A Comparative Study on the Electronics Industry of the Philippines and Malaysia

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Abstract

Despite the elimination of tariffs on ICT-related products by the Information Technology Agreement, the gains from trade among countries have not been equal. On average, the electronics sector has contributed 25% of the total exports of the Philippines, making it a key driver in the country's economic growth. This study attempts to compare the economics experiences of leading electronics manufacturers in ASEAN, Malaysia and Philippines. Also, this study assess how much domestic political and economic structures affect the attraction of foreign direct investment and the quality of research and development in the industry as well as to formulate feasible ways to enhance the competitiveness of the Philippine electronics sector. The aspects explored in this research are based on Michael Porter's Diamond Theory which is composed of government, firm structure and rivalry, demand conditions, factor conditions, and related and supporting industries. Interviews were conducted among government officials, country representatives, the academe, and firms. The government policies affect Foreign Direct Investments and both can affect the Research and Development of the industry that can lead to innovation and growth and by that it will affect the Global Value Chain that presumes the strength and stability of the industry. By identifying which policies have contributed to the competitiveness of Malaysia, such policies may be emulated by the Philippines to achieve similar results. This will allow for more development and cooperation with the government and multinational companies and may direct future research on the electronics trade of the Philippines.

Keywords
Electronics Industry; Global Value Chain; Philippines; Malaysia

1. INTRODUCTION

Global Electrical and Electronics (E&E) business is expected to expand reaching up to 3 trillion dollars by 2020 from the report of The Business Research Company entitled, Electrical and Electronic Manufacturing Market Briefing 2017 [1, 2]. The Asia Pacific would be the largest market throughout the regions with China being the biggest market among the countries [3]. Electronic industry is expanding especially with the development of technologies and consumer demands on new technological equipment.

Especially with the trade liberalization, the global trade in electronics was said to have grown exponentially. The Information Technology Agreement was established with the Ministerial Declaration on Trade in Information Technology Products (ITA). 14 States have agreed upon on 13th December of 1996 at the World Trade Organization (WTO) Singapore Ministerial Conference. According to Tang [4], the benefits and implications of the ITA are the elimination of customs tariff, lower costs to consumers and importers, cheaper inputs for exporters of sophisticated technological products, improvement in productivity and efficiency, and lastly, the creation of a global market, production networks, and supply chains. The Philippines became a signatory on April 1, 1997.

Electronic and electrical equipment took an important part in the economy since the 1970s and in the foundation of Philippine's exports up to the present [5]. From 1996 to 2017, the Electronics sector accounted for an average of 52% of the total exports from the Philippines. The industry includes semiconductors and other components, electronic data processing equipment, office and telecommunications equipment, cellphone, other communication apparatus, and medical, automotive, and other consumer electronics [6].

Some of the Multinational Companies (MNCs) in the Philippines are in the top 20 chipmakers in the world like the Texas Instruments, Philips, Fairchild, Analog, Sanyo, On Semi, and Rohm. Also, four well-known largest hard drive producers have a base in the Philippines. Those MNCs are Hitachi, Toshiba, Fujitsu, and NEC [7]. Also, Electronics industry is an important source of employment for the labour-intensive assembly and test manufacturing nature of the electronics firms [8].

Therefore, this study aims to assess how the domestic determinants such as government policies and research and development methods have given rise to the competitiveness of the electronics industry of Malaysia compared to that of the Philippines and to analyse what are the possible ways in which the Philippine Electronics industries may be more competitive. Malaysia's electronics industry roughly began at the same time in the 1970s as the Philippines and their industry has consistently risen since; while the Philippine industry has experienced continuous growth, it has not fully transcended the realms of low-skill production such as assembly, testing, and packaging. Both countries are long-time electronics producers in the region, however, the Philippines must be able to increase competitiveness through investing in high-skilled production and research and development to keep with global trends and compete with rising electronics producers in ASEAN, such as Vietnam.

1.1 Conceptual Framework

This study focused on the government policy, which might affect the Foreign Direct Investment (FDI) in the country. Figure 1 demonstrates the government policy itself, sometimes with the foreign direct investment affects research and development of the industry. The country's innovation and growth of the industry depend on the Research and Development. With innovation, the Global Value Chain (GCV) of the country would shift to a higher position. Ultimately, the degree of GCV presumes the stability and strength of the industry.

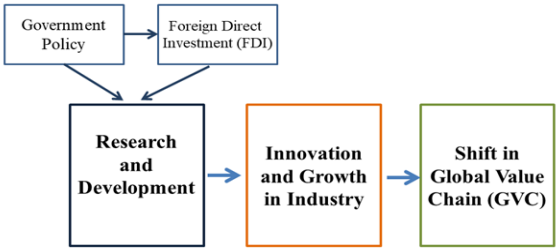

Figure 1. Conceptual Framework

2. METHODOLOGY

This study applied the exploratory design. The research design focuses on knowledge to gain information and to understand for later investigation use especially concerning the initial stage of the investigation. This study focus on the research and development of the electronics industries for the industries comprise about 50% of export. Moreover, the focus is also on improving insights and understanding for better investigation or undertakings. Exploratory designs are often used to establish an understanding of how best to proceed in studying an issue or what methodology would effectively apply to gather data.

2.1 Research Site

The Board of Investments of the Department of Trade and Industry and the Malaysia External Trade Development Corporation (MATRADE) at Embassy of Malaysia in Makati City, the Philippine Trade Training Center in Pasay City, the University of the Philippines- Diliman in Quezon City, the Department of Science and Technology-Electronic Product Development Center and the Vishay Intertechnology in Taguig City were served as the research site. It was intentionally selected for the following reasons: (1) BOI is the lead government agency which is responsible for the investment and its promotion in the Philippines while the PTTC is responsible for conducting training for firms belonging to various sectors; (2) MATRADE is Malaysia's national trade promotion agency and thus would equip to answer the research questionnaire regarding Malaysia's electronics industry; (3) Vishay Intertechnology was chosen because it is a global industry leader in technology and is responsible to provide mechanisms to new macroeconomic growth drivers such as connectivity, flexibility, and sustainability; (4) the University of the Philippines-Diliman is one of the leading producers of electronics and communications engineering graduates in the country; and (5) The Electronics Product Development Center is a facility spearheaded by Department of Science and Technology where students and companies can use various software and equipment in designing and developing electronics and electronics-related materials.

2.2 Respondents

The respondents of this study are selected trade officers from the agencies of the Department of Trade and Industry, representatives from ICT and electronics manufacturing firms, officers from the DOST-Electronic Product Development Center, and academics. The reasons of chosen these respondents are: (1) they work within the divisions concerned with investments promotion, research and development, and electronics education; (2) they are knowledgeable about the trade policies, current economic undertakings, the opportunities and challenges of the electronic industries in both Malaysia and the Philippines.

2.3 Sampling Technique

It is important to have sampled in a study because it can impact significantly on the quality of the study's findings or results [9]. Therefore, purposive sampling is applied in determining the respondents from Trade officers and semiconductor manufacturing firms, officials of the Department of Trade and Industry, Board of Directors, economists, information and communications technology (ICT), industry representative, the private sector, business associations and, academics for the interview. The respondents were tactically selected for their respective participation in the study based on their information and knowledge on this study which will be useful in providing an in-depth understanding of the research topic.

2.4 Research Instrument

This study used an interview schedule as the research instrument for the qualitative analysis. The interviewee provides the needed information orally and face-to-face [10]. The interview schedule includes questions parallel to the statement of the problem.

2.5 Data Collection

The study utilized a semi-structured interview with the selected respondents. It includes several planned questions. Furthermore, interviews are advantageous because it is more appropriate for complex situations, useful for collecting in-depth information by probing, information can be supplemented, and that questions can be fully explained by the interviewee [11]. Smartphones and recorders were used to record the audio of the interview with the consent of the interviewees. To validate the feedbacks from the experts of the selected respondents, interviews were done to achieve a triangulation.

2.6 Data Analysis

Qualitative analysis was used in this study. The gathered data were analysed according to the recurring themes in the present interviews.

2.7 Theoretical Framework

A modified Michael Porter's Diamond Model was used in this study to explain the differences of Global Value Chain (GVC) of Electronics in Malaysia and the Philippines. This diamond-shaped framework focused on why certain companies within a nation are competitive internationally, where others might not. In this study, it was used to know why certain nations are more competitive compared to the others. It also explained the differences in capability of consistent innovation and competitiveness. Michael Porter argues that interrelated sets of conditions the nations possess are namely: Firm Strategy, Structure, and Rivalry; Factor Conditions; Demand Conditions; and Related and Supporting Industries. The industry will likely to develop and prosper if the factors are in favourable conditions.

3. RESULT AND DISCUSSION

The data acquired from the interviews were analysed after a series of interpretation procedures. After a series of data consolidation and verification through consultations with industry experts, the results are categorised and presented in these four main section, Information Technology Agreement (ITA): A Key Driver of Growth, The Malaysian Experience, The Philippine Experience, and The Philippine Electronics Industry: Looking Forward.

3.1 Information Technology Agreement (ITA): A Key Driver of Growth

The Information Technology Agreement is often credited for increasing the volume of the global trade in electronics. The ITA was expanded to include 217 electronics and electronics-related products which are going to be granted zero tariffs. The Agreement went into force roughly twenty years ago in 1997 with 29 WTO member countries and now it has 74 signatories, nearly half of which are developing countries. All these countries have the potential to become and are already key players in the electronics industry. The question that matters in this discussion is whether the ITA has been a key driver in the growth of the electronics industries of Malaysia and the Philippines. The two countries have major product clusters that range from computers, semiconductors, software, telecommunication equipment, scientific instruments, and equipment for semiconductor testing and manufacturing.

Much of the literature on the benefits of ITA reiterate that tariff elimination on a larger range of products encouraged the increased use of ICT products (whose products have been lowered due to zero tariffs) which bolster the growth of economies and have bolstered the growth of developing countries such as Malaysia and the Philippines. Both countries do emphasize that while ITA did provide for most ICT products to be tariff-free but the trade liberalization achieved through the ITA has neglected the numerous differences between member countries. It does not take into account the structural and systematic differences each country has. Different countries implement different economic policies, have different political mechanisms that make business transactions streamlined and thus their capabilities to gain much from trade must be expected to vary.

For Malaysia, the ITA has helped facilitate the liberalization of trade to Malaysia but not necessarily the growth of trade for their electronics industry. Malaysia credits the growth of their industry to the proactive cooperation between the government and the private sector. The Malaysian government through its agencies such as MIDA, MITI, and MATRADE has been consistently looking for opportunities to better equip domestic industries and to attract FDI. Through thorough industrial plans as evidenced by the three Industrial Master Plans and the recently-launched Industry 4.0 or Industry 4WRD, Malaysia shows that it is very much capable of doing business in the 21st century. With this new initiative, Industry 4WRD aims to increase the number of highly skilled workers, increase innovation and have higher global innovation rankings, and increase the contribution of the manufacturing sector to the Malaysian economy. The effect of the ITA is observed to be minimal.

Similar sentiments have been enunciated by respondents from the Philippines. The trade gains from ITA benefitted some domestics firms because of the increased demand from MNCs due to zero tariffs on ICT products but this growth did not necessarily bolster the growth of innovation and R&D in the country. Technology transfers that have taken place between MNCs and domestic firms are minimal and are done mostly for the domestic firm to be able to produce the required product of the MNC, using the exact specifications and following specific standards. It was recommended by the respondents that the ITA should also provide for a harmonized standard for ICT products, thus providing equivalence on quality standards. Standards are said to be one of the leading non-tariff barriers that often discourage domestic firms to export their own products. Some respondents posited that the ITA did little to benefit domestic firms in the Philippines in terms of encouraging R&D and bolstering the growth of the industry since the country has been a hub for processes that require medium-level skills, as there is a concentration on assembly, testing, and packaging activities.

Thus, the ITA has paved the way for a greater increase in global electronics trade but it was not the catalyst for the growth of the electronics industries of Malaysia and the Philippines.

3.2 The Malaysian Experience

What began as an industry focused on providing the domestic market with final goods, Malaysia's electronics industry has transformed itself into the strongest producer of consumer electronics and high value-added, smart devices in the Southeast Asian region, with a focus on export-oriented industrialization. Much has changed since the early days of the country's electronics sector which took speed in the 1970s upon the entry of multinational corporations namely Advanced Micro Devices, Helwett Packard, Clarion, National Semiconductor, Intel Electronics, and Robert Bosch in Penang. During the early 1970s, only 36% of the labour force in the manufacturing sector was employed in the electronics and electrical sector. In 2017, the electronics exports were valued at RM 343 billion or US$84.5 billion and contributed 36.7% of the country's overall exports in manufacturing [12]. In the same year, the country was able to attract the greatest amount of FDI (84.5%) which came from Japan, Germany, Singapore, and the Netherlands, which is valued at RM 8.2 billion. Today, Malaysia employs 526,000 workers in the electronics sector. The electronics and electrical industry is very instrumental to the Malaysian economy, because more than 60% of the country's trade is in the import and export of electronics and electrical [13].

The respondents agree that the government policies and incentives, infrastructure, and the robust influx of foreign direct investment have led to a strong R&D culture, which is evident in the Malaysian electronics industry. This ecosystem of external factors has greatly contributed to Malaysia's movement along the global value-chain from the labour-intensive back-end production to high-end manufacturing which is capital-intensive.

This section aims to bring into light an array of government policies and agencies that have cultivated a healthy ecosystem for the electronics industry to prosper, the research and development initiatives that are being propagated in Malaysia, and a Porter's Diamond analysis of the current state of the Malaysian electronics sector.

3.2.1 Government policies and agencies

The visible hand of government in Malaysia's economic progress has consistently been evident, from the conception of the domestic electronics industry in 1965 upon the entry of Japanese MNC, Matsushita Electric, to the creation of laws that birthed agencies such as the Malaysian Investment Development Authority, and to the consistent attraction of foreign direct investments to the country. It is evident that government has spearheaded the creation of vast infrastructure to support and promote trade as well as incentives to attract and retain investors, especially in the electronics industry.

In 1958, Malaysia promoted its domestic manufacturing through the passing of the Pioneer Industry Ordinance (PIO). The law's primary purpose was aimed at stimulating self-reliant or economic independent manufacturing which would prevent substituting imports. Thus in 1965, Matsushita Electric relocated its operations in Malaysia

and became the country's very first electronic firm. Rasiah [14] posits that because the country has a relatively smaller local demand, it's "the screwdriver industries that were begun during this phase stagnated by 1965, by which time the Malaysian Industrial Development Authority (MIDA) was launched to spearhead industrial promotion". Also, the Investment Incentives Act enforced in 1968 set the foundation for the country's export orientation and conditions. A year prior to that, labour regulations happened to be constricted thus limiting the involvement of labour unions through executing amendments on the 1967 Industrial Relations Act. Since the later years of the 1960s, "export-oriented foreign multinational corporations relocated assembly and processing activities as they were seeking to relocate labour-intensive operations to countries endowed with a surplus of trainable labour" [14].

In 1970, the New Economic Policy Act, which aimed to generate employment and boost economic growth, was enforced. This was the first policy that heavily attracted FDI to Malaysia. Coupled with the Investment Incentives Act of 1968, the New Economic Policy Act birthed free trade zones (FTZs) in Ulu Klang and Sungei Way and paved the path for the creation of FTZs in Perlis, Kedah, and Johor Tenggara [15]. The export-oriented economy Malaysia would not have been possible without the investments by the United States of America and Japan.

Malaysia took necessary actions to boost its economic competitiveness through instituting industrial policies which aim to aid the growth of the country's manufacturing industry, more specifically in the field of electronics manufacturing. Industrial policies have played a colossal part in changing the landscape of the Malaysian economy from it being reliant on the raw materials sector to one reliant on manufacturing [16]. Since 1986, Malaysia has instituted three industrial plans which have consistently led its policies and the country's policymakers.

The Ministry of International Trade and Industry (MITI) developed the First Industrial Master Plan (IMP1) of 1986-1995. It had been devised with three principal objectives in mind: to ensure economic progress by bolstering the manufacturing growth, by promoting the efficient utilization of Malaysia's resources by engaging in value-added manufacturing activities, and by establishing the cornerstone for enhancing domestic manufacturing and technological capabilities [17]. This was initiated through the provision of fiscal incentives which were designed to attract FDI to the country by the 1986 Promotion of Investment Act. Consequently, to stimulate an increase in FDI influx, the Investment Tax Allowance and Pioneer Status were created. Firms that achieve Pioneer Status enjoy an exemption on taxes for five years upon 70% of their income. Similarly, the Investment Tax Allowance gives firms and investors a 60% exemption on taxes for five years. In line with the rules surrounding equity ownership, FDIs have 100% ownership provided that at least 80% of their products are manufactured specifically for the export market [18].

Furthermore, firms engaged in manufacturing are also awarded a Reinvestment Allowance (RA) when they "reinvest for the purposes of expansion, automation, modernization or diversification into any related products within the same industry on condition that such companies have been in operation for at least 36 months" [19]. Under the conditions presented under the Reinvestment Allowance program, manufacturers are awarded a 60% tax allowance on their capital expenditures and if their reinvestment has been significantly higher, they are awarded a 100% exemption on taxes [20].

The RA proved to be a significant incentive which ensured the growth of the manufacturing, specifically the electronics industry of the country despite numerous competitors and challenges in the global economy. Thus from 1987 to 1992, Malaysia experienced an increase in the net flow of long-term capital. It must be noted that FDI fell from 1993 to 1995 since the global economy slowed down which checked the capital influx to other developing countries. In 1995, the pace of the country in gaining FDI and private investment took speed, but the economy was then heavily affected by the 1998 Asian Financial Crisis wherein the Malaysian ringgit took a hard-hitting [21].

In the past two decades, the Malaysian government was able to formulate and implement two Industrial Master Plans which greatly contributed to the growth and evolution of the manufacturing industry. IMP1 provided the groundwork to spur the manufacturing industry in becoming a prominent economic contributor and IMP2 provided for the advancement of manufacturing through "strengthening industrial linkages, increasing value-added activities and enhancing productivity" [20]. Implemented from 1996 to 2005, the Industrial Master Plan 2 (IMP2) aimed to advance the industrialization of the country by 2005 by implementing the concept of "Manufacturing + Strategy". IMP2 has two main objectives which are to move up the value-chain and drive productivity by advancing Malaysian human capital [20]. The IMP2 can be best understood through two of its key policy thrusts: cluster-based industrial development and manufacturing plus-plus strategy.

The Manufacturing Plus-plus strategy is imbued with the purpose of expanding along the value chain to incorporate activities which are high value-added and to boost total productivity by uplifting and revamping the entire value

chain. Malaysia began its electronics industry in the fields of testing and assembly which is at the bottom of the value chain, thus the country poured so much of its efforts in strengthening its R&D, integrated circuit design, electronics product development, marketing, and distribution. Such activities are highly vital for they are the ways through which a country's industry can go up the value chain. On the other hand, the Cluster-based Industrial Development initiative redefines the term industry. MITI [16] defines a cluster as "an agglomeration of inter-linked or related activities comprising industries, suppliers, critical supporting business services, requisite infrastructure, and institutions". As a result, eight clusters were created comprising of chemicals, electronics, food processing, machinery and equipment, materials, resource-based industries, and transport equipment [16]. Clustering the industries was believed to have increased the country's total factor productivity because capital-intensive manufacturing and the use of new technologies to efficiently utilize resources were emphasized.

Recently in November 2018, the Malaysian government launched a national policy called Industry 4.0 or Industry 4WRD. It aims to transform the manufacturing sector, Malaysia's biggest GDP contributor, into one that is going to be prepared to keep up with the demands of the Fourth Industrial Revolution. Industry 4WRD aims to make Malaysia a strategic participant in the development of smart technology and high-technology industries and a total solutions provider in its manufacturing sector [22].

3.2.2 Research and Development Initiatives

Innovation in Malaysia continues to blossom, as evidenced by its high rank in the Global Innovation Index (GII) 2018, a report published by the World Intellectual Property Office, Cornell University, and Institut Européen d'Administration des Affaires (INSEAD). The country was ranked 35th out of 126 countries, based on 80 indicators which explore a broad spectrum of innovation, which includes political environment, education, and infrastructure and business sophistication. Malaysia's strengths as identified in the GII 2018 include high levels of tertiary education (rank 15) which has led to the high number of graduates in science and engineering (rank 4), high market capitalization (rank 6) and ease of protecting minority investors (rank 4), high levels of university-industry research collaboration (rank 11), as well as high levels of high-tech net imports and high-tech net exports (rank 1).

The visible hand of government has clearly left its mark upon the country's mainline industries, specifically that of electronics. Despite having a liberal free-market, it is worth noting that government policy and intervention critically fashioned the Malaysian economic landscape because of its first-hand involvement in the economic affairs of the nation through instituting generous incentives for businesses, setting up FTZs and LMWs, providing research grants in engineering and other sciences, as well as attracting both local and foreign investors. Furthermore, the government reached out to numerous European, Japanese, and American MNCs to relocate to Malaysia. What was consistent during the first wave of FDI (1970-1980) that inundated the country was that the government has never wavered in its effort to provide efficient infrastructure, tax holidays, and promotion incentives. One key feature of the government's effort is their provision of renewable, 5-year investment credits.

To boost the involvement of firms in research and development, in 1986, special tax incentives for R&D and training were devised. As a result, firms intensely competed to hire the best scientists, engineers, and other highly trained personnel which had somehow caused wages to rise incessantly during the second FDI wave. This competition for sourcing out the best people was not left unnoticed by the government. For example, the Selangor and Penang provincial governments partnered with the private sector to establish the Penang Skill Development Center in 1989 and the Selangor Human Resource Development Center in 1992, respectively. The federal government in Kuala Lumpur soon took notice and followed the example set by Penang. In 1991, to intensify the support for R&D undertakings, the national government institutionalized grant matching (which would be exclusively available to local firms until its expansion in 2005). A year later in 1992, the government enacted the Human Resource Development Act to support these training activities and to incentivize manufacturing firms that shouldered training expenses through tax cuts.

Such grants soon attracted foreign wafer fabrication companies like Infineon, ON Semiconductor, Osram, and X-Fab; chip design firms like Intel; and firms which vibrantly nurtured R&D such as Advanced Micro Devices, Alterra, Fairchild, and Renesas to relocate their factories in the country [14]. This shows that the incentivizing firms proved to be a worthwhile endeavour because 2014 saw the rise of 11 new semiconductor firms specializing in chip design and wafer fabrication while back in 1999 there were absolutely none.

According to Rasiah [14], the policies implemented by the government "proved successful but did not stimulate functional upgrading". The government decided to create the Malaysian Institute of Microelectronics Systems (MIMOS) in 1985 and eventually made it a corporation five years later. MIMOS is an agency under the Ministry of Science, Technology, and Innovation (MOSTI). MIMOS also plays a Secretariat role in the National Information

Technology Council which is helmed by none other than the Prime Minister himself. These institutions vastly contributed to addressing the problem of the government in encouraging local firms to engage in more advanced R&D.

An example of this would be the success Silterra (formerly known as Wafer Technology Malaysia), which was created under the auspices of MIMOS during the mid-1990s. In 2000, Silterra relocated to Kulim High Tech Park. Silterra conducted wafer fabrication operations and somehow increased the country's technological capability; however, problems such as a lack of a highly skilled labour force and leadership persisted. These were some of the reasons as to why the electronics sector at the time could not move forward and integrate difficult manufacturing operations such as implant activities and chip designing. This disadvantage proved to be nearly fatal until MIMOS stepped in to offer foreign firms grant matching, thus providing incentives to them akin to those received by local firms engaged in R&D and training.

Until 2012, R&D activities have been limited to some firms because there was little to no linkage between universities and national R&D agencies until the Collaborative Research in Engineering, Science & Technology (CREST) was established. CREST is a brainchild of the three key stakeholders of Malaysia's electronics sector- the government, the industry, and the academe. It is the pioneer grant-matching program that aims to cultivate the partnership between the public and private sectors in conducting R&D activities [23]. The provision of R&D grants, CREST promotes collaboration in market-driven research by linking universities to the electronics industry. From its conception, CREST facilitated 75 R&D projects between its three key stakeholders. CREST has set its eyes on producing not less than 300 researches and commercializing 61 intellectual properties before 2018.

The IMP2 and IMP3 both emphasize the country's strong need to leapfrog technology through R&D by supporting local firms and facilitating technology transfer. The government has supplemented these efforts through establishing infrastructure and government agencies that facilitate technology transfer. Agencies such as MIDA established the Bukit Jalil and Kulim Technology Parks, MITI took the Technology Transfer Unit under its wing, the Penang Industrial Coordinating Council created a public-private Technologies Council and the Malaysia Technology Development Corporation assistance of MIMOS through supporting domestic start-up companies.

Malaysia's position in the world economy in terms of conducting research and development activities in the electronics industry surpasses many OECD nations and this concentration gives the country advantage for securing a foothold on innovating towards the future. Nonetheless, Malaysia must continue to intensify its efforts in integrating itself into the higher echelons of the global value chain in the electronics industry.

3.2.3 Porter's Diamond Analysis

3.2.3.1 Firm Strategy, Structure, and Rivalry

Malaysia presents a unique case as firms in the country exhibit a strong will to complement each other and share their research with other industry members. The firm rivalry is not as intense as it is in the Philippines. It can be attributed to the fact that the electronics industry has matured from developing back-end products from the 1970s to 1990s and have transitioned into the mid- to high-end products in the value chain. The research and development activities carried out both MNCs and SMEs are harmonized are somehow made to complement each other. Malaysian SMEs have found ways to be a good supporting mechanism for the MNCs that are in the country. The first eight MNCs that have invested in Malaysia in the 1970s continue to thrive in the country and are well assisted by SMEs that have not only been nurtured to create their own products but also to provide a solid outsourcing supply base for these foreign companies. The high-quality products produced by Malaysian firms have been developed over time, considering their long-standing partnership with these MNCs. An example of this robust partnership would be the Electronics and Electricals Strategic Council where firms share their information, research, and collaborate with one another.

3.2.3.2 Factor Conditions

In terms of human resources in the Malaysian electronics industry, since Malaysia is no longer in the back-end, they are labour intensive since assembling requires such. As they progress, labour is not cheap anymore comparing to Vietnam and China. The government encourages the academies for an industry attachment in terms of their curriculums in their programs relating to electronics. Therefore, the level of skills of the graduates is industry-ready. The industry partnership and collaboration help to train the students to acquire the necessary skills in the industry and to be ready for employment. There are also development centers in Malaysia that trains workers to meet the required skills by the industry. One example of development center in Malaysia is the PSDC or Penang Skills Development Centre which was established in 1989 and the first industry-led skills training and education center in Malaysia. It has assisted in the formulation and input of national policies for human capital development.

As for infrastructure, the government of Malaysia made sure that environment is conducive enough for the businesses to grow thus, making sure that airports have available flights whenever E&E are needed to be transported, port facilities are available. The R&D of Malaysia is encouraged by the government so that the companies will go up the value chain and more incentives are given since they are outcome-based incentive but not everyone gets the incentive that's why they also need to present results and outcomes. One agency in Malaysia that pursues research and development is CREST (Collaborative Research in Engineering, Science and Technology). It represents the interests of 3 key stakeholders in the E&E industry of Malaysia-the industry itself, government and the academia. It was established to address the needs of Malaysia's E&E like platform for local companies as well as MNCs to create a strong R&D ecosystem, a justifiable pipeline for the industry-ready graduates and an industry-led organization to drive innovations for R&D.

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) published the Asia-Pacific Countries with Special Needs Development Report 2017, wherein Malaysia was ranked 35th in the Access for Physical Infrastructure Index. This report focuses on the importance of physical infrastructure to the development least developed countries, landlocked developing countries and Small Island developing States, collectively referred to as countries with special needs, in the Asia Pacific region. Malaysia believes that there should be constant investment for upgrading machinery equipment in the E&E industry since it is an expensive industry and it is very much technology treatment that companies need to be updated with new machines and other technological advances that requires up scaling of work cost.

3.2.3.3 Demand Conditions

Malaysia has been building up the credibility and image of the domestic brand. The government has been improving the quality and image of the local brand against misconceptions and colonial mentality. There are a growing number of local electronics brands in Malaysia and their products are being exported all across ASEAN. Sophisticated domestic demand certainly led to gradual progress of growth and expansion to the international market. This gradual progress is deemed to continue further expanding the market of the Malaysian electronics industry globally.

3.2.3.4 Related and Supporting Industries

The Electrical and Electronics Association of Malaysia (EEAM) is a representative organization of electrical and electronics industries in Malaysia established in 1952. It is officially represented in various Council Committees of the government. EEAM has about 1700 members classified according to the activities of the business. The membership includes individual to state associations. In the case of Malaysia, the multinational companies (MNCs) work in hand with the local companies. Aside from the MNC and local company relation, the local companies themselves depend on producing a sophisticated product. However, in the case of the Philippines, the interviewers have agreed that most of the companies depend on outsourced task, which is mainly assembly.

Moreover, there are many MNCs that do not cooperate with the local companies but rather just do the assigned task and exporting abroad for finalizing the product. This phenomenon is unlikely to happen in Malaysia where despite being an MNC, the foreign companies still engage in trade with the local companies. In Malaysia, the cooperative business ecosystem allowed MNCs and local firms to work together extensively. The differing business ecosystems in Malaysia and the Philippines appeared to be the main reason behind the different outcomes in terms of the respective countries' placement in the GVC.

The electronics industry of Malaysia has proved to be robust and poised to develop smart technology in the form of artificial intelligence, analytics, machine learning, and advanced production methods. Domestic firms and MNCs have exhibited close cooperation and have consistently harmonized their operations wherein in both actors complement each other's ventures in the industry. Infrastructure such as factories, foundries, and development centers are numerous which has, in turn, boosted the skills of their labour force. Much of the country's labour force is Malaysian and most have been educated in universities that put a premium on creating timely and innovative curricula. Equipped with a large domestic demand, the Malaysian electronics industry is also supported by other sectors which extend beyond manufacturing. The development of the industry was also cultivated through the efforts made by the government to influence policy and attract investors to the country. Figure 2 summarizes the key features of the industry based on Porter's Diamond Model.

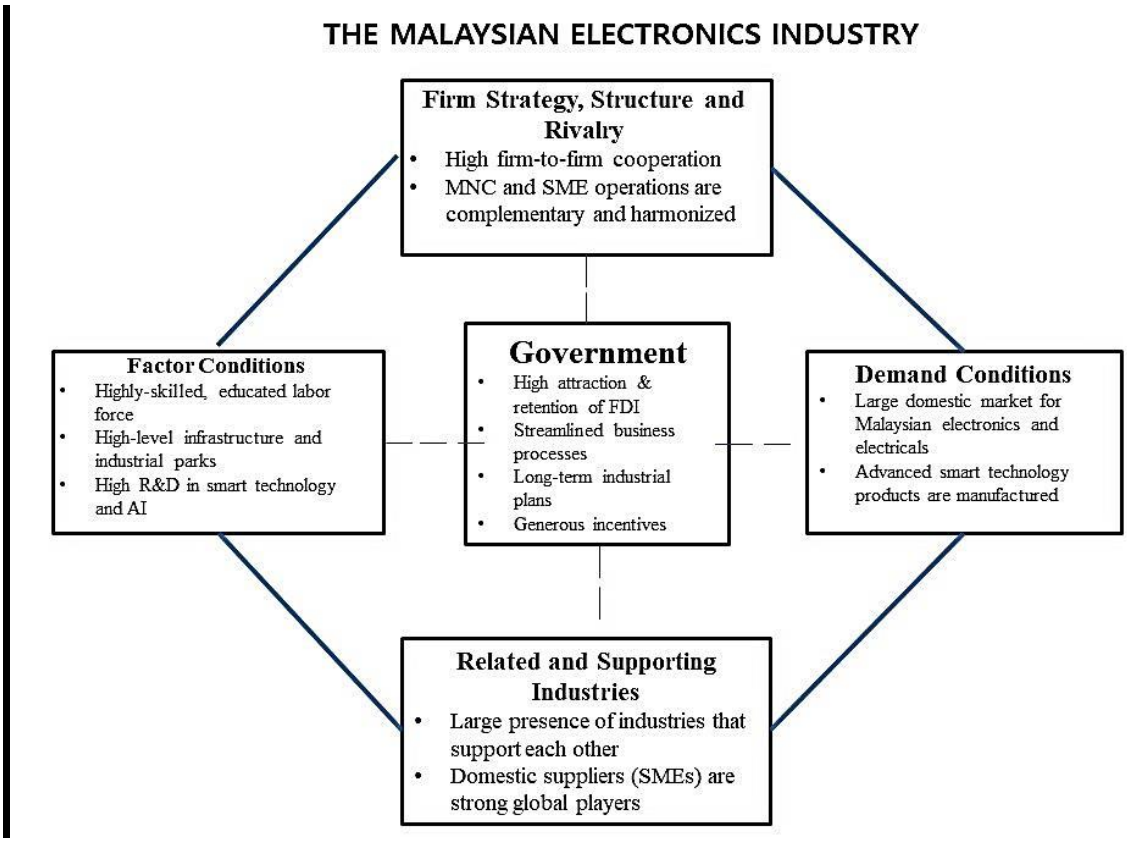

Figure 2. The Porter Diamond of the Malaysian Electronics Industry

3.3 The Philippine Experience

The electronics industry of the Philippines started to develop in the 1970s, driven by foreign direct investments, when the relocation of production facilities to third world countries increased, a response to escalating production costs. The Philippines was an ideal relocation site because of its relatively cheap and educated labour. Also, it had geographical and government incentives to attract foreign electronics companies.

In 1976, the industry hired around 5,000 people, however this quickly extended over the next decade attaining 47,000 by 1984. Because of its early start, which simply started with Intel's investment in 1974, the electronics sector has been driven usually through overseas subsidiaries of semiconductor companies. Early investments with the aid of multinational IC A&T sites were followed with the aid of agreement A&T corporations as well. This provided a pathway for some neighbourhood firms to join the electronics sector; by 1980 there have been about 11 Philippine operations in the country. In the 1990s and into the 2000s, these developments shifted and Japanese and to a lesser volume Korean funding started out to dominate.

Investments in other electronic components arose later within the 1990s along with electric gadget companies starting within the second half of the 1990s. Subassembly and final output products organizations have come in spurts–vehicle and garage organizations sprung in the 1990s and office system agencies recently emerged in the 2000s. EMS organizations have come in two shifts; in the 1980s with some new investments in the 2000s. In the past five years, the industry has persisted to develop with 110 new investments among 2010 and 2015. Some other signal is the low exit fee; except for Intel, companies that have invested inside the Philippines have stayed, with several operations dating back to the late 1970s and 1980s.

3.3.1 Government policies and agencies

Philippines have consistently provided sound trade policies and regulations. All the respondents have agreed that the government has been able to provide a stable environment for the growth of the electronics industry. The country has flourished as a mixed-market economy with a strong presence from the government. The country's Department of Trade and Industry and its auxiliary agencies such as the Board of Investment and the Philippine Trade Training

Center have constantly promoted the advancement of investments in the Philippines. Taking the lead in the promotion of investments, BOI assists Filipino and foreign investors to venture and thrive in wanted parts of economic activities. While the PTTC trains MSMEs on how to take advantage of the trends in the modern economy through numerous trainings and workshops focused on various key topics. Along with the DTI, the Department of Science and Technology has also worked closely with the electronics industry to produce scholars, aid in information sharing, and in developing new products [5].

The Philippines incentives for MNCs and local electronics firms have also been abundant. Most of these electronics firms are in the 74 manufacturing zones under the Philippine Economic Zone Authority. PEZA zone located companies enjoy fiscal and non-fiscal incentives. Fiscal incentives include income tax holidays, a 100% exemption from corporate income tax from four to six years depending upon the nature of the plan. Upon expiry of the Income Tax Holiday a 5% Special Tax on Gross Income and exemption from all national and local taxes [24]. PEZA refers to gross income as "gross sales or gross revenues derived from the registered activity, net of sales discounts, sales returns and allowances and minus cost of sales or direct costs but before any deduction is made for administrative expenses or incidental losses during a given taxable period". Also, firms located in PEZA zones enjoy tax- and duty-free importation of raw materials, capital equipment, machineries and spare parts; exemption from wharf age dues and export tax, impost or fees; VAT zero-rating of local purchases subject to compliance with BIR and PEZA requirements; exemption from expanded withholding tax; and exemption from payment of any and all local government imposts, fees, licenses or taxes.

Non-fiscal incentives for PEZA ecozone located companies include basic import–export procedures through an Electronic Import Permit System and Automated Export Documentation System; employment of non-resident foreign nationals in supervisory, technical or advisory positions; and the issuance of special non-immigrant visas with multiple entry privileges for non-resident foreign nationals in a PEZA-registered Economic Zone Enterprise such as investors, officers, and employees in supervisory, technical or advisory position, and their spouses and unmarried children under twenty-one years of age [24].

These incentives, among others, have been a key factor in attracting MNCs to invest and retain their presence in the country. However, government policies are but few of the many factors that contribute to the retention of MNCs in the country. The lack of infrastructure and the sluggish processing of business requirements are some of the aspects that the government has to focus on to make business processes less bureaucratic and to reduce red tape. For example, there is no one stop shop for all the business requirements a firm would need to apply for registration. A business owner would have to travel to different cities in Metro Manila to file paperwork and wait for five to 15 working days to process permits. This inaccessibility to smoother, simpler transactions also discourage investment in general.

Government collaborations with the private sector and the academe have also been a thriving endeavour. Under the DOST, the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) is one of the three sectorial planning councils of the Department of Science and Technology (DOST). It is directed to serve as the central agency in the creation of policies, plans, and programs as well as in the execution of strategies in the industry, energy, and developing technology sectors through the science and technology programs, especially in electronics [25].

The Advanced Device and Materials Testing Laboratory (ADMATEL) is a DOST-ITDI national testing facility equipped with state-of-the-art analytical equipment for Failure Analysis and Materials Characterization. ADMATEL conducts failure analysis to determine the cause of the product inefficiencies. It also undertakes process development testing to help manufacturers optimize their procedures. Also, it aids in product development, provide test services that address advanced analytical needs for quality control and inspections, materials identification, and research and development. The ADMATEL facility is based on the standards acceptable for a scientific laboratory to accommodate sophisticated equipment, such as Focused Ion Beam – Field Emission Scanning Electron Microscope (FIB-FESEM), Auger Electron Spectroscope (AES), and Time-of-Flight Secondary Ion Mass Spectrometer (TOF-SIMS) [5, 6].

The ADMATEL's Php 378 million-facility was established to reinforce and upgrade the capabilities of the local electronics sector and its related industries. It reduces the delays and costs of having products tested abroad. According to ADMATEL General Manager Virgilio Aguinaldo, it has already catered to 44 clients from the electronics and related sectors. The laboratory is open for R&D collaboration with the academe. "That is what we really are encouraging our students to do. Actually, we have students coming here to have their hardware tested for their thesis. Some are joining robotics events," explains Aguinaldo. ADMATEL is offering a socialized fee for students while clients from the micro, small, and medium enterprises are billed at a 20-percent reduced rate. The lab

has already applied for ISO 17025 accreditations for its three laboratories. ADMATEL is one of DOST's initiatives in strengthening the manufacturing industry. With the S&E as one of the country's leading and important industries, and giving support to the manufacturing industry, it generated $21 billion in 2013 [26].

The Product and Technology Holistic Strategy (PATHS), proposed by SEIPI and a jointed research funded by BOI – DTI and conducted by the industry with their partner agency. PATHS project aims to identify product functions and a predominant industry direction for the industry over the next 5 to 10 years. According to SEIPI, "it seeks to, first determine the global technology and industry trends in semiconductor and electronics devices and technology development, and identifying strategic electronics sectors, devices and products that the Philippine electronics industry can focus on; second identify the necessary or desired industry resources and advanced technological capabilities, as well as the policy and operating environment that will support the thrust for existing firms to go into or attract new investors to manufacture these identified devices in the Philippines; third review the current country factor resources and state-of-the-art technological capabilities and the business operating environment of the electronics and other industries and the country vis-à-vis the new product lines; and fourth formulate a product and technology strategy roadmap to close the gap between the current and the desired state of the country's electronic industry identifying specific action programs for marketing (i.e., investment promotion), physical facilities (i.e., infrastructure), skills (i.e., education, training program) policy (i.e., laws and regulations), etc. that are needed to successfully resurrect the Philippine electronics industry." [6, 27]

The Engineering Research and Development for Technology (ERDT) is a consortium of eight-member universities in the country that offer masters and doctoral degrees in various engineering fields. This consortium is composed of Ateneo de Manila University (AdMU), Central Luzon State University (CLSU), De La Salle University (DLSU), Mapúa University, Mindanao State University - Iligan Institute of Technology (MSU-IIT), University of the Philippines Diliman (UPD), University of the Philippines Los Baños (UPLB), and University of San Carlos (USC). The ERDT was a scholarship program created by DOST to promote the research and development in the field of electronics and technology. There has been a considerable lack of students who pursue graduate studies in the field of electronics engineering, thus this has led to the low number of researches produced in the academic area. Thus, the launching of this program is a reiteration of the government's support for the electronics sector.

However, despite the government's advances to modernize and advance research and development, academics from state universities have purported that the efforts of the government, which funds state colleges and universities, remain inadequate. Such is the lament of academics who wish to provide a more modern education to students, and they have suggested that higher-end facilities should be looked on for investment by the government. It is highly necessary for facilities to be present because it is where higher technologies can be housed, studied, and further innovated.

3.3.2 Research and Development Initiatives

The government continuously engages in technology-intensive research and capacity building projects to improve the quality of its service to the people. In support of local electronics industries, the Department of Science and Technology in cooperation with higher educational institutions and research institutions established the Advanced Device and Materials Testing Laboratory (ADMATEL) equipped with state-of-the-art R&D and testing facilities. ADMATEL aims to improve capabilities of the industries and seek to spur R&D activities and provide MSMEs access to testing services needed to increase their productivity and competitive advantage. The facility contains equipment for analysis on failure and materials characterization which lowers the cost down and reduces delays for product testing in another country. There are acceptable standards for scientific laboratory, accommodating sophisticated equipment. It has 44 clients, under the management of PCIEERD, and under SEIPI's guidance.

The electronics industry Technical Working Group (TWG) invites and holds meeting with the public and private sector stakeholders to share updates and current activities, and to address challenges the industry face. Activities include Product and Technology Holistic Strategy (PATHS) project, ITA expansion, IC Design Roadmap and Training, promotion and support of facility, and the 5th ICT Design Training Program held at University of the Philippines (U.P.) Diliman, in partnership with Taiwanese government and Philippine Institute for Integrated Circuits to achieve competitive digital niche in Asia. [6, 28]. Meanwhile, Technical Education & Skills Development Authority (TESDA) provides work scholarship program for skilled professionals.

In addition, the government strengthen tripartite collaboration. Collaboration in R&D based on the triple helix model, which involves the coordination and cooperation of academe, industry and government, will be further strengthened. It will be facilitated through the elimination of institutional bottlenecks for joint research activities, such as burdensome processes and administrative procedures, particularly in public higher education and research institutions. The government will also leverage public R&D grants, tax, and other incentives to increase

productivity. The government also strengthen the Balik Scientist Program. It seeks to strengthen the scientific and technological human resources of the academe, public institutions, and domestic corporations, through the promotion of knowledge sharing and accelerate the flow of new technologies into the country.

3.3.3 Porter's Diamond Analysis

3.3.3.1 Firm Strategy, Structure and Rivalry

In the Philippines, the firms involved in the electronics industry are largely composed of MSMEs and a comparatively small number of MNCs. This is expected MSMEs make up more than 98% of the firms operating in the country [29]. The interaction between these MNCs and MSMEs are largely limited to the outsourcing of services by these big companies to the local firms. Recently, there has been increased involvement from these two key players as they have been partnered together by the government to facilitate skills as well as to facilitate technology transfer. A notable example of this endeavour is through the partnership being cultivated in Cebu in the film production equipment industry. Big Foot Studios, a film production company and Lexmark, an equipment manufacturing company have recently tapped local firms to produce film equipment for them and have held several training sessions on the ways the local industry could complement and how local firms could meet the product demands of these MNCs.

However, this development and partnership are often overshadowed by the intense competition and rivalry among local firms in the country. This is further exemplified by the how exclusive associations for the electronics and electrical industry, namely SEIPI and EIAPI, often get a bigger market share compared to firms which are not members of these associations. SEIPI members come from stronger, more notable manufacturing backgrounds and they often gather to share information. SEIPI somehow acts similarly to an oligopoly, as members try to divide the market share among each other. Nevertheless, this exclusivity has not entirely excluded non-association members from being outsourced and acquiring contracts from MNCs. It must be duly noted that the Philippines' place on the global value chain is on the back-end to mid-end, hence the concentration of the efforts on testing, manufacturing, and assembly. The proximity of these MNCs to MSMEs in PEZA and other export processing zones in the country also contribute to why they are chosen as subcontractors.

There is no known collective, intra-industry collaboration for MNCs and MSMEs in the country. This is due to the secrecy that pervades the socioeconomic planes on which they exist. Much of the researches conducted these key players remain in the confines of their companies and even less are shared to the associations they belong unless it would be a source of substantial profit for them.

From the interviews, all the participants agreed that there is severe competition among the industry level to independent states. For that, the industry is secretive especially in terms of research and development which is directly related to the quality and uniqueness of their products. This study founds from the interviews that the foreign industries dominate the great shares of the industry development. There are many MNCs that add up to the secretive nature of the industry. This study aimed to verify if the shift to research and development is a wise move to be in higher GVC and to find out the problem that hinders further development and innovation of the products the industries produce. The MNCs is outsourced and mainly focuses on assembly and packaging in the Philippines.

3.3.3.2 Factor Conditions

Regarding the research and development environment of the industry, these are conflicting views on human resources in the electronics industry of the Philippines. Some participants argue that there are enough skilled professionals and the other argues that there are enough potential in the professionals, however, more government aids are needed. For the level of skills for the employment, Filipino graduates are still lacking but they have great potential. It has resulted from the curriculum in the academy which is not in line with the needed skills to be used in the field.

In terms of infrastructure in the Philippines, the facility for R&D is enough to meet the demands of industries. For example, EPDC provides a public testing center that lessens the burdens of the industries. Also, it is ISO Certified, which in terms of quality is credible. However, more attention should be given to infrastructure. Although many professionals argue there are enough facility and infrastructure for the industry but for further growth, interviewees have shown expectations for infrastructure development.

In Asia-Pacific Countries with Special Needs Development Report 2017: Investing in Infrastructure for an Inclusive and Sustainable Future (2017), United Nations has the result of the Access for Physical Infrastructure Index (APII) of 2015. The Philippines ranked 24th among ASEAN countries and Philippines must catch up with other ASEAN countries for further growth, especially in the electronics industry.

3.3.3.3 Demand Conditions

Although it is true that many countries are export-oriented, domestic demand is one of the factors to the development of an industry. Majority of the interviewees from the Philippine electronics industry answered with uncertainty to the demand condition. There are very few demands of the local consumers, lesser In terms of sophisticated demands. One of the interviewees argues that there is a colonial mentality in terms of brand preference. Colonial mentality is internalized ethnic and cultural inferiority as a result of colonization [30]. Even in the presence of sophisticated domestic product, there is a higher preference over that of domestic. Aside from colonial mentality, technological convenience and design also take into account behind the consumer preference.

3.3.3.4 Related and Supporting Industries

No company is solely independent in producing a product rather, companies depend on other partners. Such alliances and partnerships add up to the value of the product and help the company to be more competitive. Growth and development of industry are shown when these alliances and partnerships are at an international level in terms of competitiveness. Therefore, this study determines the presence of related and supporting companies within the electronics industry, as well as their competitiveness as a global player.

Much of the related and supporting industries of the Philippines include the telecommunications, medical device manufacturing, automotive, industrial, consumer electronics, electrical, and computer industries. As most domestic firms engage in electronics manufacturing services, a majority of their products are exported or are shipped to other MNCs in the country. A similar situation can also be observed in the Malaysian setting. SMEs play a key role in this regard as larger firms outsource them to create tooling and other related products for them.

Furthermore, this study has also examined the cooperation among the companies to strengthen the industry. Although the relationship is not in a supplier and manufacturer, this study had expected the union of the companies would help the industry stand firm and progressive. In the Philippines, there are organizations of the electronics industry, most notably SEIPI and EAIPI.

The Semiconductors and Electronics Industries in the Philippines, Inc. (SEIPI) has targets to build up the business environment of the industry especially for semiconductor and electronics and to develop internationally competitive technology. SEIPI promotes the competitive advantage of the Philippines and provides growth opportunities in manufacturing and management through Training, Research and Development, Advocacy, Information, and Networking and Services (TRAINS). Moreover, it encourages members to participate in trade fairs and collaborate with the SMEs. SEIPI works closely with the government to develop the labour force further and to strengthen the linkage between the industry and academe by promoting more apprenticeship and programs among companies.

On the other hand, Electronic Industries Association of the Philippines, Inc. (EAIPI) was established in 1986 by young Filipino entrepreneurs to develop products locally. EAIPI is a group of local companies that serve as a linkage between government, academes, and others being the voice of the members. Like SEIPI, it has its project like providing a forum for the members to upgrade the technology, as well as its manufacturing capabilities. It also aims to broaden the markets by providing different opportunities to the members. Its most significant project is Electronic Product Development Center (EPDC), the first EMC Test Facility in the Philippines. It is a public testing facility unlike other expensive private facilities in the Philippines.

Likewise, the union of electronic companies seems to have a lot of advantages. However, there are no clear and absolute data on the numbers or lists of the industries. There is no sufficient data on the number of electronics companies as well. One of the interviewees from governmental agency points out that it is affected by the secretive nature that some companies avoid joining the organizations. SEIPI and EAIPI aim to help the industry and they encourage cooperation within themselves. Unfortunately, the exact numbers of the functioning local companies are unknown and such expected companies do not join the union for the security of their technologies.

The electronics industry of the Philippines is dominated by the MNCs which have a base in their respective countries. Research and Development strategies of the industries are on their own without government interventions. There are notably few domestic demands and cooperation among the industries. Domestic branding is weak and the ambitions on R&D are lacking for the MNCs. It results from MNCs have their mother country and for the domestic, with few demands. Figure 3 summarizes the key features of the industry based on Porter's Diamond Model.

The Philippine Electronics Industry: Looking Forward

Philippine considers the industry seriously with its Industry Development Roadmap and Comprehensive National Industry Strategy to deepen and shift the Global Value Chain (GVC). The private sector-driven growth will be consolidated into national strategy, where the foundation has to account intra-industry cooperation, or a sound business ecosystem. On the other hand, Malaysia also sticks to the industrial policy, the latest 4.0, to attract

stakeholders and create ecosystem that fits the industry trends. Investment-wise, there are different policies that encourage foreign direct investments and SMEs to participate in business.

However, following the conceptual framework, this study found out that the current players in the industry see the government policies as institutional set-up to act within the given circumstance. Moreover, foreign direct investment (FDI) does not greatly affect the quality and quantity of industry's research and development (R&D). Instead, stronger relation has been found between the multinational corporations (MNCs) and R&D.

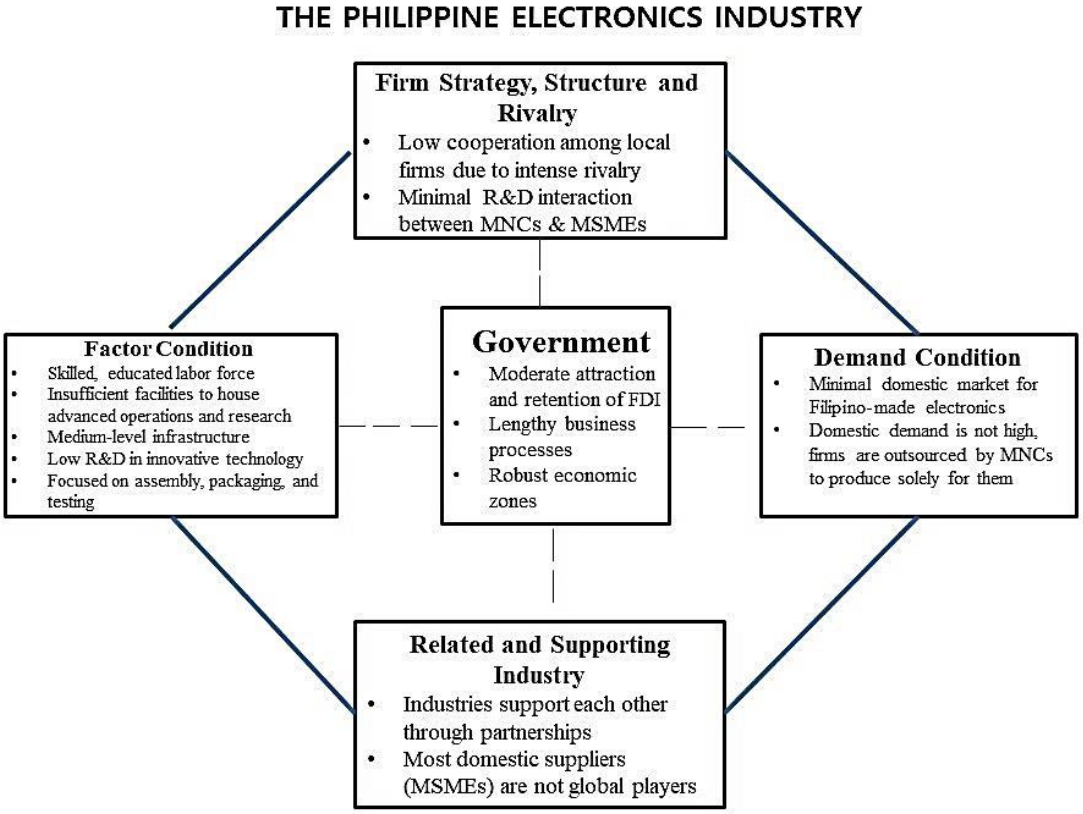

Figure 3. The Porter Diamond of the Philippine Electronics Industry

The R&D of a firm depends on the direction and strategy, as well as the financial stability. The MNCs mentioned above chosen the strategic allocation of labour, mainly assembly and testing in the Philippines, considering the relatively lower labour costs compared to the Malaysian industry, where the MNCs cooperate with the local firms and government producing an "ecosystem" of coexistence among the competition. Therefore, lesser investment on the facility and R&D has been found during the interviews, despite the government's effort to provide public testing facilities such as Electronics Product Development Center.

On the other hand, the domestic firms of the Philippines face "colonial mentality" of the citizens amounting to disbelief and doubts on the quality and brand image of a product. With slow growth of trust and investment on the domestic electronic products, which also means lower demand, the supply of the domestic products are yet to increase to be globally competitive ones, compared to the Malaysian electronic products which are in momentum of international and domestic acknowledgment. However, this domestic demand is of grave importance, for its influence on sophistication of a product; whether a company keeps assembly, if not a subcontractor, or produces its own products for consumers or other company as a product parts.

Another finding was inadequate data on the industry by the government. The two respective main statistical authorities are Philippine Statistics Authority (PSA) and Department of Statistics Malaysia (DOSM). During the interviews with the government agencies, this study have found out the incomplete data of electronic firm, in

numbers and classifications by the product, due to the secretive and competitive ecosystem. Data on the firms are important aspect to analyse and assess the progress and to understand the condition of the industry.

Regarding data collection and research on the companies, this study founds out the studies of Malaysian government and educational institutions are relatively updated and surpass in numbers the works of the Philippine government and private institutions which is important for the growth of industry, specifically electronics, which needs to react to the constantly changing trends of the technology.

As electronics industry takes up a huge part in export and import of the country, electronics industry is more likely to grow and to be in immense competition, considering the increasing demand on the products, and development of technology and policies adopting them. Therefore, proper response is needed to catch up and join in line with the futuristic potentials of electronics industry. Likewise, for the Philippine electronics industry to develop and shift its value to higher GVC, the study have compared to the industry of Malaysia.

First of all, cooperative ecosystem is needed. Throughout the interview with Malaysian embassy, the distinct difference between the business ecosystems of the two countries is found. Although, considering the nature of the business, the industry is secretive over the technologies, Malaysian government have provided cooperative ecosystem of cooperation wherein the MNCs work along with the MSMEs.

MNC, by their existence, is not harm to local industries' development but with active exchange and cooperation, helps the growth and development. Usually, natural technology transfer occurs during the business cooperation among the MSMEs and MNCs. In such aspect, blockchain technology, an online ledger of economic transactions of a company, helps the companies to open up the business accounts and sales, better than without.

In line with the disclosure of transactions and companies, assessment of companies is needed for strategic analysis. Detailed data must be gathered to comprehend and analyse the changes of trends and growth of the company.

Lastly, R&D should be enhanced, mainly for the products to be placed in higher GVC. The degree of sophistication and quality depends on the R&D, how a firm come up with trendy quality products accommodating others aside from the domestic consumers. R&D of a firm could only be enhanced when the business ecosystem accommodates the cooperation of local firms and MNCs, while the government invest on the facility, only when properly assessed and analysed the industry.

3.4 Observation

The electronics industry of Malaysia has proved to be robust and poised to develop smart technology in the form of artificial intelligence, analytics, machine learning, and advanced production methods. Domestic firms and MNCs have exhibited close cooperation and have consistently harmonized their operations wherein in both actors complement each other's ventures in the industry. Infrastructure such as factories, foundries, and development centers are numerous which has, in turn, boosted the skills of their labour force. Much of the country's labour force is not Malaysian and yet most have been educated in Malaysian universities that put a premium on creating timely and innovative curricula. Equipped with a large domestic demand, the Malaysian electronics industry is also supported by other sectors which extend beyond manufacturing. The development of the industry was also cultivated through the efforts made by the government to influence policy and attract investors to the country.

The electronics industry of the Philippines is dominated by the MNCs which have a base in their respective countries. Research and Development strategies of the industries are on their own without government interventions. There are notably few domestic demands and cooperation among the industries. Domestic branding is weak and the ambitions on R&D are lacking for the MNCs. It results from MNCs have their mother country and for the domestic, with few demands.

4. RECOMMENDATIONS

This study focused on the electronics industries of Malaysia and the Philippines, the industry which has greatly contributed to the economic growth and GDP and continues to be a sector which is of great importance to the current digital age. The dawning of the Fourth Industrial Revolution marks a future wherein the heightened use of electronics, artificial intelligence, machine learning, and increased connectivity to the Internet of Things (IoT) will be the norm pervading the lives of the common man. This advancement into a future where access to information becomes liberalized puts players such as governments, firms, and private citizens on a nearly level playing field make the undertaking of advance R&D even more vibrant and inclusive. This study suggests some recommendations for the Philippine electronics industry to increase its competitiveness.

The usage of blockchain technology for the Philippine electronics industry a method of documenting the production process and disrupting the secretive nature the firms who are members of the chain, thereby liberalizing access to

information and boosting inter- and intra-industry collaboration on research and development. Having a blockchain for the industry, would maximize the market access of domestic firms and strengthen their capacity for innovation because the entry to a blockchain entails a rigorous documentation process. The blockchain exclusivity is favourable because the prospective applicants to a blockchain are screened if they have the capability to produce a certain electronics product at a certain volume, in a certain time period. It is akin to the weeding out of the weak and only the fittest firm can be a part of the chain. Thus, firms are forced to improve themselves and increase their competitiveness to be able to stay in the chain, make a profit, and remain relevant. As a result, blockchains may also minimize the NTBs such as certifications and standards in the global electronics market. Non-compliance to costly ISO certifications, Environmental Management Systems, among others, was identified to be some of the domestic firms' weaknesses that have discouraged them from developing and selling their own designs, which is why most firms prefer to accept outsourcing commissions instead.

If a significant number of domestic firms participate, this may increase R&D and innovation because the blockchain is not managed by industry unions but rather by the market itself since choices are being made on the notion of choosing the best firm to tap for testing or to outsource products from. The cost of non-involvement in the chain would not only be the loss of potential profit but also irrelevance to the blockchain, if not the global value chain.

Blockchain technology is like the value chain, only that it is a refinement of the latter. It is a refinement because it not only emphasizes the interconnectivity of different industries and of the products they manufacture but also the interconnectivity of the information on the product itself. The blockchain makes information sharing seamless while maintaining the integrity of the trade secrets of the firm.

A recalibration of the curriculum of Philippine educational institutions for education to be more inclined towards the understanding of present technological innovations, such as artificial technology and big data analytics, and the creation of advanced technologies. Currently, the educational system in the secondary and tertiary levels does not have the leeway to nurture the mind-set for the innovating electronics. The K-12 system is a good starting point to introduce advance school projects, not just calculators or transistor radios, but rather projects that involve 3D printing, simulations, or augmented reality or projects that have real-life applications. The educational system must provide the whole training program for the electronics sector in terms of educational preparation as well as industrial readiness. This will include the creation of subjects which will require programming, robotics and IC design. If students are educationally prepared, they will be equipped with skills which are going to be necessary for the future workplace. Initiatives such as the Engineering Research and Development for Technology (ERDT) Scholarship Program should be continued to consolidate the pool of electronics and engineering scholars. Furthermore, colleges and universities should also upgrade their facilities to accommodate the development of more advanced research projects

Implementing good economic policies, streamlining business processes, and promoting must be given continued prioritization by the government to attract more investment in the industry. The Philippines can learn from Malaysia's implementation their Industrial Master Plans and their newly launched Industry 4WRD program, where different government agencies have worked together to achieve the goals being set out. The Philippine government must prioritize the full implementation of Product and Technology Holistic Strategy (PATHS) project which aims to guide firms on how to move up the value chains by determining which technologies they must pursue. Business processes must be streamlined and must not take more than three business days to process. A one-stop center must be created in every economic zone in the Philippines to enable faster transactions. Also, online government services must be strengthened so as to ensure speedy delivery of service, prevent red-tape, and minimize corruption through bribery and middlemen. Also, trade promotion must be energized through the joining of Philippine firms in global electronics expositions and through hosting such events in the Philippines. Trade promotion is not only an important undertaking, but it is the bridge through which FDI can be easily acquired.

The partnership between government, industry and the academe must be intensified to create an economic environment that is bustling with research and development, and investment. The academe plays a key role in the development of new research and it can be funded by industry members. The role that the government plays in this is in the form of a facilitator of dialogue and the catalyst for policy creation and implementation. A program similar to Malaysia's Collaborative Research in Engineering, Science & Technology (CREST) can also be replicated in the Philippines. Through a grant-matching program, partnerships between the public and private sectors can be cultivated, especially in conducting R&D activities. Through R&D grants, collaboration is promoted in market-driven research by linking universities to the electronics industry. The bonds with SEIPI, EIAPI, DOST, DTI, and the ERDT must continue to flourish through the creation of workshops, competitions, and scholarship grants that

will further the R&D in the electronics industry. Public and private partnerships are the key to achieving a holistic and inclusive electronics industry that will remain competitive and relevant in the years to come.

5. CONCLUSION

It is clear that the implementation of the ITA did liberalize trade however, the key drivers of the growth of the electronics industries remain to be the domestic political and economic conditions which attract FDI, incentivize and encourage research, development, and innovation, and promote a stable economy equipped with high-level infrastructure and streamlined business processes.

Domestic political and economic structures are highly useful in explaining the varying economic experiences and approaches of Malaysia and the Philippines towards their respective electronics industries. It is worth noting that when investments in the industry are insufficient or are minimal, research and development decelerates, if not ceases. High-level R&D is crucial for industry to meet, if not exceed, technological trends and changes. The reason behind the emphasis on R&D is that it gears a nation towards achieving a higher position in the global value chain for electronics, to be able to reap substantial gains from trade.

High-level R&D is being carried out by the Malaysian electronics industry as they are more capable through the availability of high-technology facilities, advanced equipment, skilled workforce, and the extensive cooperation and information-sharing conducted by the government and the private sector. A sharp contrast can be observed in the Philippine electronics industry which possesses a skilled and educated labour force but struggles to produce high-level R&D since there are no high-technology facilities and the existence of severe competition among firms. Firms are secretive in the Philippines while firms in Malaysia are more open to sharing information with one another, despite the industry's sensitivity to technological innovations and changes. This collaborative nature of the Malaysian electronics industry trumps the secretive nature of its Philippine counterpart, where R&D is carried out by firms on their own.

For the Philippine electronics industry to achieve a higher position in the global value chain, it must be equipped to carry out advanced R&D. In this regard, the government and firms must work together: government must act as a catalyst through creating stable and streamlined policies, promote trade, and foster dialogue between the sector and educational institutions; and firms must improve their own production and R&D through looking outwards by bridging partnerships and supporting researches conducted in educational institutions.

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