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RESEARCH, DEVELOPMENT AND INNOVATION IN MALAYSIA: ELEMENTS OF AN EFFECTIVE GROWTH MODEL

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ABSTRACT

The purpose of this paper is to examine the relationship between research and development activities in Malaysia and the country's economic growth record. In particular, the paper lays out the changes in the growth model Malaysia adopted to make the transformation from an agriculture-based to a technology-based economy, thereby moving up the value chain. Notwithstanding data sparsity, this paper makes an effort to quantitatively examine the relationship between research and development and innovation activities in Malaysia by running simple linear regressions and multiple regressions to capture the impact of these variables on the GDP per capita variations. The paper notes that Malaysia has managed to achieve significant progress in its development efforts and in transforming its economy from an agrarian-based economy into a more diversified economy with a greater role for knowledge intensive activities, research and development, and innovation. Concluding that R&D and science and technology indicators have been associated with economic development indicators, the study proposes that further research be conducted to gauge the role of public sector intervention as well as the business sector R&D and innovative activities separately, and preferably at the sectoral level, where data would probably be more available than at the national level.

Keywords: Research and development, Science and technology, Innovation, Knowledge economy, Malaysia.

Contribution/ Originality

This paper contributes to the understanding of the economic growth models which are continuously changing as technological change renders the traditional models deficient. Research and development activities have proven to be effective in generating growth and the Malaysian experience could be presented as a growth model for other Asian countries.

1. INTRODUCTION

Research and development (R&D) activity has played a central role in the advances Malaysia has been able to achieve in its endeavor to transform its economy from dependence on agriculture and exports of raw materials into a diversified economy characterized by exporting high-tech electronics and striving to become a knowledge-based economy. Malaysia has managed to stand at par with many developed countries with regard to its competitiveness through adopting science and technology policies and taking significant actions to increase the research and development infrastructure in the past three decades. The country has also witnessed a marked increase in innovative

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activity and transforming the output of R&D activities into applied patents and innovations. According to the World Economic Forum Competitiveness Report (WEF, 2015) Malaysia today ranks as the 18th most competitive economy among the 140 economies included in the report, noting that the county remains the highest ranked among the developing Asian economies. With regard to technology readiness, the country improved 13 places to rank as the 47th country in the groupings, compared with the 2014 rankings, a development that reflects the country's approaching its targets. Globally, Malaysia ranks 14 among 189 economies on the ease of starting a business (World Bank, 2016).Yet, MOSTI (2014) laments the cumbersome and lengthy bureaucratic procedures that have affected both the cost of investing, and the potential returns on investment.

This paper explores the evolution of Malaysia's economy, R&D and innovation model which aims at enabling the country to become a high-income knowledge-based economy reliant on modern technology and innovation activities. The paper also examines the relationship between research and development activities in Malaysia and the country's economic growth, in addition to examining the change in the growth model Malaysia adopted in its transformation from an agriculture-based to a technology-based economy. The first section of the paper provides a quick overview of Malaysia's development record, along with a comparative synopsis of its stock of R&D infrastructure as compared with a number of selected upper-middle income countries. Next, the paper sketches out the evolving innovation model Malaysia employs. Then, the paper uses standard statistical techniques to quantitatively examine the relationship of the country's R&D and innovation indicators with the variation in per capita income, a main indicator of change in the standards of living. The paper ends with policy implications and suggestions for further research on this topic.

2. MALAYSIA IN PERSPECTIVE

Malaysia is classified by international development organizations as an upper-middle income country with an estimated nominal GDP per capita of about US$11000 in 2015. The country is credited for achieving admirable records of social and economic development since it gained its independence from the British in 1957. According to the New Economic Model (NEM) adopted in 2010, Malaysia aims at becoming a high-income economy by 2020.

In particular, the country has managed successfully to transform its economy from an agricultural-based economy into a more diversified one with a strong manufacturing base and seeking higher value added products by becoming a knowledge-based economy.

Comparatively, in the past three decades, the country enjoyed relatively high real GDP growth rates despite the decline in the aftermath of the 1997-1998 Asian financial crises, and the downturns in 2001 and 2009, which have impacted nearly all economies. As depicted in Figure 1, Malaysia has outperformed most countries since 1970 as real GDP has grown at noticeably higher rates than world growth rates and the other country groupings, namely upper-middle income countries and East Asia and Pacific.

This favorable economic performance can be shown also when looking at the GDP per capita growth rates which have maintained a favorable level of change that is higher than that of the global average and that of many other upper-level income countries as depicted in Figure 2. The exception is the period starting in year 2003 which is due primarily to the high growth rates registered by China.

On the social front, according to OECD (2013) poverty, which was widespread in Malaysia in the early stages after gaining independence in the late 1950s' has been eradicated, except in certain pockets of the country, and the income distribution among ethnic groups has also been tackled and the gaps have been virtually eliminated.

Nevertheless, despite that labor productivity is growing, but far too slowly (NEAC, 2009) the country is still witnessing relatively high economic growth.

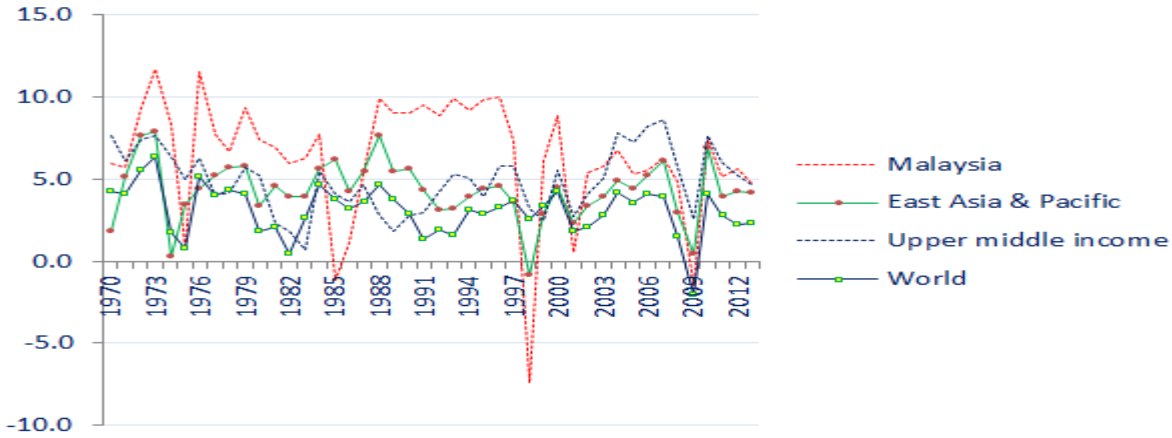

Figure-1. Real GDP (% change)

Source: Prepared by author.

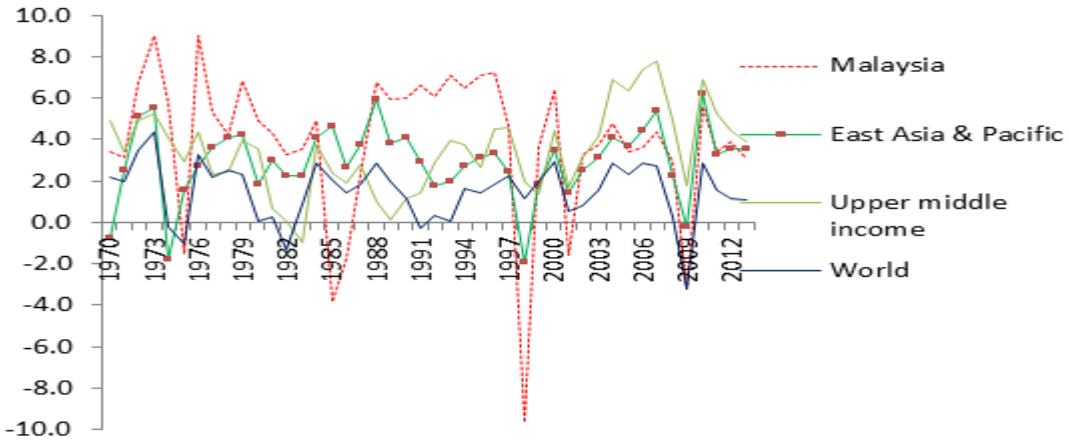

Figure-2. GDP Per Capita(constant $US)

Source: Prepared by author.

3. MALAYSIA'S RECORD OF R&D AND INNOVATION INFRASTRUCTURE

The modern development model in Malaysia assigns a great deal of importance to research and development and innovation as a main ingredient of productivity and economic success. As such, the country has embarked on advancing its innovative capabilities and promoting R&D to attain higher value-added goods and services. In particular, the Ninth Malaysia Plan (2006-2010) highlights the importance of new sources of wealth in knowledge-intensive sectors, including information and communication technology (ICT), and biotechnology. Subsequent plans laid emphasis on innovation, science and technology, R&D and improving productivity as stimuli for growth and development. These plans stressed the responsibility of the private sector in driving such activities.

The need to have a conducive institutional framework also features high on the agenda of policy makers in Malaysia as a requisite to promote technological activities. Intellectual property, for one, is recognized under the Economic Transformation Programme (ETP) of 2010 as a pillar for transforming the economy (OECD, 2013).

In line with the country's declared policy to capitalize on the utilization of advanced technology and its endeavor to foster innovation, R&D expenditures have registered significant increase, and the number of researchers and technicians involved in R&D activities has also increased. For instance, R&D expenditures as percent of GDP have steadily risen in the past two decades, registering higher growth rates than those of most other upper-middle income countries as shown in Figure 3. The domestic business sector has been increasingly contributing more and has become the largest investor in research and development with the government contributing the remaining funds.

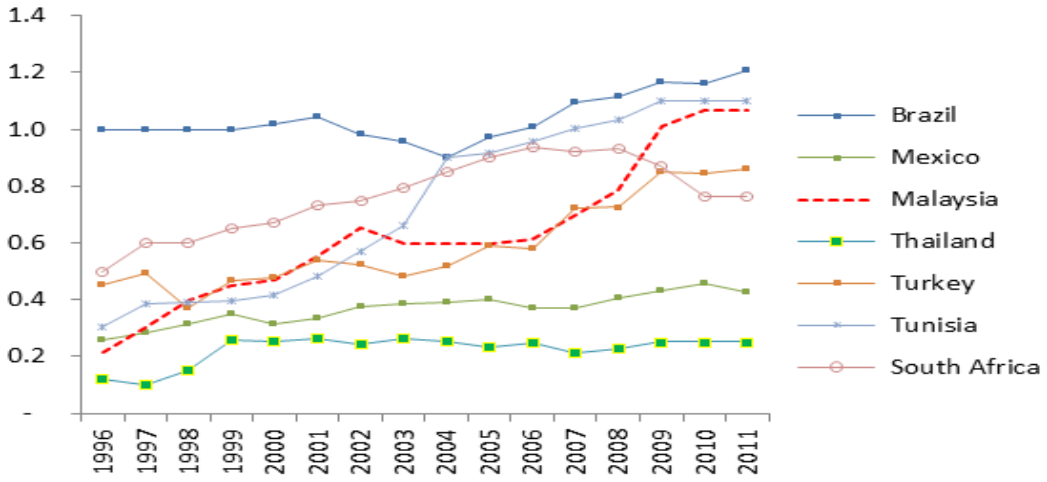

Figure-3. R&D Expenditures(% of GDP)

Source: Prepared by author.

As for the number of researchers in R&D per million people, Figure 4 shows Malaysia had only about 89 researchers in 1996 per million people, compared with about 1643 researchers in 2011. In 1996 Malaysia had the lowest number of researchers in R&D per million people among the main upper-middle income countries but the sizeable increases started in year 2008. Of this group of upper-middle income countries, Malaysia has been outperformed only by Tunisia. The number of technicians in R&D activities exhibited a similar pattern.

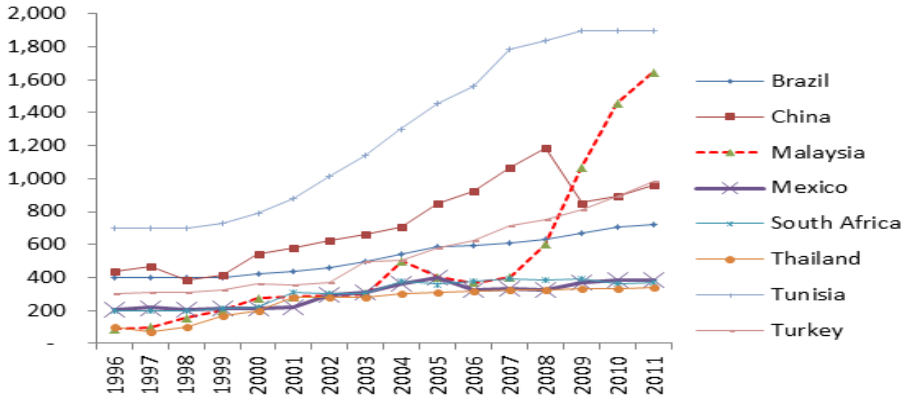

Figure-4. Researchers in R&D(per million people)

Source: Prepared by author.

On the output side of research and development efforts, patent applications have also registered evident increases since the mid 1980s amounting to about 242 patents per million people in year 2013, compared with a small fraction of that in the 1970s and early 1980's. Patents indicate the strengths of the innovation process in the economy. As Figure 5 illustrates, Malaysia leads the upper-middle income countries in this regard. However, it is noteworthy that the share of residents' patents applications is still modest compared to the non-residents share. Yet, Figure 6 shows that the share of residents' application has risen to nearly 17 percent of total patent applications in the past couple of years, compared with about 3.3 percent in year 2000, indicating more indigenous innovation activity in the country.

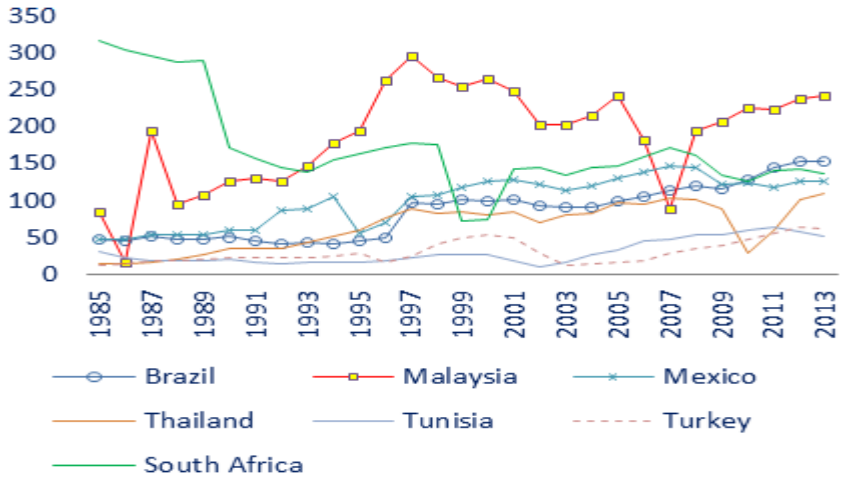

Figure-5. Patents Applications (per million people)

Source: Prepared by author.

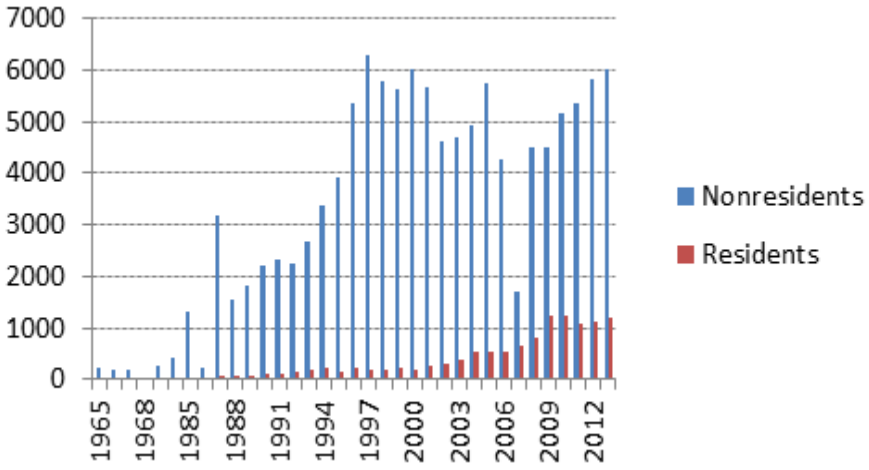

Figure-6. Patent Applications

Source: Prepared by author.

4. EVOLUTION OF MALAYSIA'S ECONOMIC AND R&D MODEL

The research and development model followed by Malaysia has evolved over the years as did the overall economic policy model which has been revised by government in response to economic development objectives of the country. In particular, the need to diversify the economic base and sources of national income necessitated that the country moves its focus from technologies that had suited its early plantation economy to technologies that can better serve and fit into a modern high value added economy.

While in the old model selected industries and firms were identified by bureaucrats and politicians and were given preferential treatment including favored financing, the new model is geared more towards technologically capable industries with firms given incentives to support innovation-driven entrepreneurial ventures.

In the early stage of its development, Malaysia's research and development activities were still based on agriculture and a number of bodies were established to promote R&D efforts on agricultural products.[1] Shah (2004) documents that at the stage when Malaysia was characterized by an agrarian economy "producing primary commodities such as tin and rubber, science and technology served as the handmaiden to agricultural development."

[1]The Malaysian Cocoa Board, the Malaysian Agricultural Research and Development Institute and the Palm Oil Research Institute of Malaysia, among others.

It is true also that the S&T policy was originally state-led and was articulated in the Fifth Malaysia Plan back in1986 and has evolved in response to the swift changes of modern information and communication technologies. In particular, on the back of adopting the Vision 2020 plan of 1991, a shift towards becoming a knowledge-based economy got underway and called for building technological capability of the country (Azizan, 2013).

It is expedient to note that some argued that the early model adopted by Malaysia did not fit the needs and particularity of its economy's needs. For instance, Daud and Shaharir (2001) lamented that the S&T model of Malaysia did not support indigenization of technology and is a copy of the Western model with the consequence that "a developing nation like Malaysia with a small export driven economy will always be at the receiving end of technology."

It is a fact that initially the industrialization setup in the country depended heavily on multinational foreign companies establishing assembly lines in Malaysia and seeking cheap labor. However, the country has since made long strides and benefitted handsomely from technology transfer of western technology. Basic research done in the developed countries still plays a major role in Malaysia as well as the rest of the emerging markets.

It is only in the early 1980s that Malaysia embarked on revamping its development model with a major shift from an agricultural-based economy to a more industrialized economy. A special chapter on S&T first appeared in The Fifth Malaysia Plan (1986-1990) indicating Malaysia's drive to making science and technology an integral part of the country's overall development process and its intent to develop its growth model.

As a result, a new era started in the early 1990's with greater emphasis on diversification and privatization and undertaking large infrastructure and high-tech projects. This new development model, according to Daud and Shaharir (2001) "is a mixture of classical, neo-classical, Keynes and modern models, which involved the generation of wealth through foreign direct investments and imported high technology."

In subsequent plans, particularly the Malaysia Plan 1991-1995 and Malaysia Plan 1996-2000, R&D was aligned to industrial priorities as outlined in the successive industrial plan, the National Plan of Action for Industrial Technology Development, and the Malaysian Industry-Government Organisation for High Technology (MIGHT). MIGHT aims at fostering Malaysia's economic growth through the accelerated use of high technology and nurturing high-tech industries via catalytic interventions programmes; its membership include private and public sector enterprises who represent the industry, government and academia (MIGHT, 1993).

The Eleventh Malaysia Plan 2016-2020 still goes far in purporting the features of the new model. The plan contends that a shift shall be made from primarily focusing on national-level initiatives to innovation targeted at both the enterprise and societal levels (EPU, 2015) thereby broadening the scope of innovation and commercialization efforts. Chart 1 epitomizes the evolution of Malaysia's Transformation model.

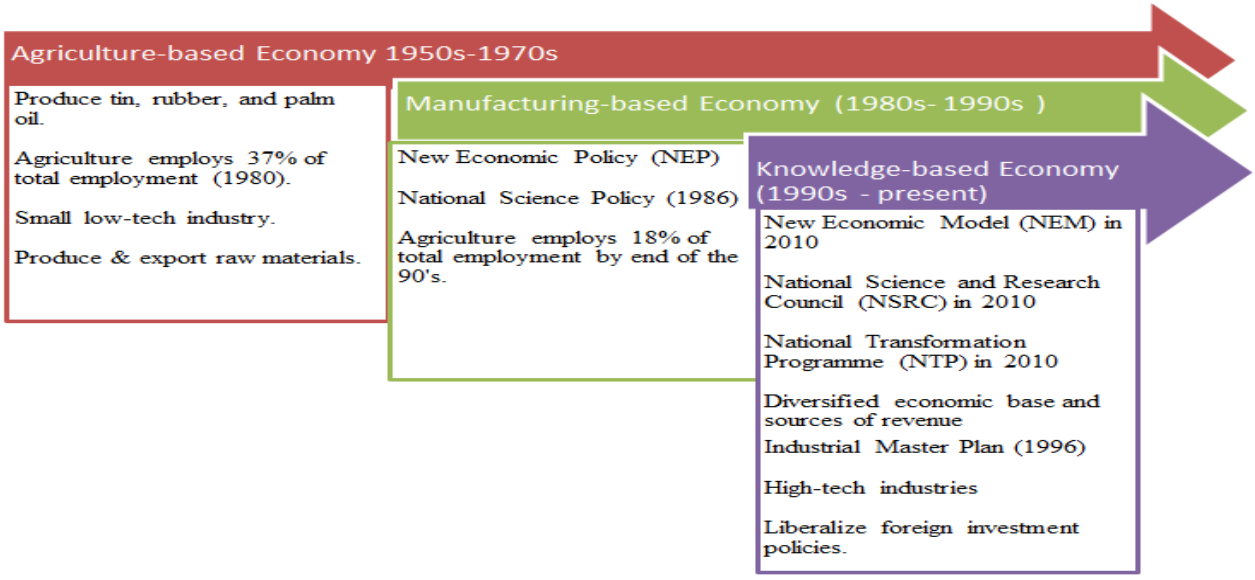

Chart-1. Malaysia Economy's Transformation Model

Indeed, recognizing the need to keep improving the transformation model constantly dates back at least two decades ago when the NEAC (2009) asserted that "many of the policies and strategies we used to achieve the current state of development are now inadequate to take us to the next stage." In this respect, a number of major issues were identified as essential to the new model, including (a) enhanced institutional framework, (b) more investment incentives, (c) better human capital, and (d) more private sector involvement in the R&D and innovation activities.

First, with regard to the institutional framework, OECD (2000) maintains that if governments wanted to obtain the benefits from greater reliance on R&D and innovation, they will have to put the right policies in place such as becoming a facilitator, enabling business and consumers to adapt to the demands and opportunities of the new economy, along with ensuring all stakeholders' involvement in policy design and implementation.

One important element of the institutional framework is the protection of intellectual property rights (IP) which the Malaysian government considered essential in transforming the economy. As such Malaysia set off in 2009 the process of liberalizing the rules to encourage foreign investment in the country's competitive sectors. But according to the OECD (2013) despite strengthening IP rights through the National IP Policy and the creation of IP courts, weak enforcement of IP rights still constitutes one of the investors' complaints.

The improvement with respect to IP was noted more recently by PwC (2014) which asserted that "Malaysia's intellectual property laws are in conformity with international standards and provide protection to local and foreign investors."

On its part, the Tenth Malaysia Plan (2011-2015) committed to more institutional change and a better regulatory environment to promote innovation especially by knowledge-based small enterprises and promised more public investment into the enablers of innovation such as venture capital firms. Other forms of support noted by the Plan include co-funding for R&D endeavors, small and medium knowledge firms, and more collaboration between Government-linked Companies (GLCs) and the private sector.

Second, with regard to encouraging investment in R&D and innovation and creating a better incentive system, PEMUDAH was established in 2007 to facilitate the ease of doing business in Malaysia and reduce costs and eliminate red tape, among other goals (PEMUDAH, 2014).

Further, a host of incentive programs have been offered to encourage private companies to participate in the innovation process. The MASTIC (2015) lists five incentives, namely research and development grants, industrial and commercialization funds, loan and venture capital, STI tax incentives, and STI human resources development funds.

Generally, the knowledge-intensive service sub-sectors have been given a boost as government has accelerated liberalizing rules for foreign investors in these sectors since 2009 (OECD, 2013) and also technology-intensive manufacturing industries have been given special incentives with market liberalization playing a significant role in positioning Malaysia in a position to attract foreign investment capital (PwC, 2014).

This incentive system and the investment-friendly policies seem to have improved enough to attract foreign investors. According to Gurría (2013) Malaysia is attracting record levels of foreign investment and its companies are becoming increasingly global. In this regard, The Malaysian Investment Development Authority (MIDA) was established to lead and coordinate all investment promotion efforts with emphasis on knowledge-intensive projects characterized by high value-added technology products (OECD, 2013).

Malaysia's New Economic Model (NEM) rests on eight Strategic Research Initiatives (SRIs) one of which is building Malaysia's knowledge-base and infrastructure; and in order to encourage investment, this model promotes technology upgrading, the creation of a knowledge-economy, and "move up the value-chain by emphasizing technology-intensive methods of production and by relying on innovation and research and development" (Nambiar, 2010).

Third, with regard to the human capital element of the new model, it does not seem that the commitments to upgrade the skills of human resources have borne significant fruits yet. Though the new model acknowledges the need for improving the education system at all levels and that noticeable focus was noted in the Ninth Malaysia Plan (2006-2010) with regard to developing human capital capabilities in science and technology, improvement on this front has not been satisfactory to the extent that some argue that the inadequate human capital and the insufficient skilled workforce are hindering the country's higher growth potential and the achieving of the goal of becoming a knowledge-based economy. It is argued that human capital is not improving as required, threatening Malaysia's growth objectives and that not enough has been done to remedy the labor-market mismatch with the economy's needs (Nambiar, 2011) and mismatch between labor supply and demand (OECD, 2014a). (OECD, 2014)

Constraining economic growth is not the only likely casualty of such a mismatch. The shortage in skilled human resources still constitutes one major impediment even to further R&D development (Azizan, 2011; MOSTI, 2014; OECD, 2015). Lamenting the inadequate skilled human capital supply, Azizan (2013) stresses the importance of having sufficient supply of human capital as a critical factor in to long-run technological enhancement and that estimates show that Malaysia will need 500,000 skilled workers by 2020.

The need to improve human capital is all the more important in view of the need of multinational corporations (MNCs) technology-related skills as they formulate their entry strategy to markets. In addition to the MNCs need for such skilled labor, sufficient human capital is a requisite to meet the needs of local firms seeking high-tech skills.

This shortcoming in the new model alerted government officials who pledged recently to focus on developing the ability and talent to knowledge creation and value-generating R&D activities, in particular in science, technology, engineering and mathematics subjects (Razak, 2015).

Fourth, with regard to private sector involvement and greater cooperation among all stakeholders, the new model envisions a greater role of R&D and innovation by the private enterprises, in collaboration with the government and research centers. In particular, the new model envisages a services sector, with emphasis on knowledge-intensive activity, and this sector is being targeted by government to contribute 60 percent of GDP by year 2020 (PwC, 2014). Minister of International Trade and Industry Mustafa Mohamed (Mohamed, 2015) asserts that "the private sector will continuously step up efforts to invest in technology, pursue productivity, nurture innovation and talent."

Thus, the new model emphasizes collaboration between the government and the private sector, with special role to the massive government-linked companies (GLCs) as stated in the Tenth Malaysia Plan (2011-2015). This

cooperation necessitates more investment in research and development and fostering innovation, through Malaysia's GLC Transformation Programme.

Further, the aforementioned SRIs purports the creation of an ecosystem for entrepreneurship, and fostering research and development links between higher education institutions and the private sector, while at the same time consolidating government R&D funding, and align R&D to national growth objectives particularly in innovative and hi-tech fields (NEAC, 2009).

In 2010, responding to the need to align S&T activities through an effective network of all government research institutes and facilities, the National Science and Research Council (NSRC) was established as a platform to provide long range scientific advice in order to improve the governance of R&D and drive the country's transformation into Knowledge – and Innovation-led economy (Pillai, 2011). Further, cognizant of the importance of wider cooperation, MOSTI[2] established the Malaysian Technology Park to foster coordination and collaboration among the private enterprises, universities, and the research community, at large.

According to the Eleventh Malaysia Plan 2016-2020 (EPU, 2015) intensifying collaborative efforts in R&D and commercialization among government, industry, and academic research centers shall be promoted by promoting activities in economic clusters to ensure industrial sustainability.

Chart-2. Malaysia R&D, Innovation, and Growth Model

5. RESEARCH METHODOLOGY AND FINDINGS

5.1. R&D and Innovation's Impact on Economic Growth

Studies on the impact of R&D on economic performance are ample with abundant academic research confirming its positive impact on economic growth and the development process (Soete, 1981; Bhalla and Fluitman, 1985; Teitel, 1987; Bassanini and Stefano, 2001). Mohamed (2013) highlights the central role innovation plays in achieving sustainable and balanced growth and the transition into a higher value-added and higher income economy.

Referring to empirical evidences that countries with substantial R&D expenditure experience steady and sustainable economic growth in the long-run, MOSTI (2014) reports that both economic theory and empirical

[2]Ministry of Science, Technology, and Innovation.

evidence suggest that R&D creates technological innovation, improves existing stock of knowledge, increases the quality of human capital, and leads to higher productivity and sustainable economic growth in the long-run.

On its part, MASTIC (2014) considers STI as the basis for economic growth and for modern societies to pursue developmental objectives. OECD (2009) asserts that technological change drives long-term economic growth, productivity and improvement in living standards.

Studying the dynamics of Bejing, Hongfu and Shiyun (2013) conclude that technological innovation and science and technology is an important source for economic development, and is a main factor of national, regional and enterprise core competitiveness. Shrivastava *et al.* (2015) also concludes that technological innovation can be highly instrumental in achieving sustainable development.

Some have claimed that R&D has two 'faces', since in addition to the conventional role of stimulating innovation, it enhances technology transfer by improving the ability of firms to learn about advances in the leading edge (Griffith *et al.*, 2001).

Relevant research by Ulku (2004) confirms a strong positive relationship between innovation (patent stock) and per capita GDP in both OECD and non-OECD countries. This is echoed by an OECD (2000) holding that the rapid application of recent scientific advances in new products and processes, a high rate of innovation across OECD countries, and a shift to more knowledge-intensive industries and services imply that science, technology and innovation are now key to improving economic performance and social well-being.

As for the impact of science and technology some researchers find a positive impact on social indicators, as well. For example, Watson *et al.* (2003) argued that S&T have been central in the progress made to date not only in stimulating economic growth but also in the fight against poverty. World Bank (2003) research also maintains that science and technology efforts are critical inputs for economic development and poverty alleviation.

It is expedient to note also that with regard to the causation between economic growth and research and development activities some research suggests that economic growth is what promotes S&T activities. For instance, the research findings of Bozkurt (2015) indicate that there is a unidirectional causal relationship running from economic growth to R&D and not vice versa.

Shah (2004) concurs with this notion arguing that unlike the case of developed countries where economic development drives science and technology and R&D development, the case in Malaysia is different; he concludes that "Malaysia's industrial R&D is still at the stage of infancy and provides more towards infrastructure and capacity-building, rather than adding value to economic production."

At any rate, little academic research has been conducted on this topic on Malaysia. For one, the OECD (2015) contends that the Malaysia's goal of becoming a high-income country by 2020 can only be realized with aid of more innovation-driven growth. In a study on the impact of ICT on Malaysia's aggregate output in the period 1965-2005, Ramlan and Ahmed (2010) conclude that the findings of the study suggest that there is a causal relation between ICT and aggregate output in the country.

6. METHODOLOGY

To assess the impact of research and development and innovation activities on growth, this section will use a standard regression model of growth on proxy variables of R&D and innovation. In particular, the standard statistical technique is used to detect the presumed association between real GDP per capital in Malaysia and the regressors, gross expenditures on research and development (GERD) as percent of GDP, researchers in R&D per million people, technicians in R&D per million people, and patent applications per million people.

MOSTI (2012) maintains that innovation is measured indirectly by proxies including R&D and patent-based indicators and documents that this practice of using R&D can be traced back to the 1930s and that the use of patents

was established in the 1950s. MOSTI shows that the use of direct measures of innovation has become increasingly popular since the late 1970s.

Our data is extracted from the World Bank's World Development Indicators (WDI) online database. Some missing data was estimated based on respective trends of each country and variable. Data for the explanatory variables for Malaysia are reported only since 1996, except for the patent applications variable whose data was sporadic in the database. The availability of data for only such a short period of time limits the model's predictive power.

The preparatory steps before estimating the model showed strong multicollinearity among independent variables. In particular, multicollinearity tests and visual examination of scatterplots between variables showed a strong linear relationship between the variable "number of researchers per million people" and R&D expenditures and number of technicians per million people, as shown in table 1.

Table-1. Correlation Table

	Patent applications	**Researchers (per million people)**	**Technicians(per million people)**	**R&D expenditures (% of GDP)**
Patent applications	1			
Researchers (per million people)	-0.202	1		
Technicians (per million people)	-0.205	0.953	1	
R&D expenditures (% of GDP)	-0.458	0.920	0.854	1

Accordingly, the only two independent variables that we included in the regression model are patent applications and number of researchers per million people. The regression is based on data series from 1996 to 2011, since this is the period for which data is available for the "number of researchers" variable. The results of the regression reported in the Regression Statistics Table show that R^2 is 0.852, indicating that the independent variables explain nearly 85 percent of the variations in the GDP per capita.

The Regression Coefficients Table shows that the variables "patent applications" and "number of researchers per million people" have *p*-values of 0.002 and 0.000 respectively, indicating significance at the 95% confidence level. However, and contrary to the expected result, the regression coefficient of the patent applications variables is negative, meaning that this variable is negatively correlated with the dependent variable.

According to the findings the equation would read as follows:

$$\hat{Y} = 6190.25 - 6.11\beta_1 + 1.1\beta_2$$

Where $\beta_1$and β_2 refer to patent applications and number of researchers, respectively.

But luckily, unlike the other independent variables, the data for the patent applications variable is available for a longer period of time in the World Bank database though sporadically since 1963. In all, there are 35 observations for this variable on which a scatterplot was made, which reversed the pattern shown in the previous model. As depicted in Figure 7, the longer series for this variable shows a positive linear relationship with GDP per capita.

Further, by running a simple linear regression of patent applications and per capita income, the results show a reasonable explanatory power (R^2= 0.64) and a positive coefficient with high significance (*p*-value = 0.0000).This finding is more in line with theoretical arguments that innovation activity and commercialization of R&D and inventions have a positive impact of economic development.

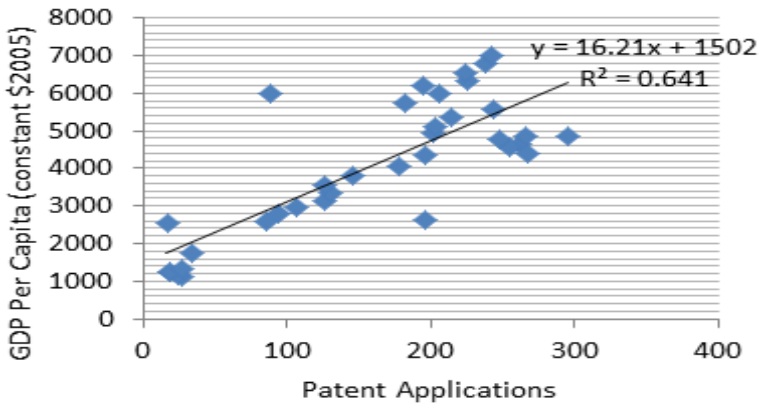

Figure-7. Patent Application

Source: Prepared by author.

As a consequence, it can be argued that the multiple regression presented earlier may generate differing results had data been available for longer periods of time for the other explanatory variables. Under such conditions, a conclusive evidence of the true impact of suggested regressors on the income per capita in Malaysia may not be at hand.

7. CONCLUSION AND POLICY RECOMMENDATIONS

Malaysia, an agricultural economy in the 1950s, is now pushing out its technology frontier and shaping the regional dialogue on numerous policy fronts, including science and technology (Gurría, 2013). As the economy moved beyond low labor costs, other drivers of growth like technology, research and development and innovation became increasingly staples of the development process (ETP, 2012). According to new economic policies, investment promotion is being geared towards capital and knowledge-intensive projects, offering high value-added and high technology (OECD, 2013).

Malaysia has managed since independence in 1957 to shift away gradually from an agrarian economy and increase the level of R&D and technology related activities. Nonetheless, more needs to be done in this regard as the most effective model would require not only establishing a science-literate society that uses advanced technologies but creating a culture of science and technology across the country. Aman (2008) stipulates that Malaysia must strive to achieve a society that not only creates scientific knowledge, but also converts it into practical technologies and innovations for socio-economic development of the nation.

Contending that R&D and science and technology indicators have been associated with economic development indicators, the study proposes that further research be conducted to gauge the role of public sector intervention as well as the business sector R&D and innovative activities separately, and preferably at the sectoral level, where data would probably be more available than at the national level.

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