Asian countries on their PISA performance. The challenges to the education sector will be discussed later in the analysis of the business environment.

Political Institutions

Malaysia has a strong institutional framework for formulating and implementing broad national development policies with success. This track record of performance combined with general transparency of policymaking and wise spending on the part of government, has fostered public trust in government officials. However, Malaysia is notorious for its poor protection of civil liberties. Although the constitution guarantees freedom of the press and freedom of expression, ambiguous laws on sedition and defamation are exploited by the government to suppress the media and political opposition arbitrarily. Politically motivated arrests are carried out through laws like the Security Offences Act which are vague in their definition of offenses, and allow periods of detention without trial (Freedom House 2014).

Rule of Law

Although Malaysia's legal system is notably efficient, ranking 14th and 13th out of 144 countries in the Global Competitiveness Report indicators for efficiency of the legal framework, corruption remains a key

challenge as indicated by 17% of businesses surveyed by the report. Corruption occurs through bribes and irregular payments to public officials. Rule of law is further weakened by a high presence of terrorism and organized crime, and the inability of the police force to maintain security (WEF 2015).

National Business Environment

Malaysia’s business environment is ranked 20th out of 144 countries in the Global Competitiveness Report (WEF 2015). This performance is due largely to strengths in factor conditions – the quality of infrastructure, ease of doing business, and financial market sophistication. Deliberate government efforts to strengthen local competition and build links between local and international firms, particularly within the electronics & electrical cluster, further strengthen the business environment. This section of the report discusses the major features of the national diamond analysis in the figure below.

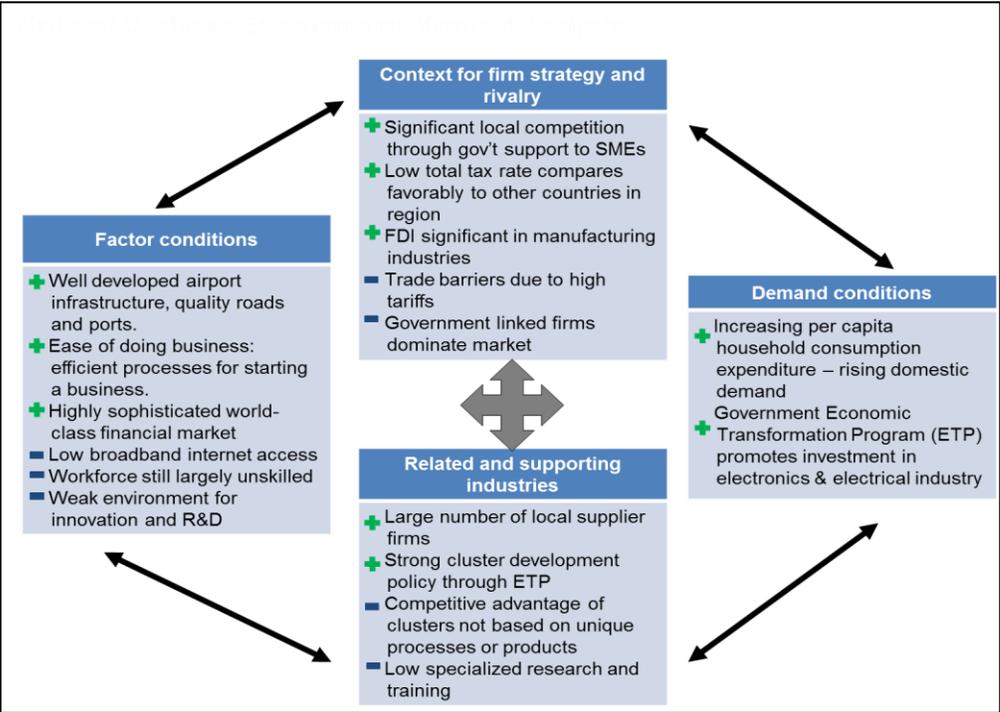


Figure 5: National Diamond

Factor Conditions: Infrastructure

Malaysia’s infrastructure is among the most developed in ASEAN countries. The country has an extensive network of roads, highways and rail lines. The 1987 road act, land public transport act of 2010, and the land public transport commission of 2010 streamlined policy development, attracting investment in infrastructure. According to the World Bankⁱ, infrastructure quality is better than its neighbors; Indonesia, Vietnam, Philippines and China. Malaysia ranks 20 out of 144 in the 2014 global competitivenessⁱⁱ (WEF, 2014), ahead of its neighbors but behind Singapore and Japan ranked 5 and 9 respectively.

Liberal policies enabled growth in transport telecommunications and electricity sectors. Infrastructure receives the highest funding from government since Private sector invested \$54 billion between 1990 and 2011. (OECD,

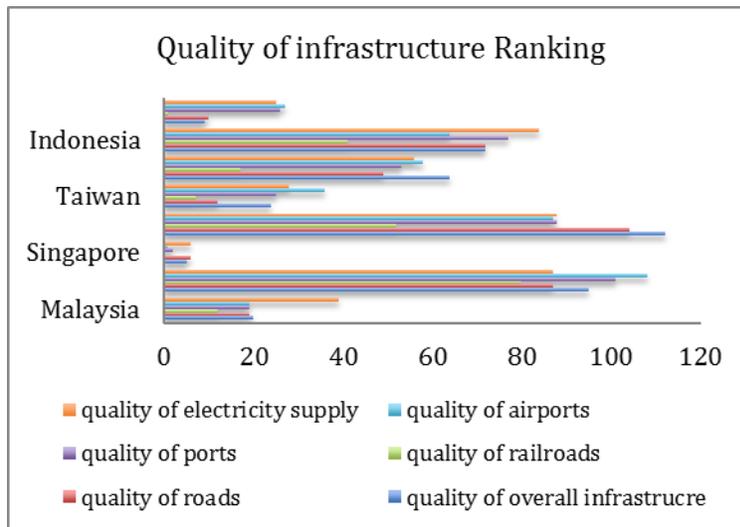


Figure 6: Infrastructure rank

Electricity and water services are developed and efficient. Electricity consumption is only second to Singapore in the region, ahead of Indonesia, Philippines, Vietnam and China. Reliance on fossil fuel; natural gas (58%), coal (33%) is unsustainable and diversifying the energy mix is a priority.

Aviation infrastructure is among the best, Kuala Lumpur airport is rated world class and was ranked the best for passenger satisfaction by IATA in 2012 (OECD, 2013)

Government linked companies (GLCs) provide funds and holds shares in infrastructure. GLCs are criticized for crowding out private sector participation. Performance of several GLCs is rated lower than private sector firms. The Government has implemented reforms to reduce dominance of GLCs and improve private sector equity participation.

The Malay peninsula has the most developed infrastructure while the Sabah and Sarawak regions lag behind. While telecommunications infrastructure is high, Internet access needs to be better developed. The Government aims to increase Internet access to 75% from 64% by end of 2015.

Outside the OECD, Malaysia is among the highest motorized economies with 361 vehicles per 1000 compared to 157 in Indonesia and 457 in Thailandⁱⁱⁱ (OECD, 2013).

Factor Conditions: Ease of doing business

According to the new World Bank Group Report, Doing Business 2015: Going beyond efficiency¹, Malaysia improved its business environment during 2013-2014. The country ranks now 18, improving its rank 20 last year. At the same time, Malaysia is still the first among emerging economies in East Asia on the ease of doing business. The higher ranking was triggered by improvements in the ease of starting a business, dealing with construction permits, getting electricity, registering property and resolving insolvency, reducing the company registration fees. Malaysia has undertaken a series of steps to ease the burden for local entrepreneurs, such as merging the company, tax, social security, and employment fund registrations at a one-stop shop in 2010. Efforts such as these have reduced the time required to start a business from 37 days in 2005 to less than 6 days today^{iv}. Additionally, over the past five years, the implementation of electronic systems made it easier for businesses to pay taxes and execute contracts. Malaysia ranks 4 among the top five economies in East Asia and the Pacific (excludes Australia, Japan, the Republic of Korea, and New Zealand, which are classified as OECD high-income economies) in seven areas: protecting minority investors, trading across borders, starting a business, getting credit, enforcing contracts, paying taxes, and resolving insolvency. Challenges persist, though. For example, further adapting the legal framework to internationally recognized best practices in the area of insolvency would better protect entrepreneurs involved in insolvency procedures.

¹¹ Doing Business 2015: Going Beyond Efficiency ranking is now based on the distance to frontier score. This measure shows how close each economy is to global best practices in business regulation. A higher score indicates a more efficient business environment and stronger legal institutions.

Factor Conditions: Education

The country has almost universal access to basic education. Limited tertiary enrollment constrains skilled labor. Low skilled wages that initially helped Malaysia’s economic miracle can no longer sustain the economy as average incomes have risen. Malaysia’s wages are now higher than early years leading to increased flow of cheap labor from labor from Cambodia, Lao, Thailand and others. Malaysia needs high skilled labor to achieve its growth plans for a high-income economy by 2020.

In 2012, among 65 countries in the Program for International Student Assessment (PISA), Malaysia was ranked 52 for Math, 53 for Science and 59 for reading. Rural Vietnamese performed better than Malaysia ranked 17 out of 65. Quality of university education is low compared to Singapore, Thailand although better than Indonesia.

World Bank reported that ‘the poor quality of Malaysia’s education system is more worrying than the level of debt in its households (World Bank, 2014). Household debt is not a

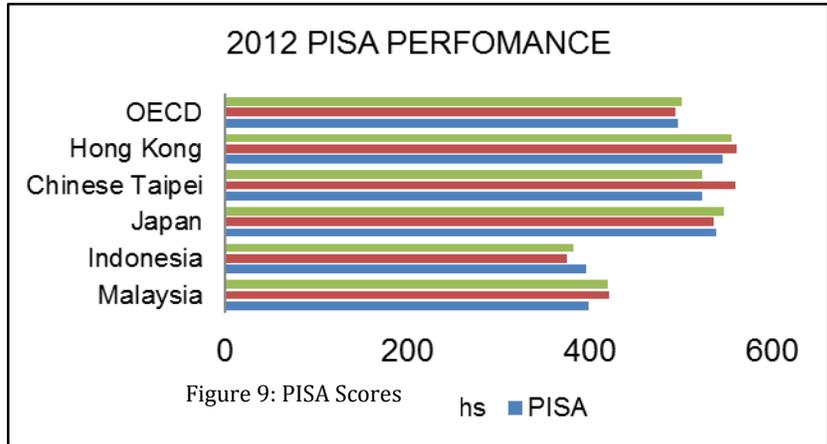


Figure 7: PISA scores

17 out of 65. Quality of university education is low compared to Singapore, Thailand although better than Indonesia.

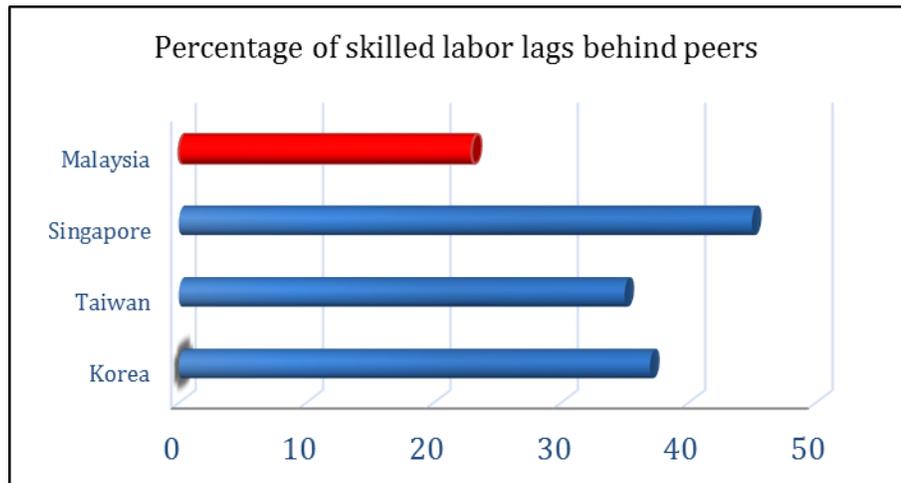


Figure 8: Skilled labor

problem if the economy continues to grow but poor education will hold back the country’s plans for high-income status by 2020^{vi}. Education lacks the quality required for a high-income economy (OECD, 2013). Affirmative policies favor an education system skewed towards Malays at the expense of other races.

Government provides scholarships to Malays forcing bright Malaysians of Chinese and Indian origin to emigrate overseas to Australia, Europe and America. About 20% of Malaysia’s well-educated citizens head abroad for employment^{vii}.

Factor Conditions: Innovation

Innovation is key to transform Malaysia from a low cost destination to a high value economy proposed in the country’s new economic model, 2014-2020. Foreign firms dominate domestic innovation. In 2014, majority of utility patents granted to firms were lower than South Korea, Singapore and Hong Kong. The majority of patents are granted to foreign firms with little spillover to Malaysian firms^{viii}.

Multinationals in electronics set up set up offshore assembly and manufacturing plans in the country. Electronics in particular semiconductors account for 40% of the country’s exports^{ix} followed by automobiles and parts, and financial services (OECD, 2013).

According to the OECD, ‘Malaysia is caught in a "middle-income trap" that can only be overcome by a stronger emphasis on innovation as a driver of economic growth’.

Government is making efforts to address the challenge and set targets to improve human capital and innovation in Tenth Malaysia Plan (2011-15) and the New Economic Model (NEM).

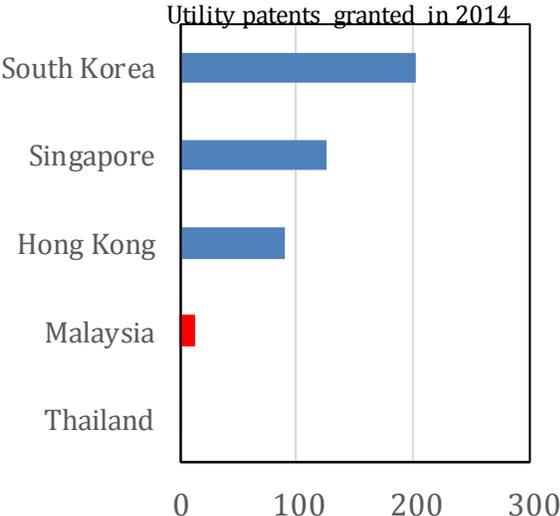


Figure 9: Patents Granted

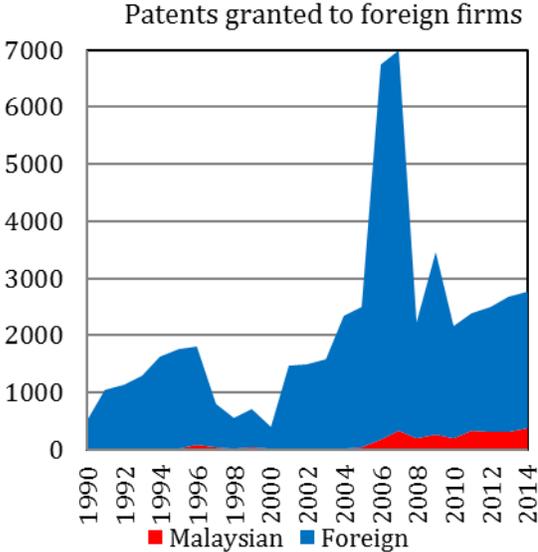


Figure 10: Patents granted

Factor Conditions: Research and Development

Multinationals concentrate in manufacturing and assembly with little research and development in Malaysia. There is little technology transfer and spillover of technologies to domestic firms. Government has introduced various tax incentives and funding for research and development but weaknesses exist in capacity of locals to contribute to cutting-edge technological innovation. Tax incentives are available for a wide range of companies but participation in product research and development by local enterprises is generally low even in Penang, the cluster region for electronics.

Government has also increased investments in telecommunications infrastructure such as the Multimedia Super Corridor (MSC), and has intensified training programs to facilitate industry-university collaboration and research outputs.

Factor Conditions: Financial market sophistication

Due to the financial reforms undertaken in 2012-2013, Malaysia has become the world's most important Islamic financial center^x. By end 2013, Malaysia's Islamic finance asset comprised 25% (US\$423 billion) of the total global Islamic finance asset. Within Malaysia itself, as at 3Q 2014, the Islamic banking sector has achieved a market share of 25% of the total assets of the overall banking system^{xi}.

According to the OECD Investment Policy Reviews: Malaysia 2013, total financial assets (banking, stock market capitalization and bonds outstanding) represented 406% of GDP at the end of 2010. Within the Asian region, only Hong Kong, China have a higher level of financial assets to GDP. This was achieved through two major reform programs, FSMP (Financial Sector MasterPlan) and CMP1 (Capital Market Master Plan 1) that allowed increased foreign participation in the sector, aligned the regulations to the international standards and promoted the consolidation of banks. In the capital market sector, reforms promoted diversification of investor base, further disclosure of standards and development as an international hub for Islamic finance. The banking sector is well capitalized^{xii} and the quality of assets has improved, Malaysia having the lowest level of NPLs since

the Asian crisis and a sound rate of credits/deposits^{xiii}. High liquidity levels in the secondary market^{xiv} (domestic public bond market) confirms the sophistication of the financial market in Malaysia compared to the rest of Asian countries. The total financing provided by the banking system has been growing by 12.6% every year as of June 2012 according to the OECD report mentioned above.

Another important characteristic of Malaysia's banking sector is the high presence of government linked investment companies in the sector, these holding approximately 30% of the capital^{xv}. The government controls 4 out of 8 domestic banks and one Islamic Bank (BIMB Holdings Berhad).

Malaysia has a deep equity market according to OECD. Market capitalization reached 173% in 2010, behind only Hong-Kong and Singapore. The number of listed companies is high (929 companies in 2012), only Hong-Kong has more companies listed (1518 companies in 2012). However, the liquidity levels are low compared to the region and asset management industry remains behind but the number of approved funds has more than doubled as of Dec 2011^{xvi}. According to the WEF Executive Opinion Survey 2012, Venture capital availability ranks 9 in the world, being overtaken only by Hong-Kong and Singapore but far above its other peers in the region. The access to credit ranks even better, the 5th worldwide. Overall, according to the World Economic Forum, Malaysia ranks 22 worldwide, surpassing Japan which ranks 29th but lagging behind Singapore which ranks 6th.

Malaysia succeeded to increase access to financial services (number of people 15+ having a banking account) from 66.2% to 80.7%^{xvii}. The economy remains highly cash based, ATMs remaining the main method of withdrawing money (72% in 2014) but gradually moves toward mobile and electronic banking (in 2011 ATM usage was 77% which confirms the decrease trend)^{xviii}. Efforts to increase the insurance penetration (6% only according to IMF) and drive the growth of the private pension industry remain a key priority in ensuring adequate financial protection.

The Malaysian wealth management industry has potential to grow as a global wealth centre similar to neighbouring Singapore which has emerged as the world's fastest growing hub for wealth management^{xix}. The

number of high net worth individuals (HNWI) in Malaysia rose 6.6% to 65,800 in 2013, with their total wealth expanding 9% to RM1.4 trillion^{1xx}.

Continued innovation of financial products and services are also crucial in raising the competitiveness of financial institutions and attraction of new capital, a goal embraced by the Government through its new Financial Sector BluePrint and the Capital Market Masterplan 2 covering the period 2011-2020.

Context for Firm Strategy & Rivalry: SMEs and large companies

According to the Economic Census 2011, Malaysian SMEs represented 97.3% (645,136 establishments) of the total establishments of 662,939 in the country^{xxi}. This represented a 2% decrease between 2005-2011; during the same period, the percentage of large companies in total number of establishments grew from 0.8% to 2.7%. Additionally, the large companies has been increasing their productivity at a higher pace, respectively 20% versus productivity's increase of 16.6% recorded by SMEs^{xxii}.

The Government of Malaysia has been implementing various policies, action plans and programs that reflect the focus and importance of SMEs and are aimed at assisting SMEs in increasing the skills level, human capabilities of the employees and access to credit. Such programs^{xxiii} are - Training grant scheme of 70% and 40 SMEs dedicated training centers for technical and soft skills; The Skills Upgrading Programme which is aimed at enhancing the skills and capabilities of employees in technical and managerial levels particularly in critical areas such as electrical and electronics, information technology, industrial design and engineering fields; the SME-University programme that links SMEs to the universities as part of the government efforts to enhance the synergy between the industry and universities; the Two Day Mentoring Programme which offers SMEs CEOs the opportunity to enhance their business performance; SME-U programme; the SLSME offering fixed assets and working capital financing; SME Corp and other government agencies such as Malaysian Industrial Development Finance Bhd (MIDF), the Ministry of International Trade and Industry, the Malaysian Green Technology Corporation and SME Bank provide funding and financial assistance such as soft loans with attractive interests

rates (4%) and venture capital funds, a variety of grants and incentives to finance product, process and quality improvement, market development, skills upgrading, factory audits and acquisition of strategic technology².

The collaboration between public sector and private sector fosters innovation in the SMEs sector. In Penang, such collaborative efforts led to the creation of Penang SMEs centre and the Penang Science Council^{xxiv}, to a number of spin-offs and to the creation of new enterprises such as Globetronics , Shintel, Loshta and BCM Electronics^{xxv}. The rise of Composite Technology Research Malaysia from a small local company to being one of the global suppliers of Boeing and Airbus^{xxvi}, underlines the idea that success can be achieved through R&D. However, the local companies in Malaysia have a lower appetite for R&D investment compared to Malaysia's regional peers^{xxvii} . However, according to SMEs Corporation, the private sector starts being more and more engaged in enhancing the capabilities of SMEs³.

Context for Firm Strategy & Rivalry: Tax in Malaysia

According to Malaysia Tax Guide 2013^{xxviii}, Malaysian taxation is territorial in scope, therefore income derived from sources in Malaysia and income received in Malaysia from abroad is subject to taxation. Malaysia adopted in 2014 a Self-Assessment tax regime (SAS)⁴, where taxpayers have the responsibility to assess the extent of their tax liability disclosing the required information, the tax authorities conducting tax audits on taxpayers to ensure compliance. The top rate of personal income tax in Malaysia is 25 percent and applies to an adjusted income threshold of MYr 400,000 or greater⁵.

² The maximum amount for project financing is RM 5 million and for working capital financing it is RM 3 million. The minimum amount is RM 50,000. New assets including IT hardware and software can be financed for up to 90% of their cost. SME Bank also gives out business loans and other financing starting from as low as RM 20,000 at interest rates ranging from 3.75% to 7.5% a year.

³ Nestlé Malaysia and Halal Industry Development Corporation (HDC) have established a strategic collaboration to promote the potential of business opportunities towards enhancing the capabilities of local Small and Medium Enterprise (SMEs) in the Halal Food and Beverages (F&B) industry.

⁴ 2014/2015 Malaysian Tax and business booklet, PWC © 2014 PricewaterhouseCoopers.

⁵ Despite Singapore increasing its tax for its wealthiest by 2% from 2017 onwards, Malaysia appears to not copy this measure, especially as this year it has reduced the tax rates by 1%. According to the former Treasury Deputy Secretary General, an increase in tax would be recommended given the country's deficit, inequality and the recent revision and reduction of operating expenditure and the rural economy profile of the economy.

Malaysia offers a wide range of tax incentives for foreign and local investors to promote investments in selected industry sectors and/or promoted areas such as Operational Headquarters, International Procurement Centres, regional Distribution Centres and Treasury Management Centres operating in Malaysia^{xxix}. Additionally, incentives are available in Malaysia for investments in promoted products and activities in the manufacturing, agricultural, hotel and tourism industries as well as training activities and specific business activities promoted by the Malaysian Government. The investment incentives have been designed to focus on the 12 National Key Economic Areas (NKEAs) identified under the Malaysian Economic Transformation Programme (ETP). The major types of tax incentives available in Malaysia are Pioneer Status⁶, Investment Tax Allowance⁷ and Reinvestment Allowance⁸ which in general provide partial or total relief from income tax or an incentive based on capital expenditure for a duration of five or ten years. R&D is encouraged through tax incentive schemes too that include tax exemptions and double deductions for certain R&D expenditure incurred in Malaysia. There is no general social security framework in Malaysia. However, mandatory contributions are made monthly by both the employer and the employee to the Employees' Provident Fund which serves as a compulsory savings and retirement plan⁹.

⁶ PIONEER STATUS (PS) translates into an income tax exemption ranging from 70% to 100% (depending on the type of promoted products and/or activities) on a company's statutory income for a period of five years. The PS is generally favorable for companies expecting to generate large profits within a short time upon commencement of production of promoted products and/or activities. The exemption period may be extended for another further five years depending on the type of promoted products and/or activities.

⁷ The ITA is an alternative incentive to PS which is preferable for capital intensive projects involving promoted products and/or activities. The ITA is accorded to the qualifying person in addition to the normal capital allowances available on the same asset. PS and ITA are mutually exclusive.

⁸ RA is available for manufacturing companies that reinvest their capital to embark on: expansion of existing production capacity, modernisation or automation of production facilities, diversification into related products

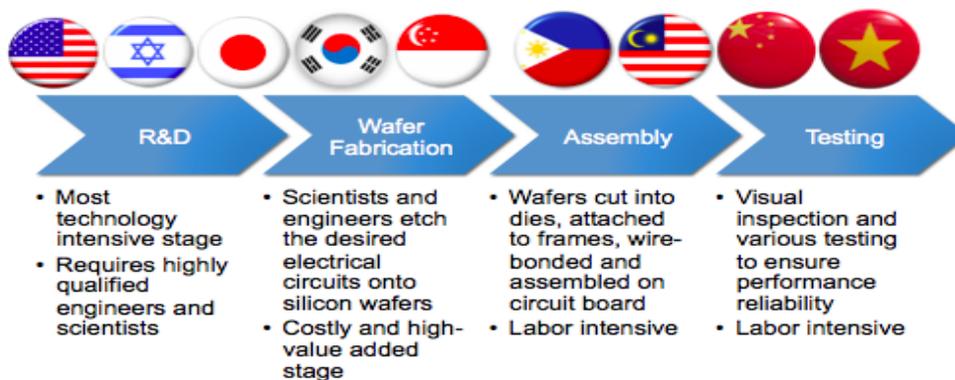
⁹ One of the rules in place is that when an employee earns less than MYR 3,000 per month, both the employer and the employee must make monthly contributions to the Social Security Organization which serves to provide certain benefits to employees in cases of employment injury.

Semiconductor Industry Overview

The primary product of the semiconductor industry is Integrated Circuits (IC) – a set of electronic circuits composed of multiple transistors connected by wires on a plate of semiconductor material, usually silicon – which is an intermediary product composed of numerous smaller parts used in several consumer and industrial electronics.

Semiconductor sales reached \$305.6 billion in 2013 and is expected to continue to grow with the increasing consumption of final products such as mobile phones, tablets, and other consumer electronics.¹⁰ It is an industry characterized by brutal competition, rapid technological changes and falling product prices. With the significant improvements in transportation and communication technology, production stages of semiconductors have been separated across multiple locations to take advantage of lower labor cost locations especially for the activities that are labor-intensive. With the globalization of production chains, more firms are relying on contract manufacturers allowing greater focus on design.

Figure 11. The Globalized Production Chain of Semiconductors¹¹



¹⁰ S&P Capital IQ, Industry Surveys – Semiconductors and Equipments, November 2014.

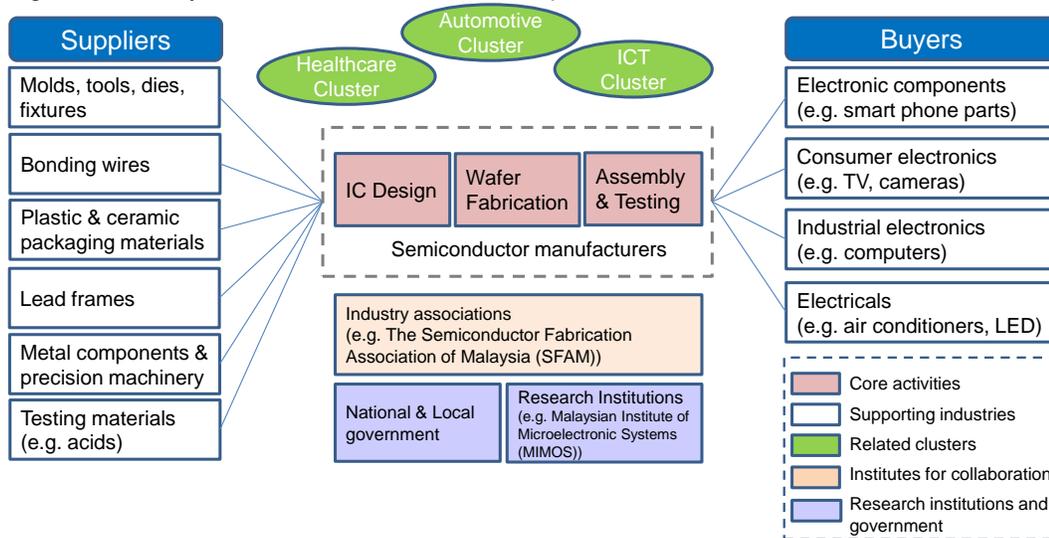
¹¹ Chen, Goh. "Semiconductor Industry in Malaysia" in Industrial Technology Development in Malaysia: Industry and firm studies edited by KS, Felker and Rasiah, 1999.

Cluster Profile and Map

The semiconductor cluster, with semiconductor manufactures at its core, involves many actors as suppliers, buyers and research institutions etc., and is related to other strong clusters including information communication technology (ICT), automotive, and healthcare (Figure 12). The value chains of semiconductor manufacturers start with Integrated Circuits (IC) design, and extend to wafer fabrication and assembly and testing. Most of the manufactures concentrate on assembly and testing process in Malaysia.

Foreign semiconductor manufacturers have strong presence throughout the value chain, mainly located in free trade zones in Penang and Negeri Sembilan. Institutes for collaboration and local and central governments have facilitated the development of the semiconductor cluster and will continue to play essential roles in its deepening especially in the critical areas of human resource development, technology upgrading and SME development. Concerning key players of human resource development, Human Resource Development Fund provides financial assistance of training cost with employers and issues certification for employees. Penang Skills Development Center has shared training and educational programs with member firms. With respect to technology upgrading, Malaysian Institute of Microelectronic Systems (MIMOS) has led applied research and offered wafer fabrication facility and technological assistance for local firms. Malaysian Industry-Government Group for High Technology (MIGHT) brings together industry, government and academia to advance high-tech industry research and promote commercialization effort. The SME Corp, as specializing government agency for SME development, provides various services including: infrastructure facilities, financial assistance, advisory services, market access and other support programs to develop globally competitive SMEs. Another important actor of SME development is the Malaysian Technology Development Corp (MTDC) which provides funding, incubation, advisory and nurturing services for commercialization activities of new technologies.

Figure 12: Malaysia Semiconductor Cluster Map¹²



Cluster History

The origin of semiconductor cluster traces back to 1970s. Since the establishment of the first Free Trade Zone in 1972, Malaysia has attracted multinational firms' assembly plant, particularly electronics industry, and promoted export as a way to develop industry with various financial incentives.

In 1970s, the competition among large semiconductor firms, mainly U.S. and Japan, caused relocation of their assembly plants to lower labor countries. For example, Intel opened its first offshore assembly plant in Penang, Malaysia in 1972. Other early foreign firms - such as AMD, HP, Hitachi and National semiconductor - also started operation during 1971-1974.

In 1980s, continuous competition among large multinational firms combined with rising cost of other East Asian economies - such as South Korea, Taiwan, Singapore, and Hong Kong - accelerated relocation of their assembly plant into Malaysia. At this time, the government started to strengthen linkages between foreign and domestic firms and formulated "First Industrial Master Plan (1986-95)." The government also revived inward FDI incentives and opened new export processing zones.

¹² MIDA (2007) and Meyanathan (2011)

In 1990s, Malaysia faced challenges to upgrade their cluster for higher value added activities because of competitive pressure from other East Asian countries with ample low wage labor force including China, Vietnam and Indonesia due to the market-oriented reform of former communist regime and political stabilization. In fact, some labor-intensive production process left from Malaysia. The Malaysian government launched several research and training institutions with the formulation of “Action Plan for Industrial Technology Development 1990” and “Second Industrial Master Plan 1996-2005.”

In 2000s, with continuous competitive threat posed by other East Asian countries with lower wage – such as China, Vietnam, Indonesia -, the government has been working to promote higher-value added activities as underlined in “Third Industrial Master Plan (2006-2020)” and “Economic Transformation Program” enacted in 2010. Some semiconductor firms started upgrading their activities into research and development, whereas the majority of firms’ activity is still limited in assembly operation.

Cluster Performance

Electronics, with the semiconductor cluster at its core, has experienced remarkable growth since 1970s. The number of firms in electronics industry surged from 4 to 1,695 and so did employees from 577 to 596,270 (37.8% of manufacturing sector) between 1970 and 2006¹³. The share of electronics and electrical industry in total capital investment approved by MIDA rose from 11%, to 22% and 30% during 1981-1990, 1991-2000, and 2001-2011 respectively¹⁴. The electronics industry accounts for the largest share (25.4%) of manufacturing sector

¹³ Malaysia Investment Development Authority(MIDA). (2006). “Performance of the Manufacturing and Services sectors”. accessed March 5, 2015.

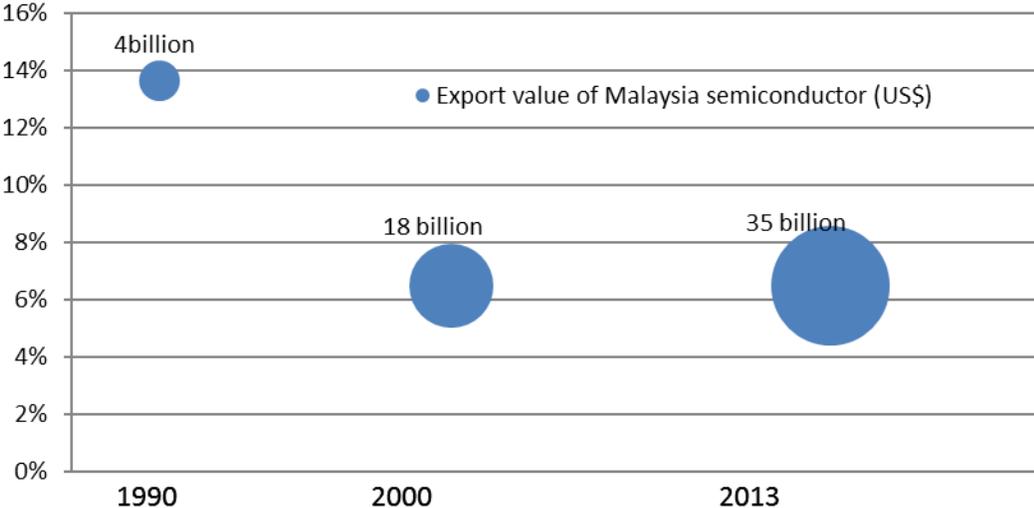
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¹⁴ Malaysia Economic Planning Unit. Malaysia Investment Development Authority (MIDA) Approved Projects by Industry. accessed March 5, <http://www.epu.gov.my/en/petunjuk-ekonomi>

value added followed by refined petroleum (15.9%) and chemical products (10.6%) in 2013¹⁵. Productivity level of electronics industry (RM 80,060) is above manufacturing sector average (RM 73,450) as of 2010¹⁶.

The growth of electronics industry and semiconductor cluster involves dramatic increase of exports. The value of electronics export and semiconductor products export increased from \$24 billion to \$168 billion (approximately 30% of total Malaysian export) and \$5 billion to \$35 billion (approximately 15% of total Malaysian export) respectively during 1981-2011^{xxx}. The share of Malaysia in world semiconductor export once reached 15% in 1990 and still maintains approximately 7% in 2013 (Figure 13).

Figure 13: Malaysia Semiconductor Export Size and World Market Share



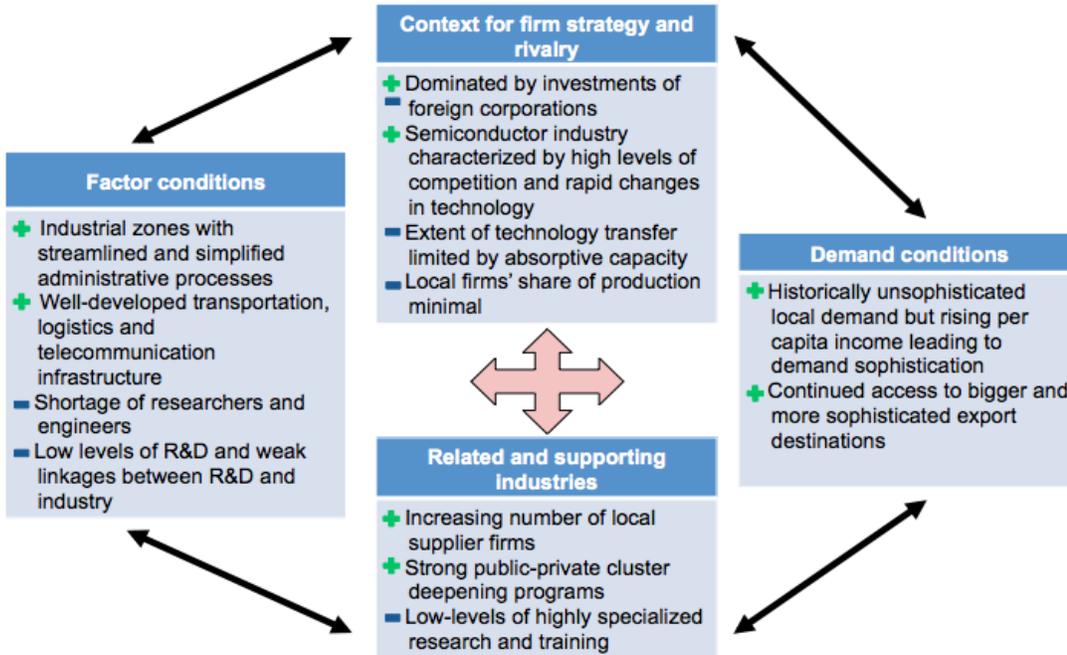
Cluster Diamond Analysis

Cluster benefits from Malaysia’s good infrastructure, stable investment climate, intense competition, and public-private initiatives to broaden and deepen related and supporting industries but constrained by low levels of R&D support and shortage of highly skilled talent.

¹⁵ Malaysian Productivity Corporation.(2014) Productivity Report 2013-2014. accessed March 5, 2015, http://www.mpc.gov.my/home/?kod1=k&kod2=announcement&item=000165&sstr_lang=en&t=3

¹⁶ Malaysian Productivity Corporation.(2011). Productivity Report 2010/2011. accessed March 5, 2015, <http://bpap.mpc.gov.my/elearn/APR/APR2010.pdf>

Figure 14: Cluster Diamond



Factor Conditions: Infrastructure and Industrial Zones

One of the key advantages of Malaysia that led to the growth of the electronics cluster is its network of over 200 industrial estates and 14 free trade zones that provide a good investment environment for the foreign semiconductor locators dominating the Malaysian electronics cluster. These top industrial zones, like Bayan Lepas, Port Klang and Pasir Gudang, provide tariff exemptions on imports and exports, tax holidays, tighter controls on labor organization, and streamlined regulatory processes. They are also strategically situated along a network of well-linked highways and railway systems, high quality telecommunications network and related services with easy access to well-equipped seaports and the Kuala Lumpur International Airport, one of the world's best airports. The Free Trade Zone Act continues to be a robust and responsive framework for industrial zones and will continue to play a role in the facilitation of foreign direct investments. And Malaysian infrastructure investments are expected to grow by 9% a year until 2025.

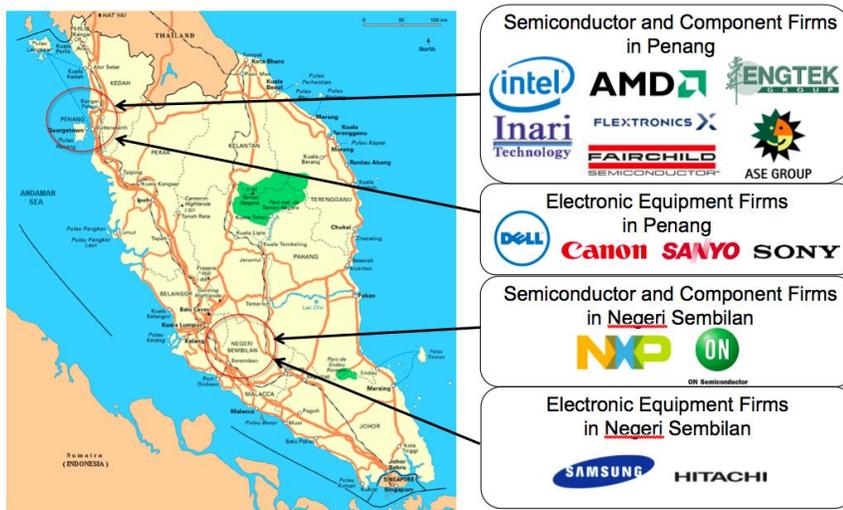


Figure 15. Cluster Location and Firm Sample^{xxxii}

Factor Conditions: Human Resource

Malaysia has a volume of unskilled literate worker with nearly 100 percent primary education enrollment rate, but higher education needs to be upgraded. First of all, the enrollment rate of secondary (67%) and tertiary school is lower than countries with strong semiconductor cluster (e.g. secondary school enrollment rate in South Korea, Japan, U.S. are 97%, 100%, and 94% respectively; tertiary school enrollment are 100%, 60%, and 95% respectively)^{xxxiii}. Consequently, the number of R&D researcher per million people (1,065) is far below than (Singapore 6,150; Japan 5,147; South Korea 5,068; U.S. 4,042) comparative countries although percentage of graduate from tertiary education in engineering, manufacturing and construction programs (21 percent) is higher than most other countries (Japan 17 percent, U.S. 7 percent, South Korea 24 percent)¹⁷.

Combined with quantitative capacity building of educational institutes, the quality of education needs to be aligned with industry needs. MIMOS and the Semiconductor Fabrication Association of Malaysia (SFAM) launched the Talent Development Program in order to overcome the severe shortage of skilled semiconductor engineers locally in 2013. Given its large share of electronics firms, the Penang State Government has taken the

¹⁷ The number of R&D researcher per million people is data as of 2009. Ibid.; Percentage of graduate from tertiary education in engineering, manufacturing and construction programs is as of 2011 data. UNESCO Data Centre.

lead among sub-state actors in promoting linkages between local suppliers and foreign multinational firms by jointly developing training courses with multinational firms in order to upgrade skills of the local supplier workforce.

Factor Conditions: Science and Technology Capabilities

Malaysia's gross domestic expenditure of R&D spending as percentage of GDP (1.1%) lags behind other comparable countries (South Korea 4.0%, Japan 3.4%, U.S. 2.8%, Singapore 2.2%)^{xxxiii}. Moreover, the share of engineering and technology in total R&D spending (24.2%) is far lower than South Korea (70.1%) and Singapore (62.8%)^{xxxiv}. These facts indicate that Malaysia is not investing adequate amount of resources to expand its R&D capabilities seriously hampering its capacity to move up the value chain.

In addition to a lack of resources, previous studies point to the weak linkage between industry and research institutions and the lack of coordination by the government as another problem¹⁸. For example, the government established MIMOS as a national research institute for R&D projects in 1985, but a local researcher considers that MIMOS failed to generate the coordination and incubation synergies necessary to support innovation in firms¹⁹. As a response, the government designated R&D centers in public universities as centers of excellence and mandated them to provide various services for the firms such as technology support, R&D facilities, market intelligence and access to funding. Another recent effort is that the government designated Batu Kawan area in Penang as a hub for high-value electrical and electronics including IC design services in 2009.

Context for Firm Strategy and Rivalry: Foreign Company Dominance

Malaysia has attracted significant foreign firms since the opening of Free Trade Zones in early 1970s, but a large number of competitive indigenous firms have yet to emerge. Foreign firms dominate capital investment in electronics & electrical products (on average 74% during 1991-2000 and 84% during 2001-2010) and patents and

¹⁸ Meyanathan, Saha Dhevan. (2011). Industrial Upgrading: Cluster Development in the Malaysian Electronics Industry," in *Industrial Clusters, Upgrading and Innovation in East Asia*, edited by Kuchiki, Akifumi and Tsuji, Masatsugu. Cheltenham and Northampton: Edward Elgar. pp.139-154.

¹⁹ Rasiah, Rajah. (2007). Clusters and Regional Industrial Synergies: The Electronics Industry in Penang and Jalisco. in *Development on the Ground*, edited by Scott, Allen J. and Garofoli, Gioacchino. New York: Routledge. p.239.

utility innovations across sectors (above 90% during 1991-2010 and above 86% during 2011-2014 throughout the period)²⁰. The inability to produce strong indigenous firms means that the higher value-added parts of the production chain continue to be performed elsewhere stunting the development of the local cluster.

A previous research, conducted by stated-owned Khazanah, found that all 9 of 12 semiconductor firms engage in early R&D activities in human resource and process technology are foreign firms^{xxxv}. In order to develop indigenous R&D capability, the government created a wafer fabrication company, Silterra, in 1995. Now, Silterra provides complete IC design service for global fabless design and product companies, but a survey conducted by MIGHT found that approximately 60 percent of the fabless IC design companies are using overseas semiconductor foundries, particularly Taiwan and China, mainly because of lack of technological support by local fabrication facility. Only 23 percent uses Silterra and 31 percent uses MIMOS facility²¹.

Related and Supporting Industries: Deepening Cluster Linkages

Despite being dominated by multinational corporations, the intense global competition, with which the Malaysian electronics cluster is subjected to due to the highly globalized nature of the industry, kept these firms constantly on the lookout for innovation and opportunities to upgrade productivity and save on costs. On the other end, government programs instituted local content requirements and provided commercial and technical assistance to emergent local suppliers and manufacturers. Together, these two forces created an environment that encouraged the proliferation of local suppliers and deepened cluster linkages within the location.

Local firms spun off from original employers to provide supplies, with original employer providing start-up assistance, ongoing technical support, valuable user-producer interaction and international management and technology practices. For example, Intel supplier development programs produced LKT Engineering, Shinca, Unico and Globetronics. With the Malaysian government and private sector association's assistance, it made

²⁰ Malaysia Economic Planning Unit. Malaysia Investment Development Authority (MIDA) Approved Projects by Industry. accessed March 5, <http://www.epu.gov.my/en/petunjuk-ekonomi>

²¹ MIGHT. (2009). Understanding the Malaysian Electronic Industry Issues. accessed March 5, 2015. <http://www.might.org.my/tda/Publications/Understanding%20The%20Malaysian%20Electronic%20Industry%20Issues.pdf>

more commercial sense for firms like Intel to invest in developing local suppliers, for some parts, than continue depending on imports.

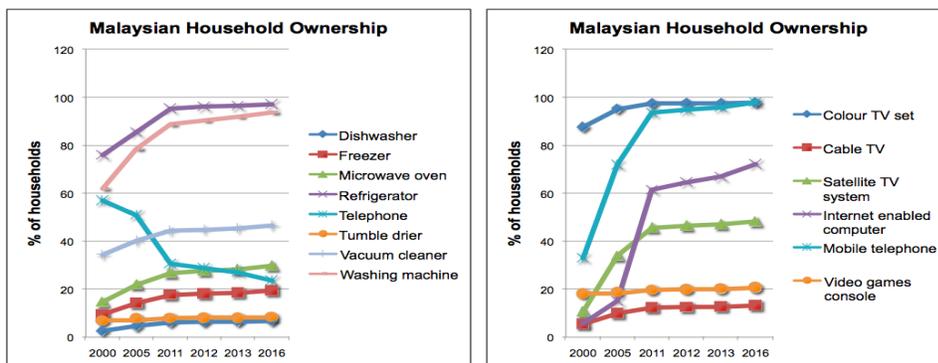
Moreover, subcontracting or technology transfer deals improve quality and technological capability of local companies allowing them to bypass foreign locators, expand into adjacent products, and move into direct exports. These led to the transformation of firms that started out as vendors to multinationals into electronics manufacturers in their own right.

Demand Conditions: Local Demand Sophistication

Two demand trends create drivers for increased productivity in the Malaysian electronics cluster. First, as already mentioned earlier, the globalized nature of the cluster and the global semiconductor industry in general, ensures the dynamism of the cluster. Even during the nascent stages of the cluster, despite the lack of local sophisticated demand within Malaysia, the cluster was exposed to and had to respond to the different levels of sophistication of their various markets. There was no room for complacency given the highly intensive rivalries in the space.

Second, as Malaysian per capita incomes rise, local demand for more sophisticated consumer electronics increases. This increase in domestic demand can catalyze more consumer electronics manufacturing in the cluster and even give growth opportunities for industrial electronics, creating more forward linkages in the semiconductor-dominated cluster.

Figure 16: Malaysian Household Electronics Consumption^{xxxvi}



These two trends can only be helpful in further enhancing the quality and quantity of work done in the cluster. The challenge will be in ensuring that the cluster will have adequate absorptive capacity in servicing these demands.

Competitive Landscape of Cluster

Malaysia is being “squeezed” by low wages in destinations like China, Philippines and Vietnam, that have stabilized their politics, enhanced their infrastructure and improved their regulatory environments, and by high barriers to innovation that R&D intensive destinations like Singapore, South Korea and Taiwan have set.²²

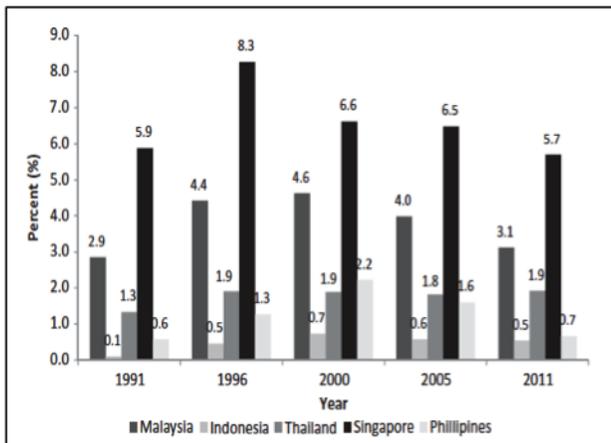


Figure 17: Share in world electronics exports, selected economies, 1991-2011.

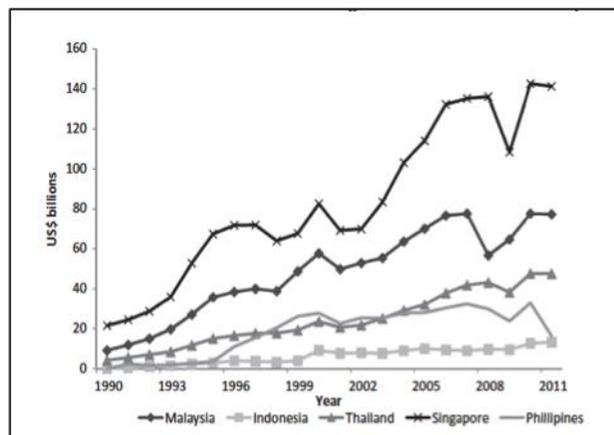


Figure 18: Electronics exports, selected economies, 1991-2011.

On labor-intensive activities, Malaysia cannot compete on wages. As the country develops, wages will naturally rise. The imperative for Malaysia is to ensure that the increase in wage is matched by improvements in productivity. To do so, it must capitalize on the fact that its electronics cluster is bigger and more complex than its ASEAN competitors.^{xxxvii} This size advantage allows it to leverage scale opportunities especially for suppliers that are essential in such a highly cost-sensitive industry. At the same time, the legacy investments of major

²² Rasiah, Rajah. “Is Malaysia’s electronics industry moving up the value chain?” in Malaysia’s Development Challenges: Graduating from the middle edited by Hill, Yean and Zin, 2012.

multinationals in the Malaysian cluster as well as the web of relationships built through time makes for a distinctive advantage.

However, Malaysia must not take these first-mover advantages for granted. It must double down on its existing cluster deepening programs, sustain infra investments and upgrade skills to further increase the complexity of work done in Malaysia.

On the need for innovation, Malaysia cannot expect to beat established high-tech locations such as Singapore, Taiwan and South Korea by sheer amount of resources alone. It is unlikely to bridge the human resource and R&D gap with these countries in the near term given the lead-time for such investments. While building its science and technology capacity, Malaysia must take advantage of its increasingly sophisticated domestic consumption to enhance its design and product development capabilities starting with basic consumer electronics. By expanding into higher value-added activities one product class at a time, it can build up its cache of knowledge and technology.

Given its more advanced position within ASEAN ex-Singapore, Malaysia can take the lead in developing a regional cluster by exploiting lower wage opportunities in other locations while maintaining and strengthening its own advantages in terms of productivity, and cluster scale and scope

Recommendations

Recommendations for improving Malaysia's business environment and semiconductor cluster are shown in the following table. Nine priorities are identified.

“Theme” Challenge	Action	Actors
Priority 1 “Human resource” Shortage of high-skilled worker suitable for semiconductor cluster	<ul style="list-style-type: none"> ✓ To expand low-interest rate scholarship for tertiary school students enrolling in semiconductor related subject with an aim to increase the number of researcher, engineer, and scientists. ✓ To introduce rating mechanism of tertiary school program quality with input from private sectors (i.e. employer of graduates). ✓ Strengthen tertiary-industry collaboration and adapt curricula to local needs. Further develop on-the-job skills training programs tailored to industry need 	<ul style="list-style-type: none"> ✓ Ministry of Human Resources, Ministry of Higher Education, Penang Skill Development Center ✓ Universities ✓ Institute of collaborations (e.g. MIGHT, Semiconductor Fabrication Association of Malaysia)
Priority 2 “Science and technology infrastructure” Weak coordination and collaboration between research institutes and companies	<ul style="list-style-type: none"> ✓ To strengthen tie between companies and research institutes. For example, provide preferential budget support for universities who achieved gained large number of private research contract from industry. ✓ To designate world-class scientist and engineers (for example, Malaysian working in Silicon Valley) as a top management of research institutes. ✓ To attract engineers from world-top class companies with high salary and position. ✓ Decentralize R &D funding and training to regional level and develop linkages between MICs, local industries and research institutes 	<ul style="list-style-type: none"> ✓ R&D centers (e.g. Institute of Microelectronics in University Sains Malaysia in Penang, MIMOS) ✓ Talent corporation (government agency recruiting overseas Malaysians back to home) ✓ Institute of collaborations (e.g. Semiconductor Fabrication Association of Malaysia)
Priority 3 “Context for local rivalry” Dependence on foreign multinational companies & weak local SMEs ²³	<ul style="list-style-type: none"> ✓ In order to encourage spin-off from foreign multinational companies, provide better social welfare service for those once worked in (MNFCS) and created start-up companies. ✓ To launch innovative start-up companies contest 	<ul style="list-style-type: none"> ✓ Ministry Of Entrepreneur and Co-Operative Development ✓ Start-up companies ✓ Regional Development Corporation

²³ - Skills upgrading and retraining is vital to enhance the quality of the workforce in order to increase the efficiency of SMEs and adapting to the dynamic business environment. Today, unlike in the 1970s and 1980s, for Malaysia, cheap labor is no longer a competitive advantage. Much cheaper labor can be found in China and Vietnam (Goh & Lim, 2004). Over the last few decades, the Malaysian economy has undoubtedly passed through a considerable transformation from agricultural-based to industry-based. Now the economy is shifting from industry-based to a knowledge-based economy to achieve the vision 2020 and to become a developed economy (Khalique et al., 2013a).

"Theme" Challenge	Action	Actors
<p>Priority 4 "Supporting & related industries" Business and technology upgrading</p> <p>Competitive advantage of clusters not based on unique processes or products</p>	<ul style="list-style-type: none"> ✓ To strengthen consulting service for local SMEs so that SMEs better manage business and get to know existing services of the government, IFCs etc. ✓ Strengthen collaboration between clusters to leverage synergies and support institutions for specialized research. ✓ Develop tailored monitoring and evaluation systems for regional and local clusters. Encourage local cluster competition. ✓ Remove incentives for local firms that promote unfair competition 	<ul style="list-style-type: none"> ✓ Institute of collaborations (e.g. SME association) ✓ Malaysian Technology Development Corp ✓ PEMANDU (ETP unit)
<p>Priority 5 "Demand condition" Lack of local specific demand</p>	<ul style="list-style-type: none"> ✓ To launch government procurement mechanism to support niche areas of semiconductor final product (e.g. disaster management electronics equipment specialized for regional circumstances). ✓ Strengthen e-governance at regional and local level 	<ul style="list-style-type: none"> ✓ All government agencies ✓ MIMOS, MIGHT (as a coordinator between final demand customer and semiconductor companies)
<p>Priority 6 Infrastructure</p>	<ul style="list-style-type: none"> ✓ Scale up its infrastructure development across all regions to bring it on par with regional competitors ✓ Continue to improve the registering property, dealing with construction permits, getting electricity, paying taxes, and enforcing contracts²⁴ 	<ul style="list-style-type: none"> ✓ Ministry of Infrastructure Development and Communications,
<p>Priority 7 Innovation</p>	<ul style="list-style-type: none"> ✓ Improve capabilities for innovation; enable firms to gain access to talent, technology and finance. ✓ Enhance competition and amplify the impact of innovation through concentration of efforts on promising product niches 	<ul style="list-style-type: none"> ✓ Ministry of information technology ✓ Ministry of Infrastructure Development and Communications, ✓ R&D centers)

²⁴ Malaysia Productivity Corp director-general Datuk Mohd Razali Hussain, has stated that "for 2016, [the] World Bank's new focus will be onMalaysia will focus on these five areas to improve further and be competitive." - See more at: <http://www.aseanbriefing.com/news/2014/11/05/malaysia-sees-improvement-world-banks-ease-business-rankings.html#sthash.sr23Gk0p.dpuf>

"Theme" Challenge	Action	Actors
Priority 8 Financial sector	<ul style="list-style-type: none"> ✓ Push more toward policies that promote regional financial integration and enlarge the capabilities of its financial sector ✓ Remaining restrictions on FDI in the financial sector are still high compared to OECD average. Reducing the barriers²⁵ ✓ Focus on internationalization of Islamic finance²⁶. ✓ Malaysia must continue increasing the number of investment products offered while enhancing accessibility to the market²⁷. ✓ continue attracting new generation of investors and opening up the market for retail investing. 	<ul style="list-style-type: none"> ✓ Ministry Of Finance ✓ Malaysia Central Bank
Priority 9 TAX Recommendation	<ul style="list-style-type: none"> ✓ Maybe a gradual increase of tax by 2% or to stick to the current policy that they attract more money²⁸ 	<ul style="list-style-type: none"> ✓ Ministry Of Finance ✓ Inland Revenue Board ✓ Royal Customs Malaysia (RCM)

²⁵ OECD Investment review project finance, private pension funds, wealth management etc, page 207 .

²⁶ This would distinguish Malaysia from the other financial markets and help building a new Islamic banking cluster . Over the past 10 years, the global market for Islamic finance has grown at an annual average rate of 20 to 30%. By 2020, the market size is foreseen to reach \$ 4 trillion. Building capacities currently would enable Malaysia to capture a big slice of this market.

²⁷ The establishment of the ASEAN Economic Community planned for the end of 2015 will heighten competition in the equity markets as regional exchanges race to attract investors and listings. In order to remain a preferred investment destination,

²⁸ http://www.treasury.gov.my/pdf/akhbar/2015/gst1_26Feb.pdf

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