Innovation Performance of the Malaysian Economy

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On the back of political stability, inflows of foreign direct investment, and export-oriented industrialization, Malaysia has successfully transformed itself into an upper-middle-income country. It had a population of 29.2 million and purchasing power parity–based GDP per capita of US$17,748 in 2014. Malaysia has been an innovation achiever over the period 2011–2014, as seen in improvements to its Global Innovation Index (GII) score relative to its GDP. Furthermore, Malaysia's remarkable innovation performance led it to record the highest GII rank among the middle-income countries in 2014.

Malaysia has remained an upper-middle-income country since the 1980s. Because the government is seeking to advance the country to the high-income group by 2020, it is attempting to determine the causes of this long stagnation so that it can intervene effectively. The slow pace of GDP growth since 1997 is largely a consequence of poor performance on the efficiency ratio of innovation inputs and outputs. Despite achieving an innovation efficiency score of 0.8, Malaysia ranked 72nd in the world in 2014. Indeed, this is a major concern of the government, which has attempted to raise the performance of innovation expenditure in the country by emphasizing commercialization and training programmes.

Figure 1: Global Innovation Index: GII and sub-index rankings: Malaysia, 2011–14

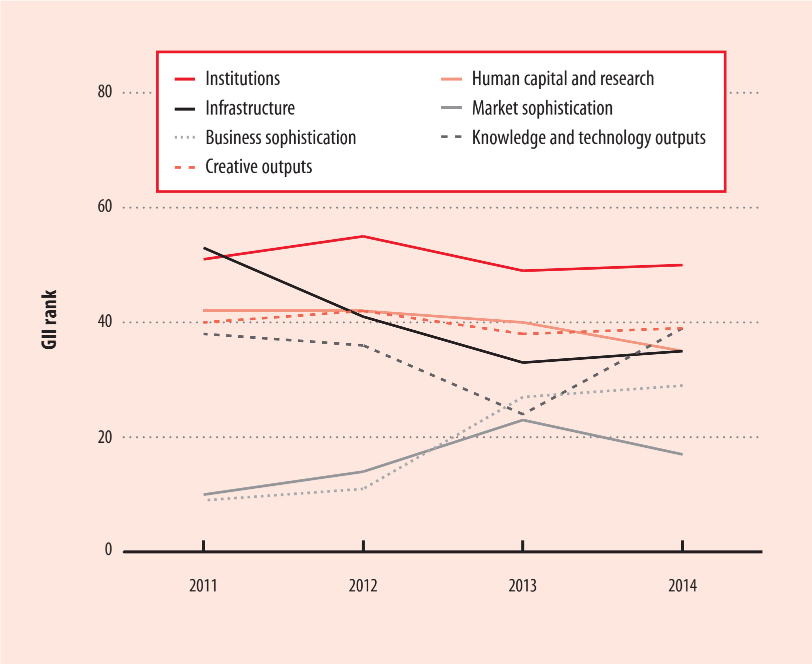
Source: GII, 2011–2014.

As an innovation outperformer, Malaysia offers an excellent example of an upper-middle-income country that has done well in areas such as business financing of innovation and commercialization, as well as Market and Business sophistication. At the same time, however, considerable improvement in areas such as knowledge-based activities and technological dependence are still needed. This chapter seeks to analyze the reasons behind Malaysia's achievements and shortcomings, and to offer policy-relevant recommendations for advancing innovation in the country.

Malaysia's performance in the GII

Malaysia placed 33rd among all countries in the GII in 2014, slightly below the 31st rank it achieved in 2011 (Figure 1). Its rankings on innovation inputs and innovation outputs were 30th and 35th, respectively. However, it did not perform well on the efficiency of innovation last year, placing only 72nd. Although Malaysia's overall

Figure 2: GII pillar rankings: Malaysia, 2011–14



Source: GII, 2011–2014.

GII rank did not change much over the period 2011–14, its actual score improved from 44.1 in 2011 to 46.9 in 2013–14. Malaysia's innovation efficiency rank fell from 52nd in 2013 to 77th in 2014, but its actual score improved significantly—from 0.7 in 2011 to 0.8 in 2013–14. The relative fall in rank is a consequence of other countries improving their scores much more than Malaysia.

Among the seven main pillars of the GII, Malaysia ranked 17th in Market sophistication with an aggregate score of 63.9 (see Figure 2). Malaysia's worst performance was in the Institutions pillar, at 50th (with a score of 68.2). It came in 39th in both Knowledge and technology inputs (35.5) and Creative outputs (40.0) with a score of 42.0, and 35th in Human capital and research (41.6) and Infrastructure (45.7). It did better in Business sophistication, ranking 29th with a score of 42.9.

Overall, Malaysia has done well in all the direct variables relevant to innovation, such as innovation inputs and outputs. However, despite strong commercialization in business research and development (R&D), including in business financing, the country's relatively poor performance in innovation efficiency indicates a need to review government policies concerning the implementation of government-sponsored R&D funds in the country.

Government policies that promote innovation

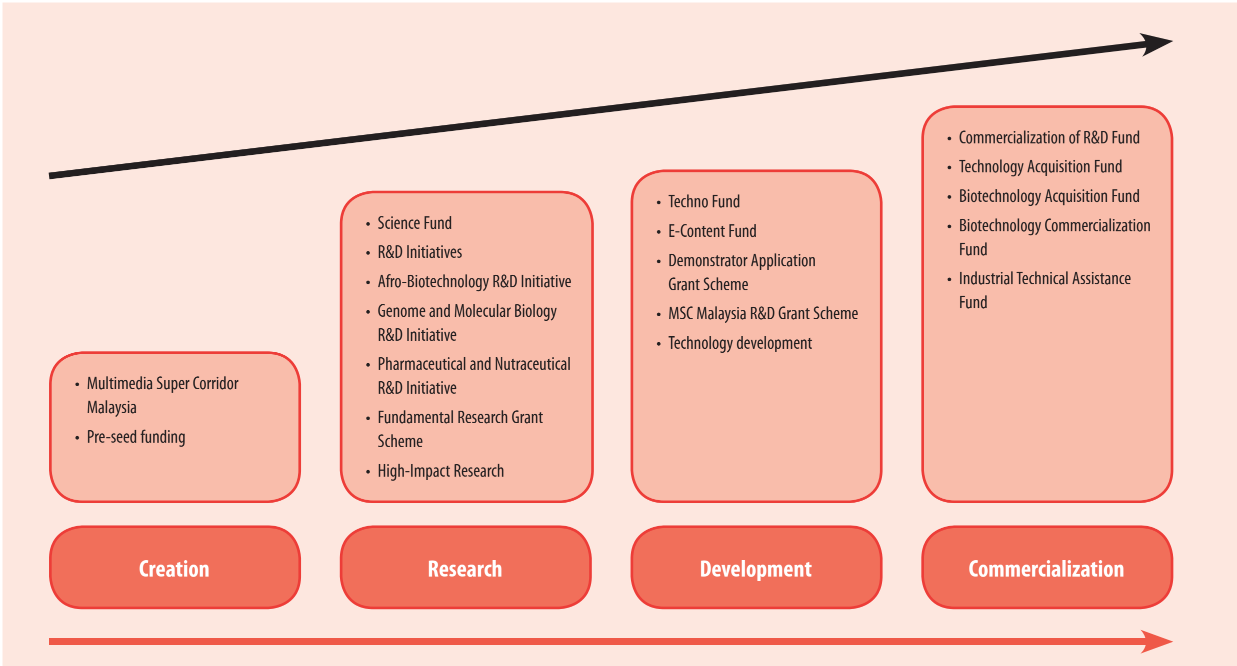
Government support of innovation in Malaysia occurs primarily through its science, technology, and innovation policies that began to be implemented in the 1980s. The types of programmes, focal areas, and target groups are shown in Figure 3; these are administered by the government directly and through the coordination of other public bodies. The Ministry of Science, Technology and Innovation (MOSTI) supports the creation, research, development, and commercialization of innovative activities in Malaysia. The number of projects approved by MOSTI and the amounts involved have increased since the government's first efforts, in 1991, to provide R&D grants following the introduction of the Action Plan for Industrial Technology Development to stimulate R&D in the country.[1]

Direct funding to stimulate research began in 1988 when the Intensification of Research in Priority Areas grant was launched under MOSTI. This grant was targeted towards public organizations such as universities and public research institutes. At the same time, the government introduced the double deduction tax incentive—a scheme offering tax exemption—for firms undertaking approved R&D. The Industrial R&D Grant Scheme to support R&D in the private sector was introduced in 1997 by MOSTI.

What has worked

Malaysia outperformed its middle-income peers in all seven pillars of the GII over the period 2011–14. Its general institutions for stimulating innovation are good, as can be seen from the improvements in its ranking in the ease of starting a business indicator, from 90th in 2012 to 15th in 2014. Malaysia's ranking in sub-pillar 1.3, Business environment, has also improved, seen in its rise from 53rd place in 2011 to 25th in 2014. At the same time, the government's increasing focus on research funding has helped stimulate expansion in innovation inputs and outputs, evidenced by the rise in R&D expenditure as a share of GDP, R&D researchers and scientists per

Figure 3: Public funding of innovation, Malaysia



Source: Adapted from Ministry of Science, Technology and Innovation, 2013.

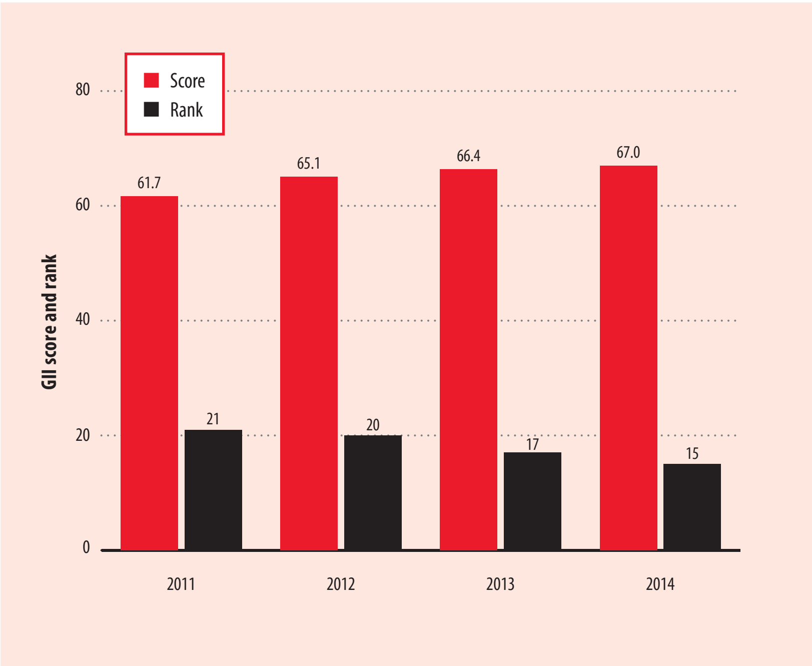
million persons, and number of doctoral graduates and scientific publications. Both the leadership at MOSTI and the National Science Research Council (NSRC) have systematically tried to address the need to target expenditure to the priority areas that can best generate innovation.

Since the promotion of export-oriented industrialization from 1971, high-tech production has become a major pillar of manufacturing in Malaysia.[2] Strong basic infrastructure and consistent promotion incentives that are well coordinated by the Malaysian Industrial Development Authority have ensured that foreign capital in Malaysia continues to assemble and test electronics products for the export market. Although the relative share of exports of high-tech products, such as integrated circuits, has fallen since the 1990s, high-tech exports have remained important. Malaysia not only ranked 2nd among all countries on high-tech exports in 2014, but the government's success in providing R&D grants to deserving firms since 2005 has successfully turned typically negative trade balances in the electronics components industry into a positive balance in 2013.[3] Although most electronics firms are still entrenched in assembly and test activities, the positive trade surplus was made possible largely through horizontal technological upgrading in assembly and testing, and vertical upgrading to wafer fabrication and chip design activities in Malaysia.[4]

Recognizing that private R&D cannot be a substitute for government funding—especially in cases where the benefits of R&D exhibit strong public goods characteristics—in 2010 the government boosted its R&D expenditure with a focus on increasing R&D scientists and engineers, commercialization, filing of intellectual property, scientific publications, and postgraduates, and began to emphasize innovation through substantially improved products and processes. Hence both R&D scientists and engineers per 10,000 workers and gross R&D expenditure in GDP rose from 15.6 and 0.5% in 2000 to 58.2 and 1.1%, respectively, in 2012.[5]

Through the coordination of MOSTI; the meso-organizations that address collective action problems, which include the Malaysia Industry-Government Group for High Technology (MIGHT), the Multimedia Development Corporation, the Malaysian Technology Development Corporation (MTDC), and the NSRC; and the country's five research universities: Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, Universiti Putra Malaysia, and Universiti Teknologi Malaysia, the government has managed to

Figure 4: University-industry collaboration in R&D: Score and rank, Malaysia, 2011–14



Source: GII, 2011–2014.

expand scientific input and output. Consequently, R&D scientists and engineers per 10,000 workers and gross expenditure in R&D (GERD) in GDP as a percentage have risen strongly; the share of R&D scientists and engineers per 10,000 workers also rose from 17.9 in 2006 to 58.2 in 2011, while GERD rose from 0.64 in 2006 to 1.13 in 2012.[6]

Since the 1990s, the government has strongly encouraged the starting of science and technology parks; it also launched MSC Malaysia (then known as the 'Multimedia Super Corridor') in 1996. Several grants, including the highly lucrative Techno-Fund, were launched to support this initiative. Since 2006, after a growing emphasis on performance (measured by the numbers of scientific publications and patents), these grants helped to raise the quantity of university-industry collaboration links and scientific publications. The provision of research grants to universities—which include some, such as the E-science fund, that encourage participation by industry—has helped raise university-industry collaboration in R&D activities in Malaysia. As shown in Figure 4, the university-industry collaboration in R&D score improved from 61.7 in 2011 to 67.0 in 2014. As a consequence, Malaysia's ranking in this indicator went up from 21st in 2011 to 15th in 2014.

Among the positive impacts of government support for funding research in universities through the Long Run Research Grant Scheme, the Fundamental Research Grant Scheme, the High Impact Research, and E-science grants is the sharp rise in scientific publications, though the numbers are still not comparable to those produced in the Republic of Korea or Taiwan, Province of China. Publications listed in the Thomson Reuters Web of Science index and the scopus databases of Malaysia's five public research universities rose sharply, from 1,391 and 2,228 in 2006 to 8,736 and 12,122, respectively, in 2014.[7] The total number of publications is not yet fully recorded in both databases, suggesting that the number of publications in the two databases may actually show a significant rise in 2014.

Business R&D has also performed well in Malaysia, both in terms of the commercialization of output and in the financing of it. An example of a successful business R&D programme is the R&D undertaken by members of the Malaysian Palm Oil Board (MPOB), which is financed from cess (taxes) collected from firms. Despite the saturation of land available for physical expansion, palm oil exports and the supply of palm oil products rose over the period 2000–14.[8] A major contributor to the sustainability of oil-based products is the new technologies and services emerging from R&D financed through MPOB's cess fund. The number of successful transfers of new technologies and services from such R&D varied between 21 and 59 over the period 2000–14.

What has not worked

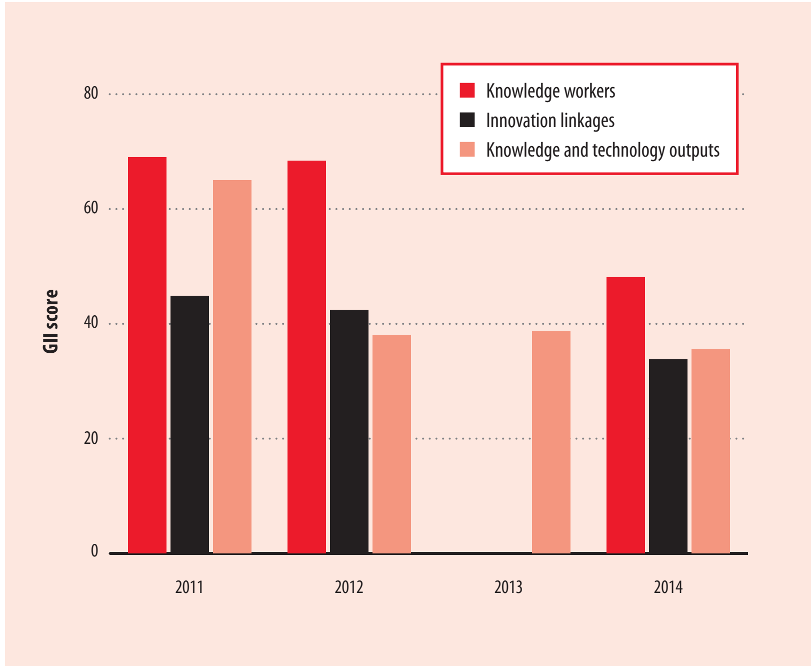
Despite being an innovation outperformer, some weaknesses still need to be addressed. Malaysia's performance in the efficiency of innovation has not kept pace with the significant improvements made in several pillars. Although Malaysia's Innovation Efficiency Ratio placed it 72nd in the 2014 GII (score 0.74), dropping from 52nd in 2013 (score 0.81), it was ranked 84th in 2012 (score 0.69) and 77th in 2011 (0.66). This relatively low performance can be attributed to its weak institutions, trade balance in royalties and licensing fees, and knowledge output.

Knowledge and technology outputs (pillar 6)

Innovation is strongly influenced by knowledge-based activities. Malaysia has not done well in this area: its ranking on knowledge-based workers, innovation linkages, and knowledge and technology outputs has fallen from 2011 to 2014. Indeed, the GII scores for Knowledge workers, Innovation linkages, and Knowledge technology and outputs for Malaysia fell from 69.0, 44.9, and 65.0, respectively, in 2011 to 48.1, 33.8, and 35.5, respectively, in 2014 (see Figure 5).

The government created the institutional setting for solving collective action problems by launching several initiatives: the Malaysian Technology Development Corporation, the Human Resource Development Council, MIGHT, the Multimedia Development Corporation, and the Multimedia Super Corridor. It also corporatized the Malaysian Institute of Microelectronics Systems in the 1990s to stimulate knowledge-based activities in the country, and increased grants to support R&D.[9] But much remains to be done to establish and strengthen links between these organizations and private firms, which may explain why Malaysia's strength in innovation linkages fell between 2011 and 2014.

Figure 5: Knowledge workers, Innovation linkages, and Knowledge and technology outputs scores: Malaysia, 2011–14



Source: GII, 2011–2014.

Business sophistication (pillar 5)

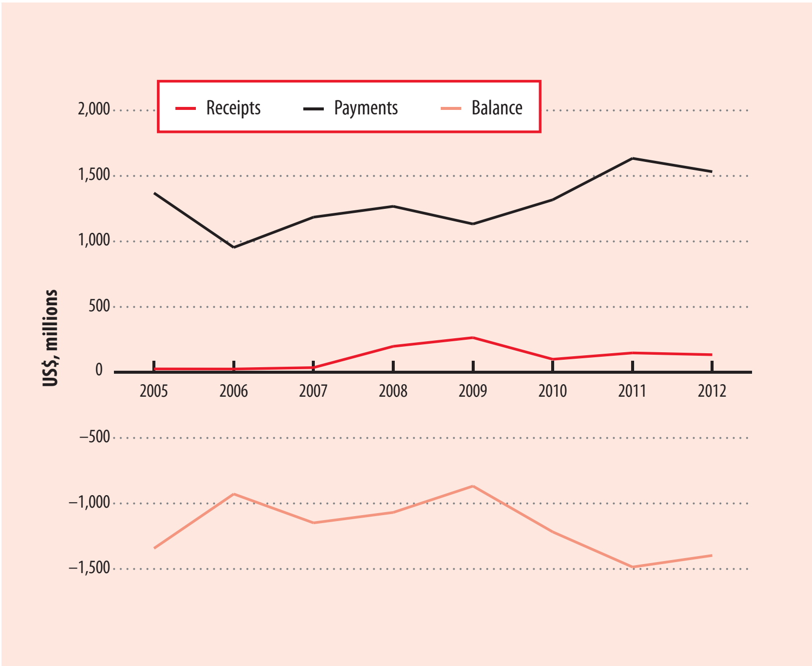
Trade balance in royalties and licensing fees is one indicator of innovation performance. Malaysia's score and ranking in this indicator has fallen over the period 2011–14 (its score fell from 57.5 to 19.6, and its rank fell from 11th to 47th).[10]

An intense assessment of receipts and payments shows that Malaysia has faced chronic deficits on trade in technology and service. Receipts enjoyed by Malaysia initially grew sharply from US$26.2 million in 2006 to US$265.7 million in 2009, but has since fallen in trend terms to US$135.4 million in 2012 (Figure 6). Payments made fell initially from US$1370 million in 2005 to US$954 million in 2006 before rising to US$1,634 million in 2011 and falling again slightly in 2012 to US$1,532. The much larger payments made against receipts received has continued to produce net deficit in receipts on the royalties and licensing account of trade. The net receipts improved in trend terms from negative US$1,343 million in 2005 to negative US$867 in 2009. However, net receipts increased in 2010, to negative US$1,485.

The chronic deficit in royalty and licensing fee receipts and payments demonstrates that Malaysia still relies strongly on foreign technology and services. Policies are needed to transform Malaysia from a technology-importing country to a technology-exporting one. In addition to aggressive marketing of national technologies, it will be important for strategies to stimulate the gradual substitution of imported technologies.

Although strong government funding has been accompanied by strong innovation output, such as in scientific publications and patents, it has not produced the same effect on the commercialization of these results. While the weak results are largely a consequence of weak university-industry linkages, it cannot be due to a lack of businesses capable of undertaking such activities, because businesses in Malaysia show strong internal funding and commercialization capabilities. Strong university-industry linkages exist in industrial training of undergraduates, but those linkages are not so obvious in R&D and in the placement of academics in firms. Hence, although the government

Figure 6: Royalty and licensing fees: Malaysia, 2005–12



Source: GII, 2011–2014.

has emphasized university-industry linkages in a number of grants distributed to universities, such as the E-science fund, much of the university research in the country is undertaken without much input from firms.

What Malaysia can learn from others

There is a need to enforce the university-industry matching grant framework that some economies—such as Taiwan, Province of China—successfully launched to ensure strong commercialization of GERD.[11] The Inno-fund in Malaysia partially deals with that framework but should be expanded to cover all grants advanced by the government.[12]

The case of Taiwan, Province of China, is a good example. The economy's Industrial Technology Research Institute (ITRI) has served as a key incubator that commercializes R&D and spins off indigenous technology-intensive firms, ever since the government identified catching up in the integrated circuit industry as a goal in the 1970s. Since then, the incubator continues to spin off firms in other important technology-related industries, aligning with the technology roadmaps of the government. Although still primarily specialized as original equipment manufacturers and original designing manufacturers, integrated circuit firms in this economy have caught up with world's frontier technologies by constantly absorbing and assimilating new external knowledge while developing their own.[13] In sub-industries, such as integrated circuits and machinery and equipment, firms in Taiwan, Province of China, are shaping the globe's technology frontier.[14]

Malaysia can also learn from the brain gain and brain circulation strategies of Taiwan, Province of China, because large numbers of Malaysia professionals are still living in Singapore, the United States of America, Australia, and the United Kingdom.[15] The economy's existing brain gain policies should be complemented by giving leadership positions in the key meso-organizations, such as MOSTI, the MTDC, and MIGHT, to Malaysians who are endowed with tacit and experiential knowledge. Such an effort will also allow Malaysian firms to leap across stages in the technology trajectory of products.

Future work

Although Malaysia has performed well as an innovating nation, much has to be done for it to move up the GII rankings in a number of innovation pillars. The most pressing are the Knowledge workers and Innovation linkages subpillars and the Knowledge and technology outputs pillar, as well as the net royalty and license fee receipts, as Malaysia's rank in these areas fell over the period 2011–14.

Knowledge and technology outputs (pillar 6)

The government can introduce a number of strategies to check the fall in ranking in knowledge-associated activities in Malaysia. The problem is not so much a consequence of falling enrolment in science and technology–based courses in schools and universities—Malaysia has done well using such measures. Instead the issue appears to be a relative decline in quality. A first step will be to investigate why the average performance of students in science and mathematics in the PISA assessment placed Malaysia 51st in 2014. The low performance is an indicator of the lack of quality that is essential for workers participation in knowledge-based activities.

Although university-industry linkages are relatively strong, Malaysia's progress towards a developed country will require greater numbers of information technology graduates, R&D scientists, and engineers; increased R&D expenditure; and improvements in university-industry linkages. Only then can Malaysia compete with the Republic of Korea and Taiwan, Province of China, in the commercialization of university research. Malaysia should use its excellent business environment, especially for starting new businesses, to strengthen innovation linkages between universities, science parks, and firms. Recently established in 2012, the Collaborative Research in Engineering, Science & Technology (CREST) is a key public-private initiative in Malaysia that has begun driving growth in the electrical-electronics industry. CREST focuses on bringing together the three key stakeholders (i.e., the industry, academia, and the government) in collaborative R&D, talent development, and commercialization. Because each research project granted by CREST conditions the participation of both universities and industrial firms, it is directly targeted at building university-industry linkages in the country (see Box 1).

Box 1: CREST as the bridge of university-industry linkages

The Collaborative Research in Engineering, Science & Technology (CREST) is the first research grant provider that targets only those R&D projects that drive university-industry linkages in Malaysia's electrical-electronics industry. By providing R&D grants, CREST promotes and facilitates academia and companies in collaborating in market-driven research. CREST does not operate research labs but focuses on funding research located either in universities or industry, as nominated by each research team.

CREST has received a good response from the industry players by focusing on projects that are relevant to and of values to market growth. Through close interactions with the industry players, CREST identifies the weak links in strategic segments and sets the direction of the types of R&D to be conducted. In addition, CREST promotes certain cluster programmes with the ultimate objective of driving local firms to gain higher-value-chain governance at the regional and international levels.

Since 2012, CREST has approved 74 projects through matching grants. Both universities and firms participate in every project. The projects involve a total fund of approximately US$16.5 million as of 2014, 65% of these funds were provided by companies. Eight projects were completed in 2014 and another 18 are expected to be completed in 2015. The remaining 48 projects are scheduled to be completed in 2016–18. CREST is aiming to gain 61 commercializable intellectual properties as of 2018, accompanied by 299 research publications, 89 Master's, and 32 Doctoral degree graduates.

Source

Author interview of the Chief Executive Officer of Crest, 2015.

Synergies between pillars: Linkages among Pillars 2, 5, and 6

Effort must be made to reduce the heavy reliance on technology and service imports in order to mitigate the chronic imbalance between royalties and licensing fees. Although it is typical to be a net importer of technology and services in the initial phase of economic growth, successful economies gradually overcome their dependence on these imports by developing domestic capabilities to overcome the deficits, thus eventually generating a positive trade balance in royalty receipts and licensing fees.

The Republic of Korea and Taiwan, Province of China, have both managed to achieve this transition over the period 1970–2000. Like these economies, Malaysia has relied heavily on foreign technology and services since 1970, but it has yet to evolve sufficient domestic capabilities to overcome the deficit, though national firms have managed to expand construction services abroad (e.g., highway construction).[16] Although considerable capabilities have evolved in resource-based industries—as in the oil palm industry, through the R&D and commercialization activities of the MPOB—similar efforts should be directed towards the high-tech industries of electric-electronics, automotive products, and biotechnology.

To ameliorate the above problems it will be imperative to maximize linkages between the networks linking firms to the universities, training centres, research institutes, and standards organizations. While connectivity is important, expanding the supply of knowledge workers is also critical because they are important participants in building innovation linkages. The expansion of innovation linkages will help increase knowledge and technology output.

Conclusions

Although export-oriented high-tech production has steered Malaysian's industrial expansion since the 1970s, its first few decades were dominated by low-value-added assembly and test activities. Following the realization in the 1990s that science, technology, and innovation are crucial to sustaining rapid growth and structural change in the country, the government began directly and heavily financing R&D activities in universities, public laboratories, and industry. Important initiatives, funded through the pooling of cess, have been instrumental in stimulating the commercialization of R&D in businesses. The MPOB is a good example of such an initiative. Other successful schemes include the provision of grants to research universities, which has significantly stimulated expansion in scientific publications since 2006 and expanded innovation inputs and outputs.

The steering provided by the NSRC has been important, because this council has attempted to systematically address the different innovation pillars. It has called on the government to raise R&D funding and has periodically evaluated the performance of the meso-organizations, such as MIGHT, MTDC, and the Multimedia Development Corporation, which were launched to solve collection action problems, including those in public universities, associated with the production and delivery of knowledge output.

The main shortcomings preventing Malaysia from lifting its GII ranking above 33rd place relate to the efficiency of the innovation inputs and outputs. Both its scores and rankings in Knowledge workers, Innovation linkages, and Knowledge and technology output rankings have fallen between 2011 and 2014. As a consequence, Malaysia has remained a net technology and services importer, with net receipts and licensing fees remaining negative for many years. Greater efforts should be made to improve institutional support and knowledge-based activities to turn Malaysia into a net exporter of technology and services. Taiwan, Province of China, is a good model for Malaysia to consider in its efforts to strengthen innovation efficiency.

Malaysia's boosting of university–industry linkages, as reflected in the efforts of CREST, is a good example for other countries that want to improve their innovation capacity. By making it a requisite for universities to engage industry when seeking public R&D grants, scientific research at universities is increasingly targeted at commercialization.

Notes

1 Malaysia, 1995.

2 Rasiah, 2011.

3 WTO, 2014.

4 Rasiah et al., 2015b.

5 MASTIC, 2012; Ministry of Science, Technology and Innovation, 2013.

6 MASTIC, 2012; Ministry of Science, Technology and Innovation, 2013.

7 Information about the Web of Science index can be found at http://wokinfo.com/; information about the University Malaya database (2015) was accessed on 15 May 2015 from http://portal.um.edu.my/mt.php?f=perpustakaan&fn=Comparison-5RU-WOS-SCO-2006-2015-30Apr15-chart-asean.pdf.

8 MPOB, 2015.

9 Malaysia, 1995.

10 Indicator 5.3.1, royalties and license fees payments over total trade, changed in 2014 from being divided by total services imports to being divided by total trade.

11 Rasiah et al., 2010.

12 Ministry of Science, Technology and Innovation, 2013.

13 Rasiah et al., 2015b.

14 Tsai and Cheng, 2006.

15 Rasiah et al., 2015a.

16 Ministry of Science, Technology and Innovation, 2013.

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