Complexity and Growth: Malaysia's Position and Policy Implications

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Introduction

The favourable global environment presents a timely opportunity for Malaysia to undertake important structural reforms. While higher growth can be achieved through capital accumulation and productivity gains, for an emerging economy such as Malaysia, technological advancement and innovation are critical to expand the country's production frontier and lift long-term growth potential. A study by Hausmann et al. (2013) looks into the role of technology and innovation as a fundamental predictor of future growth, namely, through economic complexity. Economic complexity expresses a country's overall productive capabilities through its cumulative know-how, skills and technological endowment. It is, therefore, a useful indicator to track structural change. This article serves as a primer on the key concepts of economic complexity. It then proceeds to showcase the evolution of Malaysia's economic complexity and its position relative to regional peers. The article also outlines several strategies to increase Malaysia's complexity, by utilising Hausmann et al.'s pioneering product space and feasibility maps which lay out the ease of diversifying into more complex products. The article concludes with an estimation of Malaysia's potential GDP growth based on our ability to converge to the income levels of countries with similar economic complexity.

Understanding Economic Complexity

'Economic complexity' is a summary measure of the productive capabilities within a country, as reflected by the diversity and complexity of products it makes and exports. Complex economies tend to be characterised by the prevalence of a vast amount of skills and knowledge which are the necessary pre-conditions for the production of highly diversified and complex range of products. Less complex economies, in contrast, can only make fewer and more elementary products on account of their limited skills and knowledge base. Because greater levels of complexity entail the creation of high-skilled jobs and a more sophisticated supporting ecosystem, more often than not, complex economies enjoy higher per capita GDP.

Sectoral diversification is an important means to enhance economic complexity. As a country diversifies its production base, individuals and firms amass a large amount of knowledge and expertise, thus increasing sophistication and income levels over time. An advanced economy like Japan can manufacture diversified and complex products, ranging from chemicals to robotics and autonomous cars, as a result of continuous innovation and technological advancement over the years.

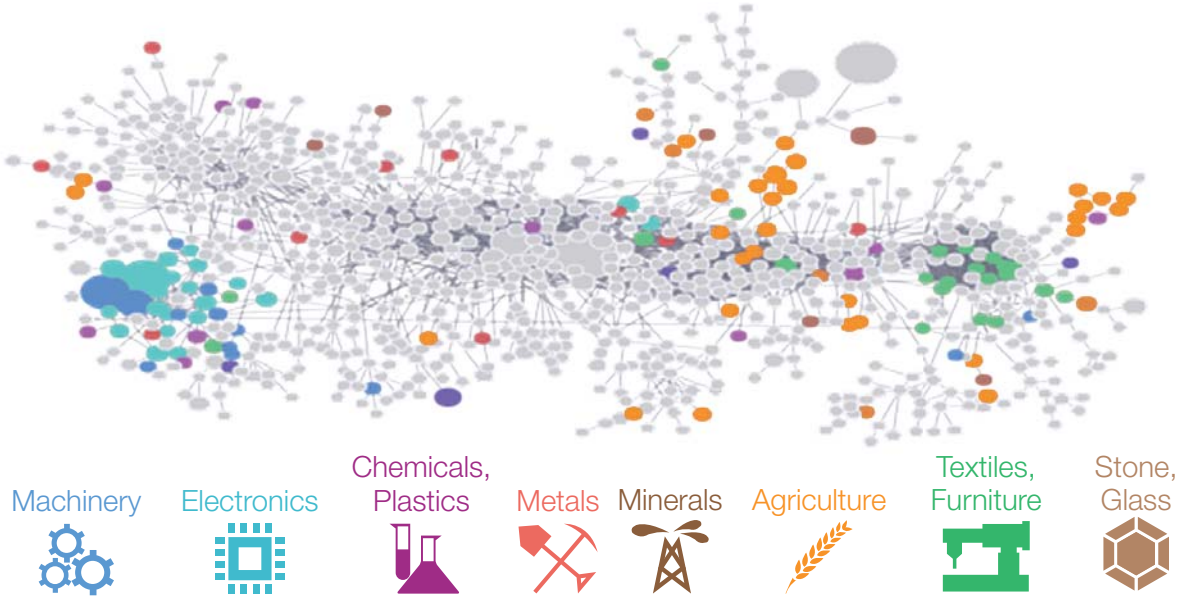
A country's degree of economic complexity can be measured using the Economic Complexity Index (ECI). The ECI is calculated by taking into account the number of export products a country has comparative advantage in (*product diversity*), and the number of countries that make those products[1] (*product complexity*). The complexity of specific products that a country makes is represented by the Product Complexity Index (PCI). Based on the PCI, the most sophisticated products are machinery and chemicals (e.g. steam turbines, photographic chemicals), while the least complex products are mainly raw commodities (e.g. tin ores, cotton). The ECI and PCI are measured as the standard deviation above or below the world average (denoted by positive or negative values, respectively). Key to analysing economic complexity is the 'product space' map, a pioneering tool developed by Hausmann et al. that illustrates the country's product mix and ease of future diversification to raise overall economic complexity (*Details in Insight Box 1: The Product Space*).

[1] A product that is made by only few countries can be considered a 'complex' good, as this reflects the need for more advanced capabilities to produce them (e.g. X-ray machines).

Insight Box 1: The Product Space

Chart 1: The Product Space

The product space depicts the diversity of products made and the ease of diversification into different, more complex products



Source: The Atlas of Economic Complexity

The product space visualises the universe of products that a country can export. Every dot or node represents a different export product. The different colours represent the broader industry that these products are in. Nodes that are coloured in the product space indicate the products that a country has comparative advantage in exporting, while nodes that are greyed represent products that a country has limited exposure in. Two key features of the product space illustrate a country's level of economic complexity. Firstly, the diversity of products can be seen from the number of coloured dots across the product space. The greater the number of dots in different colours, the more diverse a country's export products. Secondly, the location of the product nodes (i.e. dots) matters. A high number of products located at the centre of the product space reflects its high connectivity to a multitude of goods. In addition, the product space also provides insights on the ease of diversification into new and more complex products. The ease in which a country increases its complexity depends on how tightly connected the country's product space is, and is represented by the distance between the product nodes. The closer the product nodes, the easier it is to increase complexity. Products that are tightly connected share most of the requisite capabilities. Thus, firms can easily diversify from one product to another by leveraging on existing capabilities. Conversely, a sparse product space suggests greater difficulty in raising complexity as producers have insufficient pre-existing capabilities to make new products. They would need to acquire vast knowledge and skills to make these products, which will take considerable time and effort.

Evolution of Malaysia's Economic Complexity

Over the last two decades, Malaysia's economic complexity has improved from +0.39 in 1996 to +0.82 in 2016 (Chart 2), making it the 29th most complex economy in the world. The increase not only reflects Malaysia's ability to produce more varied and complex goods over time, but that Malaysia has been able to grow its complexity at a faster pace compared to the rest of the world.

Chart 2: Trend in Malaysia's Economic Complexity Index

Malaysia's economic complexity has improved over the past two decades

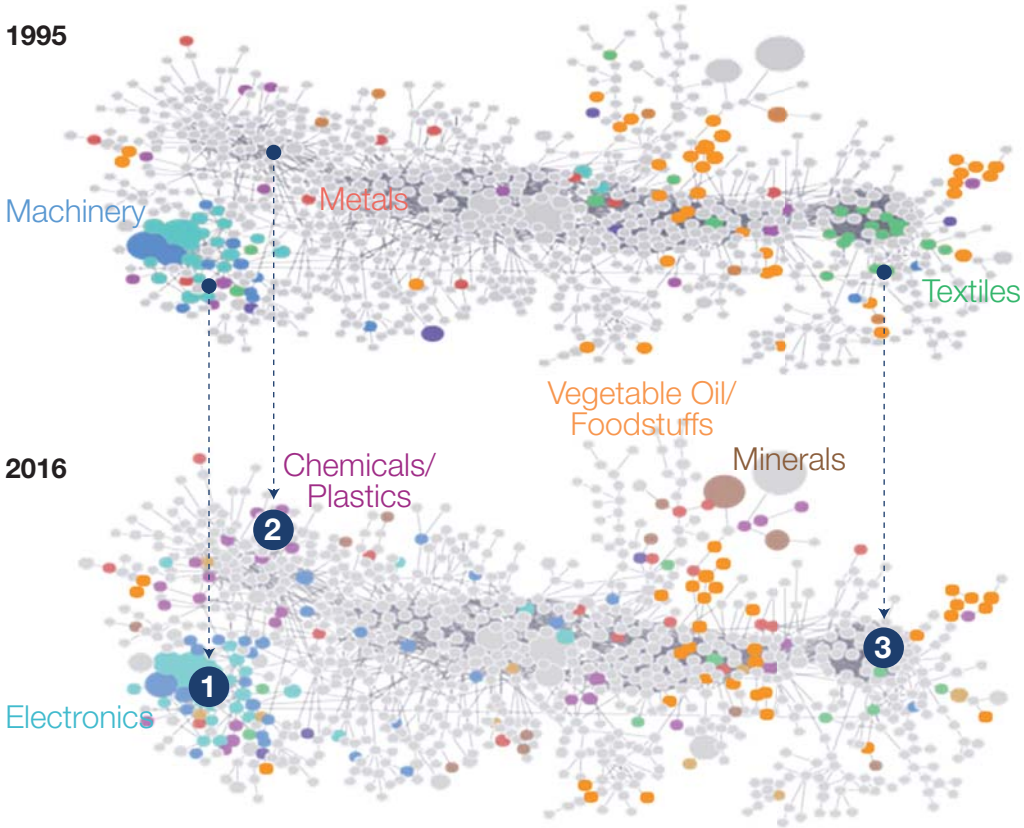
Source: The Atlas of Economic Complexity

The evolution in Malaysia's product space over time reveals three key developments (Chart 3). These include:

1. Greater linkages in the machinery and electronics cluster (*represented by denser blue dots*),
2. Development of new products, such as chemicals and plastics (*emergence of new purple dots*); and
3. Hollowing out from low-complex products, such as textiles (*reduction in green dots*), which frees up resources to develop comparative advantage in more complex goods.

Chart 3: Snapshot of Malaysia's Product Space in 1995 and 2016

Higher economic complexity supported by sectoral diversification into more complex products

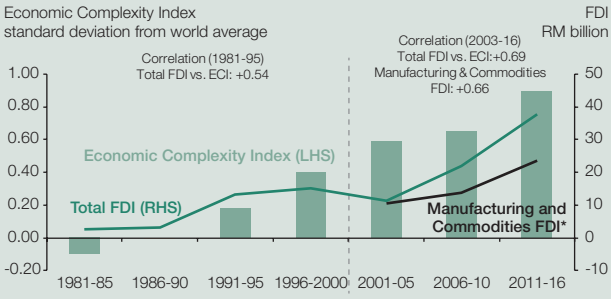


Source: The Atlas of Economic Complexity

The increase in Malaysia's economic complexity can be traced back to the rapid industrialisation phase in the 1980s and 1990s. During this time, the composition of Malaysia's exports shifted from mainly commodities to manufactured exports[2] (1975: 22% share of exports; 1995: 80%). Comprehensive policy initiatives were undertaken to enhance the supporting business ecosystem to ensure an environment conducive for the manufacturing sector to flourish[3]. These include improving training and skills development, financing support, physical infrastructure, and regulations pertaining to trade and investment activity. Of significance were the enactment of the Promotion of Investments Act 1986 and reduction in trade barriers that facilitated production, trade and investment activities. Buoyed by a favourable business climate, foreign direct investment (FDI) in the manufacturing and mining sectors surged. These FDIs were a critical game-changer in Malaysia's development as they provided impetus to job creation and productivity in addition to the country's economic complexity (Chart 4).

Chart 4: Foreign Direct Investment (FDI) and Economic Complexity Index (ECI) in Malaysia

FDI provided impetus to Malaysia's economic complexity



*Official data for FDI by sector only available from 2003 onwards

Source: The Atlas of Economic Complexity, United Nations Conference on Trade and Development (UNCTAD), Department of Statistics, Malaysia

This was particularly evident in the machinery and electronics cluster. In the 1990s, there was a gradual transition from basic testing and assembly services for integrated circuits to the more complex production of office and computer equipment. This transition allowed both multinational and domestic manufacturers to develop and hone the necessary knowledge and skills to achieve global production standards. The growth in capabilities catalysed the subsequent diversification into even more complex electronic products, particularly for semiconductors in the fast-growing consumer and automotive segments[4]. Home-grown manufacturers are now more integrated into the E&E global value chain and are capable of producing parts and components independently for international brands, such as Apple, Samsung, Intel, BMW and Airbus.

Over the years, Malaysia's ability to produce more complex chemical, plastic and rubber products reflects the expansion in downstream activities in the mining and agriculture sectors. The establishment of large local and foreign corporations in these sectors spurred Malaysia's manufacturing capabilities in downstream products, such as petrochemicals, oleochemicals and rubber gloves. Refineries and gas pipelines were constructed for production purposes, further supported by the availability of feedstock inputs given the country's endowment of natural resources[5]. Going forward, Malaysia's downstream production in the oil and gas industry is poised to benefit from the Refinery and Petrochemical Integrated Development (RAPID) operations which are nearing completion.

[2] For a more detailed account, please refer to the Box Article on 'The Changing Structure of Malaysia's Exports' in Bank Negara Malaysia's Annual Report 2011.
[3] Yusoff et al. 2000. Globalisation, Economic Policy and Equity: The Case of Malaysia; Wong 2013. The Malaysian Electrical and Electronics (E&E) Industry: At an Inflexion Point.
[4] For a more detailed account, please refer to the Box Article on 'Shifting Shapes, Turning Tides: The Evolution of Malaysia's Electronics and Electrical (E&E) Industry' in Bank Negara Malaysia's Annual Report 2015.
[5] Foo 2015. The Malaysian Chemicals Industry: From Commodities to Manufacturing.

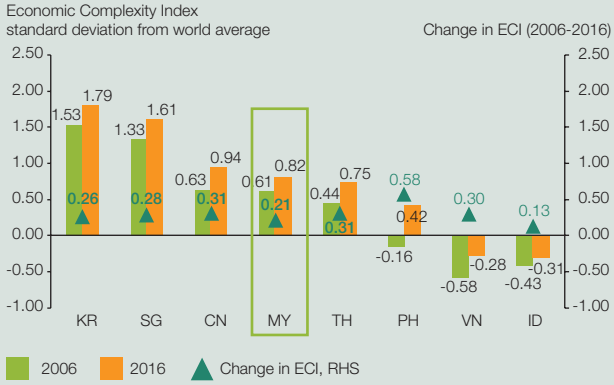
While downstream activities expanded in the past two decades, the product space also shows that Malaysia continues to export raw mineral and agriculture products (*brown and orange dots, respectively*). The centre of the product space also remains relatively sparse, which suggests that Malaysia has yet to develop comparative advantage in some products. These indicate opportunities for further downstreaming in the commodities sector and the development of comparative advantage in new products.

Comparing Malaysia's Economic Complexity to Regional Peers

While Malaysia's economic complexity has grown over the years, the country remains behind advanced and fast-growing regional peers (Chart 5). Among the selected regional countries, Korea is deemed the most complex economy with an ECI of +1.79 in 2016. This is followed by Singapore (+1.61) and PR China (+0.94).

Chart 5: Economic Complexity Index (Malaysia and Selected Regional Countries)

Malaysia's economic complexity lags behind advanced and fast-growing peers, while others are fast catching up



Note: CN = PR China, ID = Indonesia, JP = Japan, KR = Republic of Korea, MY = Malaysia, PH = Philippines, SG = Singapore, TH = Thailand, VN = Vietnam

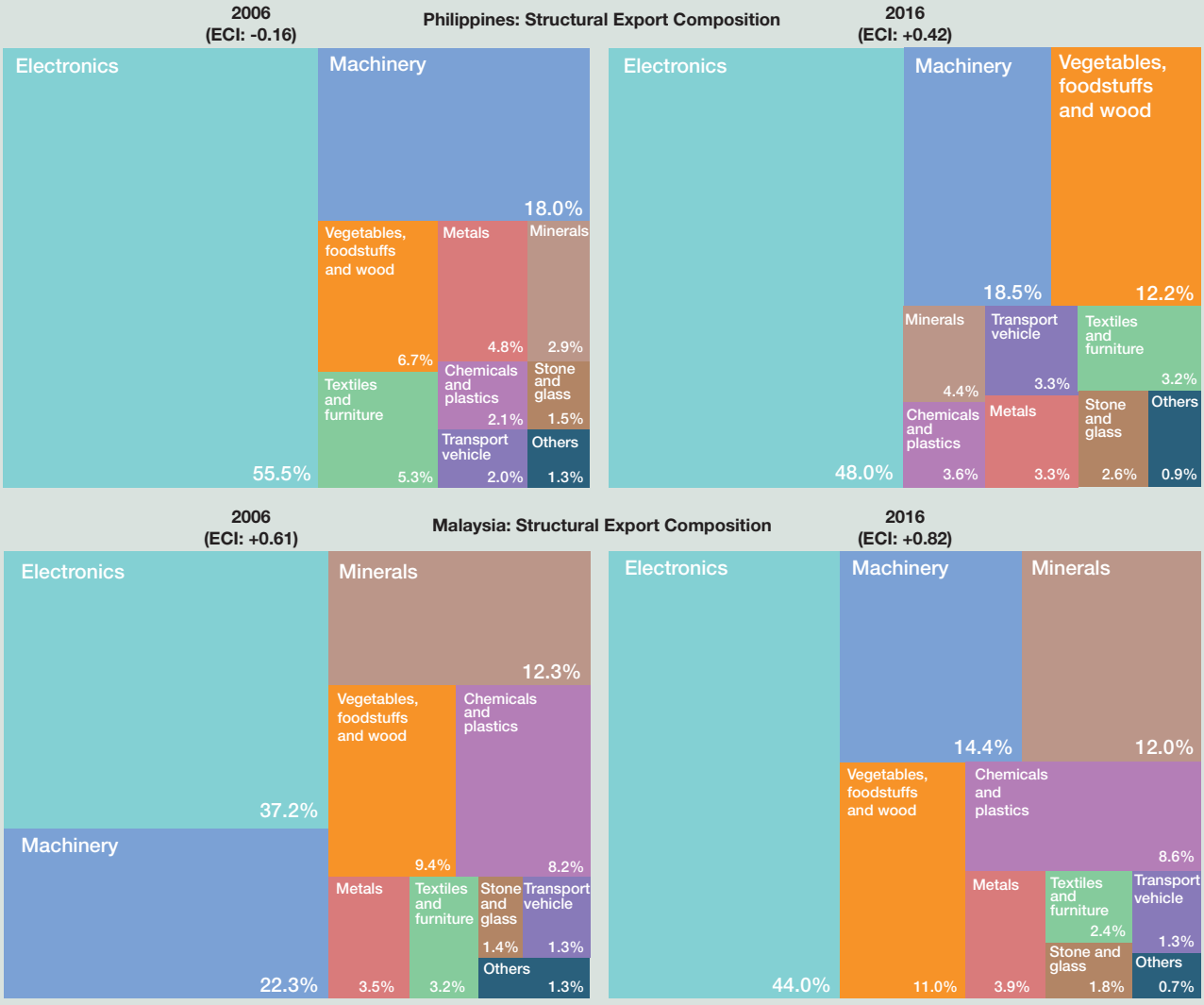
Source: The Atlas of Economic Complexity

Looking at the change in ECI over the recent decade, most regional countries have accomplished greater complexity gains than Malaysia's improvement of +0.21. This suggests that these countries experienced more substantial diversification in their product mix or have ventured faster into highly complex products. Of note, Philippines' economic complexity improved the most in the region by +0.58. This resulted in a shift in its level of complexity from below global average to above global average within ten years. Chart 6 compares the structural changes in the export composition of the Philippines and Malaysia over the last decade. Starting from a lower level of ECI, the greater complexity gains was attributed to the product mix in the export basket of the Philippines which had become more varied. The country lowered its exposure in electronic products, reflected by the decline in its share from 55% in 2006 to 48% in 2016. Conversely, there was greater focus in more complex chemicals, plastics and transport vehicles as the share of these products increased from 4% to 7%. The share of agriculture products also rose from 7% to 12%. More importantly, within the agriculture sector, there was a diversification away from less complex items such as bananas (PCI: -2.28) into the more complex wood carpentry (PCI: +0.09).

In contrast, the improvement in Malaysia's ECI is relatively slower as the export mix diversified by a smaller extent and the entry into new products has yet to materialise significantly. The profile of the products exported offers some insights. Firstly, Malaysia's concentration in electronic products (PCI: +0.76) rose from 37% to 44% share of total exports over the last decade as the country remains firmly plugged in the global value chain. At the same time, exposure in the machinery cluster, which has a higher PCI of +1.00, halved from

Chart 6: Snapshot of the Structural Export Composition of the Philippines and Malaysia (% share of total exports)

Improvement in Malaysia's ECI is relatively slower than Philippines



Note: Figures may not necessarily add up due to rounding

Source: The Atlas of Economic Complexity

22% to 14% share. Within the machinery cluster, while firms shifted their focus away from PC and parts (PCI: +0.64) in line with the global technological shift towards internet-enabled devices, progress in growing the more complex medical and scientific instruments base (PCI: +0.94) remains fairly limited at 4% share of total exports. Finally, Malaysia had only managed to expand incrementally into the more complex chemicals and plastics, as reflected by the small increase in its exports share from 8.2% in 2006 to 8.6% in 2016.

Strategies to Increase Economic Complexity

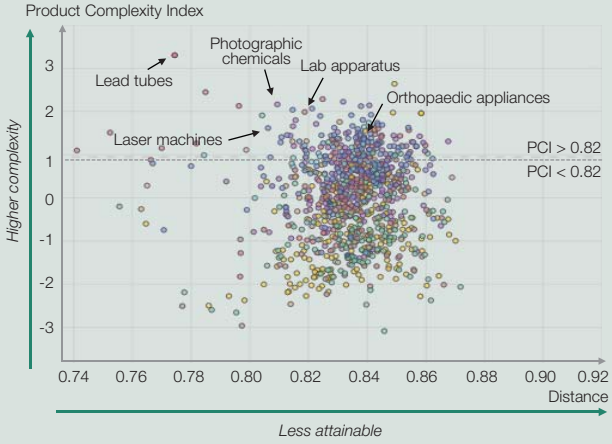
The emergence of overarching megatrends such as technological disruptions, rapid urbanisation and climate change requires countries to rethink their current growth strategies and adapt to new realities. In this regard, there is room for Malaysia to further diversify its product mix and deepen its product complexity in order to maximise the opportunities for the nation in the highly-dynamic global environment. As identified earlier, Malaysia's current product space is relatively sparse at the centre, which suggests room for the country to develop comparative advantages in some of these products.

These are products that are 'rich in complexity' as they are situated at the centre of the product space with tightly connected nodes. Malaysia could leverage on the vast experience and significant productive capabilities it has developed over the years particularly in the electronics and commodity sectors, and increasingly the chemical and plastics industries to diversify into new, more complex products.

The product feasibility map presents a useful tool to identify the range of potential product diversification options and its feasibility (Chart 7). The map demonstrates how attainable it is to produce certain products, given existing capabilities (horizontal axis) and the corresponding product complexity (vertical axis). Increasing Malaysia's complexity would require diversifying into more complex products with PCIs that are above Malaysia's current ECI of +0.82. Such products include *lead tubes*, *laser machines, photographic chemicals* to *laboratory apparatus* and *orthopaedic appliances*. They are also of high complexity and could catalyse production in other more complex products. Based on the map and experience in other countries, it is relatively easier for Malaysia to diversify into *lead tubes, laser machines* and *photographic chemicals* in the near term as they are more closely connected to existing products that Malaysia currently manufactures.

Chart 7: Product Feasibility Map for Malaysia

The product feasibility map indicates the range of potential product diversification for Malaysia



Source : The Atlas of Economic Complexity

To enable further diversification and ventures into more complex industries, focus should be directed towards modernising and augmenting the supporting ecosystem of pertinent industries. The strategy should centre on four key pillars which are proven enablers of rapid diversification in the past: talent, financing, infrastructure and regulations.

Firstly, a sustainable supply of a well-educated and experienced talent pool forms the bedrock for the diffusion of knowledge within and across industries. The emergence of new trends such as Industry 4.0 would have significant consequences on the labour market, requiring an adaptable workforce that can be reskilled and retooled. While institutions were created in the past to address skills shortages, they should now proactively embed joint industry-academia element in new and existing course and training curricula, and research programmes. This will ensure that the talent produced matches the dynamic needs of industries, anchored firmly with strong research skills to drive innovative change. To cater to Industry 4.0, some progress have been made to encourage such industry-driven research and training partnerships in Malaysia. Notable examples include the establishment of Collaborative Research in Engineering, Science and Technology (CREST) in 2012, and more recently the launch of MIMOS-NCIA Advanced Competency Development Centre in 2017. Currently, these efforts are focused primarily on the E&E sector. Extension of such initiatives to the non-E&E and commodity industries, which account for a larger share of exports at 62%, and 23% of total employment[6] in 2017, would upskill a greater share of the labour force. Efforts

[6] Employment in the non-E&E sector is estimated by applying its ratio of employment in the manufacturing sector using the Department of Statistics, Malaysia's Monthly Manufacturing Survey for establishments.

to attract and retain the existing base of high-skilled talent is equally important. In addition to the current efforts by the Government, the private sector can also play a role by ensuring that labour remuneration, including wages and salaries are commensurate with productivity levels.

Secondly, both regulators and private sector players must work closely to encourage more widespread use of alternative financing platforms, such as crowdfunding, peer-to-peer lending and venture capital. This could be an important source of funds for businesses, particularly SMEs, that are involved in innovative or new growth areas which entail higher risks[7]. Bank-based financing may not be the best means to finance these activities. For comprehensive credit risk assessment, banks would require an established credit history and collateral, which start-ups in new growth areas often lack. Multiple policy priorities have been identified to further promote alternative finance. These include, among others, enhancing institutional arrangements to coordinate, streamline and anchor policies in developing alternative finance, and improving the quality, coverage and credibility of alternative financing data to support credit decisions.

Thirdly, user-friendly physical infrastructure remains a critical component of the industrial ecosystem. With the increasing utilisation of digital platforms for the efficient sharing of knowledge and information, more attention should be placed on upgrading virtual and digital infrastructures in Malaysia. This could encompass the integration of big data analytics into national databases, greater use of remote desktops and improving broadband connectivity. Leveraging on existing initiatives to maximise the potential of digital platforms in Malaysia, it is critical to accelerate the integration of private sector data into the National Data Ocean Platform by MAMPU. The pooling of a broader set of data (e.g. consumer preferences revealed through search engine database), complemented by the use of data analytics can create valuable insights for more informed business analyses and decisions to enhance product range, quality and sophistication.

Finally, the regulatory environment will need to adapt to and leverage on the rapid technological change taking place. Ongoing efforts to reduce regulatory redtapes and reorientate incentives (e.g. taxes, subsidies) will encourage quality investments in more innovative and complex industries, particularly those that involve downstreaming and R&D activities, and also technology transfers. In the past, the implementation of the upstream petroleum income tax at 38% in the mining sector had incentivised diversification into the more complex downstream petroleum products. Taking into account the market structure and firms' operating environment, similar strategies could be considered to spur the crude palm oil (CPO) industry to accelerate expansion in downstream activities by reviewing the corporate tax on CPO firms' upstream revenues. Intellectual property rights and certification standards can also be strengthened to foster a safe environment for innovation.

The intended outcome of these strategies is to foster the agility, efficiency and sophistication of local players to push frontiers and remain relevant in a fast-changing environment. Solid public-private coordination and collaboration would ensure that these objectives are achievable.

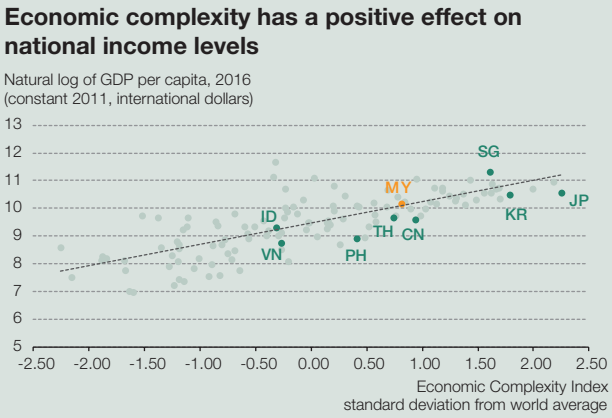
Economic Complexity and the Impact on Malaysia's Economic Growth Prospects

As economic complexity reflects the capabilities embedded in the productive structure of an economy, Hausmann et al. finds that economic complexity has a positive effect on income levels (Chart 8). The gap between a country's complexity and its level of per capita income could be used to predict future GDP growth. If a country's income level is lower than average at a given ECI, income is likely to grow at a faster pace going forward. This is because the country already possesses the necessary productive capabilities to easily diversify into more complex products within a short time-frame. This will allow the country's income to converge to the levels that are consistent with other countries possessing similar levels of economic complexity.

Given the marginal gap between Malaysia's current GDP per capita and complexity, the study projects Malaysia's real GDP to grow by 4.8% up to 2025 (lower compared to the 1990-2017 long-run average of 5.9%). With this projected growth rate and assuming a stable population growth of 1.3% (2017 rate), Malaysia is expected to achieve a per capita income level of about USD11,900 by 2020, which remains slightly below the latest high-income threshold of USD12,236 as defined by

[7] Refer to the Box Article on 'The Role of Alternative Finance to Fund the Needs of a New Economy', Bank Negara Malaysia's Financial Stability and Payment Systems Report 2016.

Chart 8: Economic Complexity Index and GDP Per Capita (2016)



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Source : The Atlas of Economic Complexity, The World Bank

the World Bank. In other words, by this technique, Malaysia's present level of economic complexity is currently insufficient to propel the economy to sustainably achieve high income status by 2020. Therefore, it is imperative that Malaysia implements the necessary strategies that will improve its overall complexity not only to remain competitive against regional peers, but also to meet its high-income aspirations.

Conclusion

As a summary indicator of a country's overall productive capabilities, the concept of 'economic complexity' is an insightful tool towards understanding a nation's structural change and competitive advantage while serving as a useful guide to strategise future development. Over the last two decades, Malaysia has been successful in raising its level of complexity as a result of past structural reforms, supportive business ecosystem and greater presence of FDI. Despite these gains, other developing regional peers are fast catching up, and at its current pace, Malaysia may risk lagging behind its high-income aspiration targets. Therefore, it is imperative to accelerate efforts to further diversify the product mix and deepen product complexity. The product feasibility map presents a viable range of diversification options, leveraging on the knowledge and capabilities that the nation has developed over the years. Implicit to this is the realisation that a dynamic and robust manufacturing base remains a vital aspect in a complex economy. The key policy thrust should therefore be directed towards continuous and deeper structural reforms, particularly in modernising and augmenting the support system of the relevant industries. These include, among others, (i) extending the industry-academia element in research and training programmes beyond the E&E sector, (ii) promoting alternative finance via coordinated efforts among relevant institutions, (iii) elevating the digital National Data Ocean Platform, (iv) reviewing upstream tax to promote downstream activities in the palm oil industry, and (v) explicitly including complexity as an incentive criteria. This would encourage quality domestic and foreign direct investments in new complex growth areas, foster innovation and sophistication, create greater job opportunities and improve income prospects. Higher economic complexity would therefore enable Malaysia to compete and thrive in a fast-changing global environment, ultimately paving the way towards greater prosperity.

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