

THE IMPACT OF CORRUPTION ON INNOVATION
ACTIVITIES: THE CASE OF MALAYSIA

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- (3) Equal contribution has been made by each group member in completing the FYP.
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LIST OF ABBREVIATIONS

1MDB	1 Malaysia Development Berhad
ADF	Augmented Dickey Fuller
AIC	Akaike's Information Criteria
ARCH	Autoregressive Conditionally Heteroscedasticity
ARDL	Autoregressive Distributed Lag
ASEAN	Association of Southeast Asian Nations
BIC	Bayesian Information Criteria
CCI	Corruption Convictions Index
CLRM	Classical Linear Regression Model
CPI	Corruption Perception Index
CRI	Corruption Reflections Index
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Square
DF	Dickey Fuller
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNI	Gross Nation Income

IBA	Innovation Blocking Activities
ICT	Information and Communication Technology
JJ	Johansen and Juselius
MACC	Malaysian Anti-Corruption Commission
MIC	Middle-Income Country
PP	Phillips-Perron
R&D	Research and Development
RCEP	Regional Comprehensive Economic Partnership
SC	Schwartz Information Criteria
SEA	South-East Asia
SME	Small and Medium Enterprise
TOL	Tolerance Level
VIF	Variance Inflation Factor

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PREFACE

Corruption involves the abuse of public power for personal interests. This issue has already plagued our nation – Malaysia for a long time and it is prevalent for the government officials and businesses to involve in the corruption act. Meanwhile, Malaysia government does not appropriately control of the corruption happening in Malaysia. There were still happened many scandals involving bribery and that has tarnished the image of the country. This also clearly indicated that some of the fund and resources are misallocated for the development as well as innovation activities. Malaysia as a developing country, innovation performance is playing an important role for the development of the country. If the rampant of corruption continue to happen in Malaysia, this will create obstacle for the development and innovation performance in Malaysia. However, companies and businesses can also improve their innovation activities through corruption. Thus, this becomes the motives for us in study the impact of corruption to innovation activities in Malaysia.

Apart from that, there are still various external factors that will affect the innovation performance in Malaysia. In this research, the impacts of those external factors comprising of foreign direct investment (FDI), trade openness, and human capital to innovation activities in Malaysia will be examined as well. At the end, the insights of impact on the variables to innovation activities in Malaysia will be provided.

ABSTRACT

The primary objective of this research is to determine the factors that impact the innovation in Malaysia, especially to put the spotlight how the corruption impacts on the innovation in Malaysia. As the world is moving toward industrial revolution 4.0, and the innovation activities are getting complex yet important due to the change in global landscape. Malaysia as a developing country in Southeast Asia which is one of the fastest growing regions, the well innovation environment is indispensable for the country to growth and compete. However, the accountability of government in terms of clean handed was suspected by the world, so this study is to investigate on the relationship between innovation activities and corruption in Malaysia. Other than that, this research used secondary data from 1995 to 2019 and the methodology of ARDL to investigate the long run effect of corruption as well as other control variables which included foreign direct investment (FDI), trade openness, and human capital on the innovation in Malaysia. The empirical test result showed that corruption has significantly negative impact on the innovation in Malaysia, which mean the corruption “grease the wheel” of innovation in the case of Malaysia. On the other hand, the other control variables; FDI has significant positive relationship, while trade openness has significant negative relationship with the innovation in Malaysia. The human capital has showed no significant impact on the innovation in Malaysia. All of these provided insights for implications. This provides a crucial notice to Malaysian that the innovation activities are positively affected by corruption activities which need to pay more attention on in order for a more sustainable growth for the country. Not only that, it was also concluded that attracting FDI is also important for Malaysia to improve in the innovation activities. Besides, the Malaysia’s policies and governance need to revisit in order to win in trade with other countries and make it have positive effect on the innovation. Lastly, the limitations and recommendations of the study are discussed as well for future improvement for future researcher.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

This chapter will begin with a general introduction to the linkage between corruption and innovation. With the research that we do, we can better understand the seriousness of the corruption affects innovation and the relationship between corruption and innovation of the country. We will provide online research such as the research background, problem statement, research questions, research objectives, significance of study, and structure of study.

Based on the research of Mahagaonkar (2008), it stated that corruption greases or sands the wheels of innovation. Meanwhile, it leads us into the two types of arguments in which corruption can become a barrier or boost to innovation. As a developed and bureaucratic country, we need to investigate the impact of corruption on innovation activities in Malaysia. Therefore, innovation and corruption will be discussed in this part to provide a more complete understanding of innovation and corruption.

1.1 Innovation

Innovation is widely being a key driving force or major engine of productivity worldwide increased, a view which is put forward most obviously for the economic growth. Innovation is one of the most important concerns for all organizations and it also plays a role in developing and improving, which is indispensable in the market. According to Tohidi and Mohammad Mehdi Jabbari (2012), innovation in all human areas is applicable from the ways or processes of doing work, product development, and marketing management and system. It is a process of changes, improvement, or the transformation of knowledge, ideas, and inventions into creating commercially viable

products, services, and processes (Syed Muhammad Imran, Hafeez Ur Rehman, & Rana Ejaz Ali Khan, 2020).

Also, based on the research of Kotsemir, Abroskin, and Meisser (2013), innovation has a vital impact on the structural changes in the individual industries and market segments which is in line with the Schumpeterian concept. Schumpeter's innovation theory stated that innovation is the center of economic change causing the gales of "creative destruction" which is the development in the economy of the country while all organizations perform the function of the change creator (Śledzik, 2013). Therefore, it is so important for a country to innovate as innovation improves in all organizations in problem-solving, maximizes globalization, evolves the workplace dynamic, and as essential competitiveness in the workplace.

Based on our country, Malaysia needs innovation as a backbone for the development of the country. Malaysia is a country that ranks 55th out of the 157 countries based on the World Bank's Human Capital Index (World Bank, 2022). In addition, Malaysia can improve its innovation and development by fully utilizing the capital and human potential as well as the status of the country. We cannot deny that innovation is crucial for Malaysia in many perspectives such as it can grow faster, assist the organization to sustain, and be more efficient since it plays an important role to boost the country's economy and performance as well as allow the country to grow consistently at a sustained rate. According to The Sun Daily (2020), our Ministry of Science, Technology and Innovation said that Malaysia must set up a hub for attracting the global entrepreneurial talents to be based in our country. This is due to our country having the benefits of being an English-speaking country, with a relatively high-skilled workforce. Indirectly, it will create an opportunity to accelerate the economy of the country as well as it is one of the steps towards innovation in the country. Other than that, innovation in Malaysia can also improve productivity and remain competitive in the world through the digitalization which is one of the digital investments for innovations in the country. For example, our country can use digitalization that can transmit information at the speed of light in particular conditions such as the length of

time, complications, and high risks (Siti Hamisah Tapsir, 2021). Concurrently, Malaysia can attract more investors to invest in our country's digitalization for economic recovery especially during this pandemic Covid-19. Besides, based on NST Business (2021), there are some policies and regulations that need to encourage and support the digital foreign direct investment which can also respond to the innovative business from the growth of the digital economy and digital technology. Moreover, it is important to realize that there are some opportunities for Malaysia to grow further through the innovation. Thus, innovation is being a key to help Malaysia to sustain the economy.

In the meanwhile, based on our perspective and research, we believe that if there is a benefit or obstacle in the innovation of a country, it may improve or delay the development and economic growth of the country. According to the research of Méon and Sekkat (2005), it investigates the impact of corruption on growth and investment. This supports the sands the wheels' view on the corruption. In contrast, there is also a view of greasing the wheels on the corruption that can help corruption in compensating the bad governance. Therefore, corruption and innovation are compatible in this study. We can explore more about the types of corruption where it can indirectly cause impact to the country's economic growth and innovation.

1.2 Corruption

Corruption is a widespread phenomenon in most developing and growing countries such as Malaysia. It abuses the entrusted public power and violation of rules for private gain (Manion, 2004). Corruption can be formed by taking place in bribery, extortion, fraud, embezzlement, illegal gambling, blackmail, money laundering, and nepotism which are misuse the public power and authorities. Based on the research of Petrou and Thanos (2014), corruption indicates that people will misuse their authority in order to obtain someone's private gain as well as misuse of illegitimate action for the

bad purpose. This includes public officials take or offer bribes through money or service which is behaving dishonestly.

1.2.1 Types of Corruption

Grand Corruption

Grand corruption occurs when the government officials who are higher ranking receive or accumulate an undue advantage for personal use which disregards the public interest. It means that the government officials and elected officials exploit the opportunities that are presented through government work. For example, the result of bribes is usually offered or paid in connection with the larger scale government projects, such as infrastructure and construction projects. According to Jain (2001), the research stated that grand corruption is considered the most serious type of corruption as it involves the politicians and the elected elites. As all of these corrupted decisions are decided by those who are on top of the government hierarchy, they can put their votes and trust into society which can balance up the society's interest and influence everyone in the nation. If we live in a country with political leaders enriching themselves on the public funds, we will suffer from life on a countless level which all the necessities such as infrastructure, health care, and education will be massively underfunded. Based on our perspective, grand corruption can also break the standard law and regulations so as to gain a close network, where it will lead to distribute the contracts of common government purchasing. Thus, it provides severe impacts on a country in which the image of the country will be influenced.

Bureaucratic Corruption

Bureaucratic corruption comprises two connections which are the corruption will happen between the political elites with the bureaucrats as well as the

more of a low-level of corruption which usually involves within the executives or managers in the environment of the office. The government officials could choose to accept bribes to fulfill tasks assigned to them by the leaders who are involved in politics, or to carry out tasks they should not be doing illegally. For instance, bribe activities that happened in the market are considered as corruption that can be done by bureaucrats or officials for them to gain the advantages for themselves. They are able to form the obstacles to affect the people who want to enter the market, or they would try to monopolise the market where the permits will be prioritised to the person who involved the highest bribes. Moreover, they can also decide to accept the corruption that offered and next they will fulfill services to speed up the process of bureaucratic for the low level of corruption. This bureaucratic corruption is decentralized that the payment of the bribe can be given to many bureaucrats to avoid and escape from the legal penalty by the related authorities (Jain, 2001).

Political Corruption

Political corruption is defined as the corruption in which political decision-makers are involved. According to Amundsen (1999), political decision-makers will use their political power to sustain their power, status, and wealth. Therefore, this political corruption can be distinguished from the grand and bureaucratic corruption, which is the corruption in the public administration, at the implementation end of the politics. Furthermore, political corruption is the manipulation of political institutions and the rule of procedure. Therefore, it will influence the institution of government and the political system as well as lead to decay in the institution. Besides, people will affect the voting behavior of the legislators in this political corruption (Jain, 2001). This is because political corruption can be including “voting-buying” behavior and in order to be elected through this political corruption, the legislators have the chance to take or offer bribes and increase the frequency of the corruption activities.

As above explanation, it can be known that corruption exists in all the countries, both developed and developing, in the public and private sectors as well as the non-profit and charitable organization (Myint, 2020). This also provides a clear picture of how the corruption takes place and the effect of it. Consequently, corruption will affect the economic growth and innovation of the country due to misallocation of the resources. Malaysia as a country that is notorious with scandals and corruptions which included bribery, yet the country as a developing country which facing highly competitive from other countries in the Southeast Asia (SEA) region, innovation become one of the factors for the country to growth faster. This becomes a serious issue that we need to explore and study. In our study, corruptions being the main independent variable that we want to investigate the relationship of it with innovation activities in Malaysia case. Hence, this part of the study could provide better understanding of corruption before showing how corruption impact on innovation activities.

1.3 Background of Research

In the past there were already some studies that focused on studying the relationship between corruption and innovation. However, the studies are not able to deliver the exact objectives that we want to study about. For example, according to Mahagaonkar (2008), the study focused on investigating on how the corruption affects the innovation in Africa region. Besides that, according to Syed Muhammad Imran et al. (2020), they also studied the effect of corruption on the Pakistan firm level innovation. Both studies are good to be referred as they were analyzing the relationship between corruption and innovation. Unfortunately, these studies are only focused to the African firms and Pakistan firms, which are not same with our aim where we wish to study the same topic, but it is focused in Malaysia. Other than that, we also found one study from Malaysians in studying both variables. According to Ismail Johari & Saifuzzaman Ibrahim (2017), they were focused on investigating how the innovation can affect corruption by using the data from 131 countries. This study is different from

our study because they aimed to study on how the innovation impact the corruption, rather than the corruption affect the innovation., and their data is from various countries. The study that we found that are focused on Malaysia is more to the investigate about the corruption and economic growth. For example, according to Chua, Goh, Lee, Moo, and Tham (2015), they are focused on studying corruption and economic growth. There is also another research studied on how the corruption impacts the FDI that will affect the economic growth too. After reading through these research, we feel that it is important for us to carry out the study on how the corruption impact the innovation that is only focused on Malaysia.

In our research report, one of the key terms that becomes the attention is innovation. According to Schmuck and Benke (2021), innovation is making a new product or product feature that the idea is originally produced, and it is new, and this includes also the newly established business models or process of production. Innovation could help entrepreneurs to create new products and services in the market. Innovation indicates the process of combining the invented chances, then developing an idea to grasp the chances, and lastly carrying out the idea to reach the outcomes (Anthony, 2012). Innovation, such a process is important because it could enhance the overall economy growth in a country through some channels. For example, the contribution of innovation to the country's economy also could come from Small and Medium Enterprises (SMEs). According to Mircevska (2015), SMEs can contribute a great impact on the competitiveness of the country and economic growth, and the reasons are SMEs got their flexibility or adaptability on market changes, and most importantly their impact on employment and knowledge sharing. In order to let small and medium-sized enterprises to maintain competitiveness, develop, and survive for a long time in a dynamic and competitive environment., they must involve themselves frequently in the innovation activities (Mircevska, 2015). From here, we can understand that if SMEs involve themselves frequently in innovation, this can make them become more competitive and contribute to the country's economic growth. Since innovation can promote more discoveries and adopt more new technologies, the productivity in a country also might be improved as well. Not to mention, there are

more than 1.1 million of SMEs in Malaysia which accounted for 97% of established businesses and contributed total of 38.2% of GDP or RM512.8 billion as at 2020 (Mohd Uzir Mahidin, 2021). Hence, innovation could be a very important role for SMEs in Malaysia to grow bigger and go onto global. In addition, they discovered that increasing the innovation doings could improve the output and income on average in developing countries where they measured the innovation level with innovation patents. According to World Bank (2021), Malaysia might turn into a high-income economy between 2024 and 2028, yet there are needs to be further reform in order to join the ranks of other leading and advanced economies. The article stated one of the further reforms was investment in innovation-led private sector growth and policies. Therefore, here is the important to increase the innovation in Malaysia as it can enhance the high-income economy and economic growth through SMEs as discussed above.

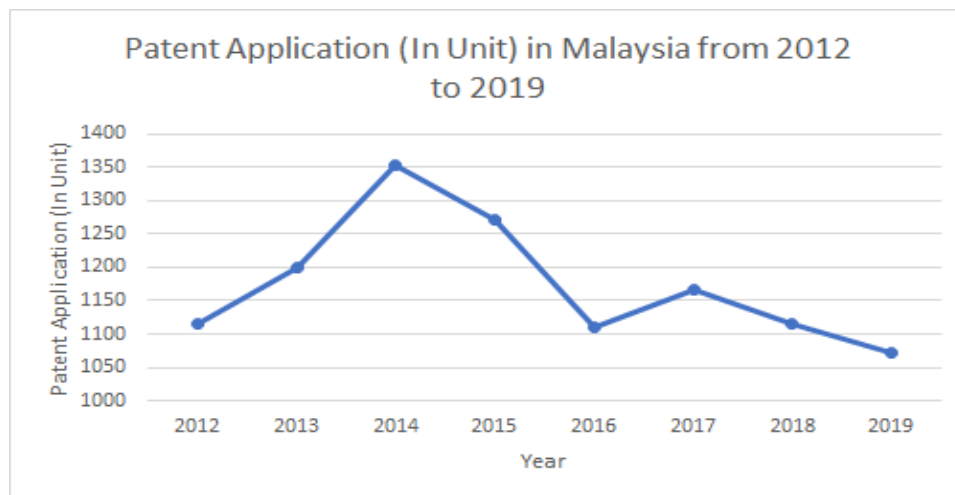


Figure 1.1. Patent Application (In Unit) in Malaysia from 2012 to 2019. Adapted The Global Economy. (2022). Malaysia: Patent applications by residents.

Figure 1.1 shows the number of patent applications in Malaysia from 2012 to 2019 (the Global Economy, 2021). We can witness the highest of patent applications in 2014 which is 1353 applications. From 2012 to 2014, the line graph is moving in upward sloping which indicates the people who applied for patent was increasing

during that period (2012 = 1114 applications, 2013 = 1199 applications, 2014 = 1353 applications). However, the number of people to do innovation is getting lower in 2015 and followings until 2019. The line graph is moving downward sloping pattern from 2015 to 2019. Malaysia achieved the lowest patent applications among these 8 years, which is 1071 of patent applications in 2019.

Based on Figure 1.1, the patent application in Malaysia was dropping since 2014 until 2019. From the performance of patent application in Malaysia, we can see the innovation sector in Malaysia is not doing well or decreasing as the unit of patent application in recent years decreased. According to Tran (2013), among the ASEAN countries, Vietnam, Philippines, Thailand, and Indonesia are classified as lower middle-income country and Malaysia is an upper middle-income country based on the criteria of World Bank. Malaysia as an upper middle-income country should be able to reach higher innovation level but the current situation is not optimistic. If we look into the other ASEAN countries, for example in Indonesia. Although Indonesia is a lower middle-income country, but the innovation performance in the country is improving. Based on Figure 1.2, we can see from 2012 to 2016 the movement is quite stationary which is the fluctuation is not really big (2012 = 557 applications, 2013 = 663, 2014 = 702. 2015 = 1058, and 2016 = 1101). After that, Indonesia achieved a higher record in 2017 which is 2271 applications. In 2018, the patent application dropped to 1407. Surprisingly, they achieved the highest which is 3093 applications in 2019. The overall trend of the graph is considered as upward sloping which also indicates the innovation in Indonesia was doing good. Indonesia, which is a lower middle-income country, is developing their innovation, better than Malaysia which is an upper middle-income country. There must be some reasons or factors that caused Malaysia could not move toward efficiently in the innovation sector.



Figure 1.2. Patent Application (In Unit) in Indonesia from 2012 to 2019. Adapted from World Bank. (2022). *World Development Indicators*.

One of the possible reasons or factors for the dropped patent application in Malaysia might be corruption, where it might obstruct the road to enhance innovation in Malaysia. This is because when there is corruption taking place, we expect the misallocation of resources would be happened where the resources for innovation might get affected. Corruption has always been a hot topic in Malaysia. In recent years, the former prime minister was involved in the 1Malaysia Development Berhad (1MDB) scandal. According to The Star (2020), Datuk Seri Najib Razak was sentenced by the High Court, to go to jail for 12 years and RM210 millions of fine. He was found guilty and charged with the abuse of power, money laundering, and others. The 1MDB scandal could be considered one of the biggest news which involved the corruption of Malaysia Prime Minister. According to Al Jazeera (2021), the investigation persons from United States asserted that there are more than USD 4.5 billion was pilfered from 1MDB fund and some of it might be involved in the laundering activity too. This portion of money should be utilized in building and developing the country such as investing in innovation that is important. Innovation is crucial to the country's wealth or prosperity, yet corruption might be conflictive to innovation. For instance, according to Pippidi (2015), there are some governments who purchase political support from a

group of voters, then governments would allocate resources more to the benefits of supporters. Typically, the education and health care were all neglected without receiving fair treatment. Moreover, both sectors are the root cause of being able to improve and increase the innovation performance in a country. Therefore, we can see there is possible the misallocation of recourse to happen if corruption takes place in a country.

In the past, some researchers published their research that the results are negative and positive relationship regarding the impact of corruption to innovation. For example, according to Ellis, Smith, and White (2020), they found there is an inverse relationship between innovation and political corruption after performing the empirical tests. When the level of politicians involved in corruption is high, the number of patents established is low. However, there is a study indicating that corruption might have a positive relation to innovation. The term is called ‘Grease the wheels of innovation’ which indicates in some cases, corruption can be said to promote or increase the speed of innovation. For example, according to Mahagaonkar (2008), some companies or firms would have corruption with government officials so as to achieve their business affairs. For information, whenever companies wish to invent a new product, they are required to seek approval from the authority, then only these firms would be given license or permit to carry out their project. In this case, the normal procedure could take time, and this would delay the company’s time for proceeding. Therefore, some firms choose to do corruption with the relevant person to speed up the procedure and the firms could practice early. From this phenomenon, the corruption is still contributing to innovation. In this research, we will focus on investigating the relationship between corruption and innovation on whether the corruption impedes or enhances the innovation.

Besides that, we must understand about measurement that is used to determine the level of corruption in a country. According to Baldock (2020), Corruption Perception Index (CPI) was released by Transparency International that evaluates countries based on their perceived levels of corruption in the public sector.

Transparency International's CPI has a high correlation to the other corruption perceived measurement such as the corruption control index by World Bank and corruption index by International Country Risk Guide (Saha, Gounder, and Jen-Je 2012). A high level of CPI score indicates low corruption in the country, while a low CPI score represents high corruption in the country. The graph below is the CPI of Malaysia from 1995 to 2020 which can show an idea about the corruption phenomenon in Malaysia.

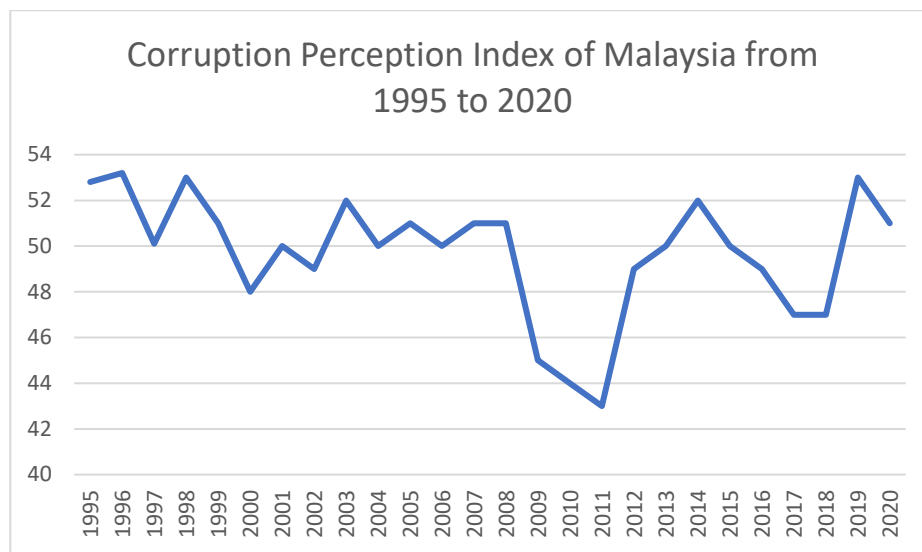


Figure 1.3. Corruption Perception Index of Malaysia from 1995 to 2020. Adapted from Transparency International. (2021). *Corruption Perceptions Index*.

Figure 1.3 shows the score of the CPI in Malaysia from 1995 to 2020 (Transparency International, 2021). We can witness the highest CPI score that Malaysia had achieved in the year of 1996 with 53.2 of CPI score. From 1995 to 2008, the movement of CPI scores did not too fluctuating. However, the CPI score started to drop in 2009 with 45 of CPI score and then in 2010 it continued to decrease to 44 of CPI score. Malaysia achieved the lowest CPI score in 2011 with only 43. Although the CPI score went back to a higher level with 49 in 2012, 50 in 2013, and 52 in 2014, the performance started to drop from 2015 until 2018. For the year of 2019 and 2020, the

CPI scores were 53 and 51. We can see since 2008 afterwards, the Malaysia CPI score was unstable which is more fluctuating. In the recent years, we can see that CPI score in Malaysia has been improving and getting better. However, based on the patent application in Malaysia that discussed in figure 1.1, the trend is downward sloping. The innovation seems like it is not just affected by corruption, but there are also other factors.

Besides that, we will be investigating the relationship between corruption and innovation, we can take the Foreign Direct Investment (FDI) into the investigation as well. According to Ramlan, Md Salleh, and Shamsuddin (2021), FDI plays an important role in influencing the financial development of a country, especially to promote innovation, economic growth, capital accumulation, and labour productivity. Therefore, it is also important to understand the FDI performance in Malaysia. The Figure 1.4 is the performance of FDI in Malaysia from 1995 to 2019.

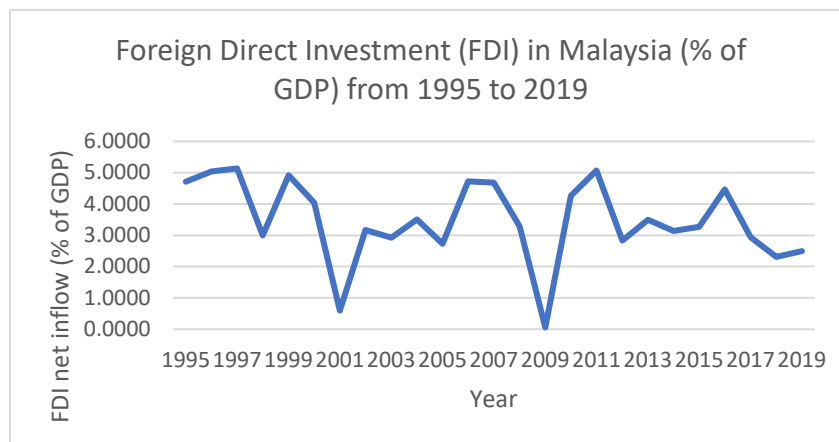


Figure 1.4. Foreign Direct Investment (FDI) in Malaysia (% of GDP) from 1995 to 2019. Adapted from World Bank. (2021). *World Development Indicators*.

Figure 1.4 shows the FDI in Malaysia (% of GDP) from 1995 to 2019 (World Bank, 2021). We can observe the overall trend is in fluctuation from 1995 to 2019.

After the year 1999 the FDI percentage in GDP started to drop until 2001. After that, the performance was quite stable from 2002 to 2006. During 2007 to 2009, the dropping trend was repeat where Malaysia achieved the lowest FDI percentage in GDP in 2009 with only 0.05%. Luckily, the performance increased back in 2010 onwards, but the trend was quite fluctuating as well until 2019. There could be some reasons that caused the foreign investors to pull out from continue investing in Malaysia. According to Kumar and Kaur (2018), there was a total RM308.7 millions of foreign investments by foreign companies have stopped their operation in Malaysia. The main reason is due to the uncertainty in the market and the slow performance of the global economy. The unstable performance of FDI is not favourable because it involves the investment funds to develop the innovation in Malaysia. It is important for people to pay attention to the FDI because this is a way for the country to increase the funds for innovation after the investment by foreign investors. This is also the reason we investigate the Malaysia's FDI performance to investigate its relationship to innovation. If the FDI is low or decrease, this might affect the funds for innovation that come from the investment by foreign countries.

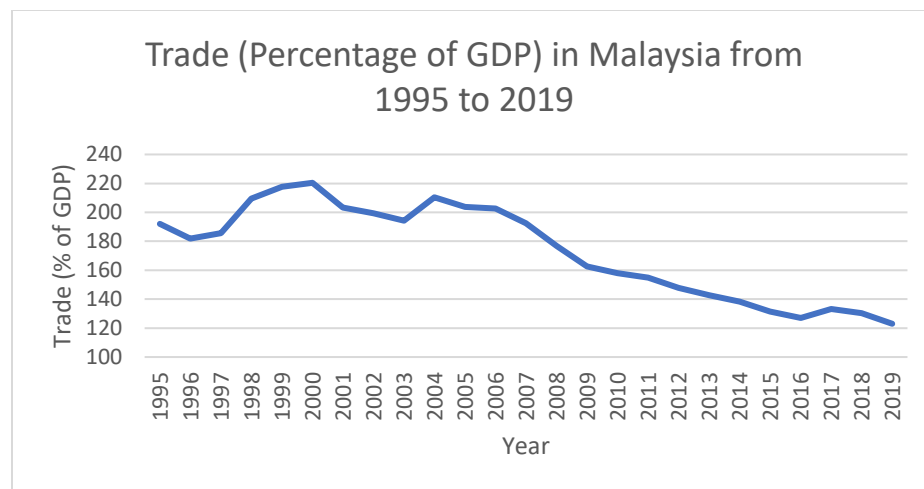


Figure 1.5. Trade (Percentage of GDP) in Malaysia from 1995 to 2019. Adapted from World Bank. (2021). *World Development Indicators*.

Moreover, the other factors that we consider affecting the innovation include the tradetrade openness. The trade openness here includes the total of import and export in Malaysia. Figure 1.5 the trade openness in Malaysia which is calculated by the percentage of GDP from 1995 to 2019. During the year 1995 to 2000, the trade performance in Malaysia is considered good as the trend was in upward sloping which indicates the export and import was increasing. In 2000, Malaysia achieved the highest trade percentage of GDP which is 220 percent of GDP. In 2001, the performance started to slow down until 2003. Although in 2004 there was a slightly increased, but then the trade performance went down again in the following years. From 2005, the trade percentage of GDP in Malaysia has been decreasing until 2016. Even though the percentage went up a little bit in 2017, the performance was still dropped in 2018 and 2019. The overall trend we can see is in downward sloping trend. The possible reason that caused the low performance of trade openness in Malaysia might be the competitiveness of global trade. As time goes on, the countries across the world have improved their own domestic production with more quality and efficiency. In Southeast Asia countries, Singapore was managed to achieve the highest percentage of world exports which is 2.70 percent in 2018. Then, it follows by India with 2.19 percent, Thailand with 1.33 percent, Vietnam with 1.05 percent, and Malaysia is ranked at 5th with only 1.00 percent in 2018. Especially the strong countries like China, United States, Japan, and others that achieved impressive performance in their trade. China has achieved the highest exports which is USD2.7 million, then followed by United States with USD2.1 million in second place. If the poor performance of trade openness continuously to be happened, it might affect the innovation in Malaysia. This is because when countries trade with each other, they are able to exchange ideas when they got to see the product and service. Then, they can improve the innovation by adding a new and special element or feature into it and come out with a new innovation. Therefore, it is important to find out the relationship between trade openness and innovation.

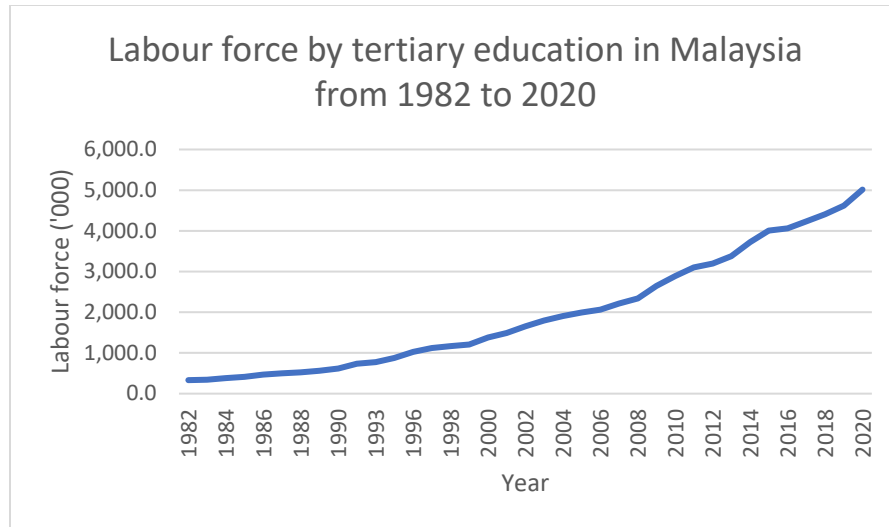


Figure 1.6. Labour Force by Tertiary Education in Malaysia from 1982 to 2020. Adapted from Department of Statistics Malaysia. (2021). Labour force by educational attainment, Malaysia.

Other than that, human capital is also one of the factors that we look into as we believe this will affect the innovation in Malaysia too. The human capital here we refer to the labour forces that come from tertiary education. Figure 1.6 shows the the labour force by tertiary education in Malaysia from 1982 to 2020. The overall trend is upward sloping as you can see the quantity of labour force by tertiary education was improving every year from 1982 to 2020. In 1982, the country only achieved approximately 330 thousands of labour force produced from tertiary education. With the latest performance that found, Malaysia achieved the highest record in 2020 which is around 5 millions of labour force produced from tertiary education. From this, we can see that there are more and more labour forces that come from tertiary education graduates. The reason is the higher education insitutions' quantity is improving as time goes on. There are 92 local universities in Malaysia which includes public and private. The quantity of graduates from tertiary education sure will be increased as there are so many universities in the country and mostly these graduates will work in different sectors. When talking about the relationship between human capital or work forces to

innovation, we believe that the work forces from tertiary education can help in contributing to innovation. This is because tertiary education like university students able to learn many skills or knowledge in their university life and there will be some programmes they could join to assist them to innovate. For example, according to New Straits Times (2022), the University Malaysia Terengganu was having collaboration with IBM so that the students can take the opportunity to join the programme to improve their digital skillset and technology knowledge. This is a valuable opportunity to prepare the university students to contribute it in the working place and society to boost the innovation-driven economy. Therefore, we will investigate the relationship between human capital and innovation.

1.4 Problem Statement

The existence of corruption is always could be seen in most of the countries and this is also including Malaysia. When people talk about corruption, they would feel in the sense of bad or immoral which typically if the person who found guilty of corruption, the person needs to bear the penalty for breaking the law by going to jail or paying the fine. In Malaysia, corruption has always been a common problem, and every time when the citizen is asked about corruption in the country, everyone understands the seriousness of this matter. According to Shankar (2020), there is a surveyed done by the Transparency International and they found that 71 percent of Malaysians see their country is in a massive problem with corruption especially the government sector. Moreover, the organization also found a few portions of Malaysians have the experience of using the personal relationship to achieve their own benefits which is also considered as corruption. All these survey evidence proved that the corruption does really happens in Malaysia rampantly. Not only that, but there are also still many examples happened in Malaysia about the corruption involved government and officials. For instance, the 1MDB case in which the previous prime minister, Najib Razak was suspected of strained RM2.7billion for person use. Besides that, the lack of

stern governance and accountability of the Malaysian Anti-Corruption Commission (MACC) as always got doubted by public that MACC having double standard. All of this not only deprived the public resources that are used for development, but also damaging the country's image and lead to a reduction in investors' confidence.

Moreover, Malaysia is one of the countries that struggling in the middle-income trap. Middle-income trap means the condition of a middle-income country does a transition to the higher-income status for a long time, but they are unable to reach to the higher level of income status as in the developed countries. According to World Bank (2021), middle-income countries (MICs) are referred to as those countries with the Gross Nation Income (GNI) between \$1,036 to \$12,535. Many MICs continue facing the challenge of the middle-income trap which is preventing and delaying the country shift to higher-income status. In other words, it is also difficult in promoting the higher-income status from the low-income status of a country and this goal seems to be unachievable (Farah Adilla, 2020). Malaysia will be stuck in the middle-income trap because of the slower productivity growth from a competitive viewpoint. It will lead Malaysia to face the challenge of being able to become a higher-income nation. Innovation as one of the essential factors in improving the competitiveness of country, this proven that Malaysia will need to work more on innovation in making the country achieve high-income income through creating more high skills job vacancies instead of letting the skillful human capital leaving the country to seek for a better job.

In addition, Herizal Hazri and Vega (2011), claimed that Malaysia is concerned about moving the country out of the middle-income trap to the high-income status country. For example, the Vision 2020 for Malaysia keeps postponed until the year 2050. It also added some new policies from Vision 2020 to Vision 2050 in order to achieve high-income status. Based on our perspective, it is reasonable to believe that this could be the problem of governance. One of the reasons is the rampant of corruption definitely caused the misallocation of resources to use on the right sector which included the innovation, and it also created an unequal business environment for investors and entrepreneurs. The long-term of corruption issues happening in Malaysia

may cause the lack of confidence from foreign investors at the same time reduce the resources for innovation. However, there are also other perspectives that corruption can be a catalyst in boosting the innovation and economy of a country as it could smoothen the long waiting bureaucratic process. The main concern is whether the corruption 'grease' or 'sand' the innovation because there are some studies around the world stating their research results and some showed positive and negative relationship between corruption and innovation. For example, the Pakistan case they found the corruption jeopardizes the innovation in the country (Syed Muhammad Imran et al., 2020) and the corruption such as bribery can speed up the procedure of innovative companies (Ayyagari, Demirgüç-Kunt, & Maksimovic, 2014). There are more cases or evidence that will be shown in the literature review. Malaysia as a developing country must completely utilize the resources with the equitable allocation in all the sectors. If corruption really lowers the resources balancing performance in the country which would impede innovation and growth, then we should strictly prohibit the corruption. Therefore, it is important to find out whether how is the corruption impact the innovation in Malaysia and whether the corruption impact the innovation in Malaysia, and the factors will affect innovation of Malaysia in the long run so that Malaysians will get the right ideas in order to improve the innovation in the country. This becomes a motive for us to study the relationship between corruption and innovation activities in Malaysia. This would help us to know the innovation performance in Malaysia is growing in healthy way or corruption taking a part to improve it.

1.5 Research Objectives

- 1) To examine the relationship between corruption and innovation in Malaysia from year 1995 to 2019.

- 2) To analyze the effect of the control variables (FDI, trade openness, and human capital) to innovation in Malaysia.

1.6 Significance of Study

For Malaysia to become a high-income economy country or developed country, innovation such as in the private sector is essential and can bring the country to that level that is better living standards¹. Based on the past research, there are already many studies focused on the relationship between corruption and economic growth in Malaysia. For example, the research that focused on studying the connection of corruption to economic growth in Malaysia² where the result showed and they believe the corruption will jeopardize the economic growth. Besides that, there is also research mentioned the corruption would lower the FDI which also would further affect Malaysia's economic growth³ (Kapeli & Mohammad, 2015). Although innovation has some research reports in recent years, unfortunately these studies are focused on other countries, for instance, the research that focused in studying the relationship between bribery and innovation in Latin American countries⁴ and the Pakistan case that they found the corruption would affect the innovation in the country⁵. Therefore, we aware there is a gap from here and more studies are demanded to be done on the relevance between corruption and innovation in Malaysia so that Malaysia's innovation could be given more attention by the government and public.

For another importance to do the research on this, innovation is one of the essential paths that require a high attentiveness from every country and everyone due to the value that can be created by innovation. In addition, the ability to perform the innovation is soon become the most important determinant of economic growth in order to strive in

¹ World Bank (2021) the improvement of the quality due to achieve the higher income status between 2024 to 2028 in Malaysia.

² See Chua et al. (2015) the relationship between corruption and economic growth in Malaysia.

³ See Kapeli and Mohamed, N. (2015) for more detailed on the insight of anti-corruption initiatives in Malaysia.

⁴ See Wellalage and Thrikawala (2021) the example of the relationship between bribery and innovation in other countries.

⁵ See Syed Muhammad Imran et al. (2020) the effect of corruption on firm level innovation.

21st century global economy⁶. While technology is often the first aspect, innovation and the involvement of technology can even make the results better and more impressive. Whether the corruption phenomenon in Malaysia enhance or impede the innovation sector, this is still clueless or ignorance. Thence, at the end of this research, readers will be able to have a clear idea on how the corruption impact the innovation, which is focus on Malaysia case.

Besides that, in this research report, there are also some control variables and independent variables such as corruption, foreign direct investment (FDI), trade openness, and human capital will be testing with the innovation. It is important to find out the significance and relationship between these variables and innovation in Malaysia for people to identify the aspects need to be given more attention. With these identifications, people like policy makers would emphasize more policies or advise the government in those fields. The government must strengthen control in these areas to eradicate the harmful activities like corruption or money laundering to secure the innovation efficiency in Malaysia.

1.7 Structure of Study

In this research study, there are consist of three chapters which are Chapter 1: Research Overview, Chapter 2: Literature Review, Chapter 3: Methodology, Chapter 4: Data Analysis, and Chapter 5: Conclusion. Firstly, chapter 1 will be viewing the introduction, research background, problem statement, research objectives, significance of the study, and structure of the study. Next, it will enter to the chapter 2. The chapter 2 will be discussing relevant theories, conceptual framework, relevant past studies, and gap of literature review. The chapter 3 will be showing the methodology introduction and theoretical framework. Following by the data description which is talking about the independent and dependent variable and source of data. Then, it will

⁶ National Research Council (2012) for more detailed on the innovation and strive to the global economy.

continue discussing about the model specification, data analysis method and diagnostic checking. The chapter 4 is data analysis that will be doing the test such as unit root test, autoregressive distributed lag (ARDL) approach, and diagnostic checking. Under unit root test, there are two methods which are Augmented Dickey Fuller (ADF) and Phillips-Perron (PP). For diagnostic checking, we will check the multicollinearity, heteroscedasticity, autocorrelation, normality test, and CUSUM of squares test. In the chapter 5, we will be discussing the summary of study, policy implication, limitation of study, and recommendation.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This chapter discusses how the corruption and the other control variables which are foreign direct investment (FDI), trade openness, and human capital impact on the innovation. Besides that, the relevant theories and concept of the topic will be showed in this chapter and forming the conceptual framework to provide a clear view on the connection between the independent variable as well as the control variables with dependent variable that we study. Past relevant studies will be reviewed to examine the relationship between independent variables and control variables towards dependent variables. Lastly, the gap of the research will be determined in the last part of this chapter as well.

2.1 Review of Theories and Concepts

2.1.1 Schumpeter's Theory of Innovation

The Schumpeter's theory of innovation is one of the most discussed theories when come to the research on innovation. Schumpeter defined the innovation only correctly applied if the invention penetrated every layer of the market by an entrepreneur and even involved economic level when he defines innovation (Golla, 2011). According to Schumpeter innovation is a "*process of industrial mutation, that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one*". He also

argued that innovation is important for anyone seeking profits and innovation will cause the different employment of the economic system's prevailing supplies of productive methods (Schumpeter, 1934). This is because Schumpeter believed that innovation is a key factor of competitiveness (Porter & Stern, 1999) and economic dynamic (Hanush & Pyka, 2007). In Schumpeter's publication of *Capitalism, Socialism and Democracy* (1942), he also believed that innovation may cause gales of "creative destruction" as it is the central feature of economic change. Sweezy (1943), also supported the perspective of Schumpeter which innovation is the central feature of economic development and even asserted that who denied this concept of disobeying a large amount of obvious and indisputable facts.

Schumpeter emphasized on innovations are key factors to defining the economic growth, while the "entrepreneur" is the central innovator. He described that the main function of the entrepreneur is to utilize the existing resources for "new uses and new combinations". Besides that, Schumpeter divided the innovation process into four dimensions which consist of invention, innovation, diffusion, and imitation (Burton-Jones, 1999). Based on his explanation, in the invention phase or during the early process of innovation have lesser impact to economy, while the diffusion and imitation phase will create much higher impact on economy. This is because during the basic innovation phase, the investment and employment are not noticeable, but rather in the diffusion stage which is the period when imitators started to have the profitable potential of the new product and begin to largely invest in that technology (Freeman, 1987). Then, this brings a higher influence on the economy.

Moreover, Schumpeter also stated that invention is not the factor for economic growth as discovery and execution are totally not the same things (Schumpeter, 1939). As being said, a pure new idea is not enough for implementation, and it must be implemented by a strong person (entrepreneur) through his influence (Schumpeter, 1912). Hence, execution is a key driver for economic growth rather

than a good idea. Also, according to Schumpeter (1942), the key driver of capitalism is the “creative destruction”. If there is no creative destruction, then it would be timeless of imitation and it is not the key factor of capitalism at all (Schumpeter,1942).

In a nutshell, innovation is essential to the economy growth, and it is the “creative destruction” in economic development, while the entrepreneur holds the role of change creator. From the Schumpeter theory on innovation, we can know that how important innovation is toward a country’s development.

2.1.2 Rent Seeking

Rent seeking refers to an act of using scarce resources to gain monopoly rents without contributing to the society by individuals or firms (Khemani & Shapiro, 1993). Other than that, based on the research of Bade and Parkin (2013), rent seeking activities are intended to increase the profits through lobbying and other political activity from finding the trade opportunities in between. Besides that, Chowdhury and Latif (2006) claimed that rent-seeking able to apply on bureaucratic corruption who seek and extort bribe or rent for using their legal but discretionary authority for providing legitimate or illegitimate benefits to the stakeholders. From that, it can be seen that the concept of rent-seeking is actually related to corruption, lobbying and bribery which all of these can be covered by the concept of rent seeking.

If deep dive into the rent seeking theory, the theory of rent-seeking was first introduced by Gordon Tullock in 1967. However, the term “rent seeking” had not yet been used in the study. Tullock (1967) claimed that the welfare losses caused by monopolization are much greater than the typical triangle welfare losses. He argued that the total welfare cost should incur transfer costs that result from activities like taxation and tariffs. After seven years since his paper was published, a study by Anne Krueger with the title of “The Political Economy of

Rent-Seeking” had been popularized the term “rent seeking” and has been widely used since then (Tullock, 2003). The restriction on output by the government would create the potential for monopoly rent and it would come in the illegal form, such as corruption, bribery, and the black market. Hence, the firms would compete and spent resources in lobbying the government to obtain the monopoly rent (Krueger, 1974). As a result, the resources spent might offset or even greater than the possible monopoly profit in the process of competing with other firms and ended up giving no welfare to society. This can be illustrated by Figure 2.1 below:

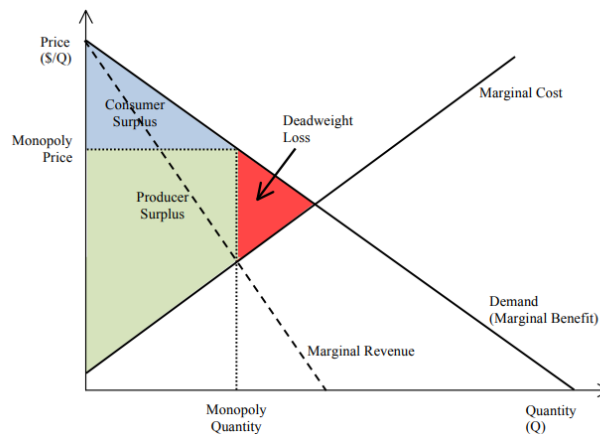


Figure 2.1. Rent-Seeking Diagram. Adapted from Mitchell. (2012). The Pathology of Privilege: The Economic Consequences of Government Favoritism.

The Figure 2.1 showed that the monopolist would charge a higher price than a competitive firm as shown in the Figure 2.1 at point “monopoly price”. This led to the consumer surplus becoming smaller while the producer surplus increased. The monopoly profits are larger compared with the common profit obtained by a competitive firm as the monopolist can capture the whole producer surplus. This effect of consumer surplus transfer to producer surplus is known as redistributed effect (Bade & Parkin, 2013). Thus, the total of

producer and consumer surplus become lesser under monopoly than under competitive environment. This caused the loss in social benefits which refers to the area of deadweight loss (Mitchell, 2012).

2.1.3 “Grease and Sand the Wheel” Hypothesis

Corruption can be used to facilitate certain situations in the bureaucracy such as ill functioning or bad governance situations sometime and create growth. According to Acemoglu and Verdier (1998), they have supported the idea that corruption is positive toward the growth rate. In this case, it is known as “grease the wheel”. According Lui (1985), he stated that corruption is able to accelerate the slow administration process as it provides incentive to speed up the process. For instances, the companies will receive the business licenses that give out from the bureaucrats and this can benefit those who perform the corruption with the government officials for speeding up the process. This shows how corruption can help in reducing the time for bureaucratic administration process and regulations. Not only that, according to Beck and Maher (1986) and Lien (1986), if there is the situation that lack of information or difficult in decision making for bureaucrats, then corruption can improve the decision making which normally replicated by the outcome of a competitive auction. In other words, corruption may be an efficient method for bureaucrats in providing authority to the bidder that bribes, so that they do not need to go through a longer process of evaluation and review. According to Leff (1964), the government license has the higher chance allocated to bribers that provide more bribes. Besides that, Bayley (1966) claimed that corruption is able to improve the results of government’s policy based on the objectives. Bribery can be used to hedge against unfavorable public policies (Leff, 1964; Bayley, 1966). Corruption can use to avoid dealing with inefficient regulations and bias such as racist, gender discrimination and more. This can create a favorable outcome of a policy that are benefits to growth (Méon & Sekkat, 2005). Leff (1964) also

claimed that corruption might increase the quality of investment if it able to hedge or reduce the risk that is caused by the bad political system, such as expropriation. Overall, this shows how corruption is able to “grease the wheel” in making growth to economic activity, development as well as the innovation if there is unfavorable bureaucratic system and bad quality of governance.

However, it cannot be denied that corruption can bring negative effects due to higher costs and lower competitiveness led to low quality. Hence, the other side of the hypothesis, “sand the wheel” shows that corruption will bring harm to growth as the bureaucracy and the quality of governance. One of the negative effects is that the corrupt civil servants may intend to extort bribes and then deliberately delayed the administration process (Myrdal, 1968). This is relatively obvious when the officer can use their authority and veto power to slow down or reject a project just to extract more bribes. Thus, this could create a culture of corruption to accelerate the process or just to get the work done. Kurer (1993) also claimed that corrupt officials may purposely create more inefficiencies in economy to make their illegitimate source of income sustainable. Apart from that, Shleifer and Vishny (1993) stated that the cost of corruption can be increased to get approval for the right of control of a project when more officials are involved. This led to an increase in the number of transactions due to corruption and according to Jain (2001), this will eliminate the benefits and reduce efficiency due to the higher in cost. There are also another side of views of whether corruption is able to improve the government’s decision making or right selection. According to Rose-Ackerman (1997), he argues that a firm may produce lower quality products due to the increase in cost as the results of paying higher bribes. Thus, this could cause a low in innovation performance as lower quality products in the market due to corruption.

Furthermore, there is also evidence argued that corruption may not improve the quantity and quality of investment as it drives misallocation of public spending

from the investment (Mauro, 1998). This means that the public investment led by corruption may invest into nonproductive sectors which make the investment inefficient. Not only that, but the whether the corruption can hedge against risk due to weak political environment is also questionable. There are many other additional risks that could cause the agreements through corrupted ineffective (Bardhan, 1997). This is further supported by Campos, Lien, and Pradhan (1999) and Lambsdorff (2003), they pointed out that the uncertainty of corruption holdback the investment and capital inflows. In short, corruption can also have negative impacts as increases in the risks, costs and lower the quality of economic activities.

2.2 Relevant Past Studies

2.2.1 The Role of Corruption on Innovation Activities

The relationship between corruption and innovation is very controversial. This is because in the past, some researchers were studying the positive and negative effects of corruption on national development. In the role of corruption on innovation activities, there are arguments on both stand which refer to “Grease the Wheel” that means the corruption could increase the innovation, and “Sand the Wheel” indicates the corruption would jeopardize the innovation. According to Veracierto (2018), there was a finding that shows the corruption is able to reduce the investment activities. The researcher mentioned that when there is an improvement of anti-corruption, the gross domestic production tends to increase in its performance. Besides that, by using an instance to describe it, they also found if a country could increase their moral value or integrity regardless public and private, the investment level like Foreign Direct Investment (FDI) would increase as it would raise the GDP performance as well. This is because mostly investors have their confidence in those countries with a positive image

and reputation are high. The positive image here includes low corruption level, high trustworthy, and consistency growth development. If the corruption is high, the investors are less likely would put their investment in the country since they do not want the funds provided by them are misallocated or wrongly allocate to do any unknown or even illegal activities. From this past study, we could become aware the relationship between the corruption and innovation is in a negative relationship.

Besides that, there was a study that focused on Pakistan where they found the relationship between the corruption and innovation is also inverse relationship. Pakistan is same with Malaysia as a developing country have a same goal which is move towards the future evolved as a developed country. It is also worth mentioning that Pakistan is a frequent corruption case country, and its score in Transparency International is also low, which also represents high corruption. According to Transparency International (2021), Pakistan achieved the Corruption Perception Index (CPI) of only 31 score and rank as 124 of 180. Hence, the case study in Pakistan could be used as a reference for Malaysia to pay attention to. According to Syed Muhammad Imran et al. (2020), they found the corruption is pulling down the innovation as well as the entrepreneurship in the country. Moreover, there was a study mentioned those countries that are weak in governance or decline performance tend to harm the company that is doing innovation projects. This is because based on the other countries policy, the government has been giving subsidies or allowance for those firms that are doing research and development. If the country with high corruption, then it might affect the efficiency in allocation of the resource to all parties or sectors. Investors do not want to risk their fund into an uncertainty or unstable country performance which would cause them lost.

Moreover, there is research we found about an investigation of the impact of bribery at the firm level in Latin American countries on product and process innovation. According to Wellalage and Thrikawala (2021), the research stated

that bribery has a significant negative impact on innovation at the firm level and corruption has a greater adverse effect on innovation in small firms than on innovation in large firms. From this, it shows the corruption or bribery could affect the innovation and the firms progress in Latin American countries. There was another research which focus on investigating the relationship between corruption and innovation by using the data of 48 consecutive U.S. states. According to Dincer (2019), he found that the corruption can decelerate innovation activity after he ran out the estimation by using Corruption Convictions (CCI) Index and Corruption Reflections Index (CRI).

Other than that, there is a study which is specifically discussing about both of two stands which are 'Grease the wheel' and 'Sand the wheel'. According to Mahagaonkar (2008), there are some perspectives people could see in the situation of corruption improves innovation. In the case of 'Grease the wheel', Most businesses in the innovation industry, whenever they want to create a new product or idea, since most of their products are the latest and no one has promoted them, these businesses first apply for copyright or patent for themselves. They need to pass government departments and officials to obtain accuracy. Often these processes require some time or a long time to evaluate and judge. From this perspective, this process is time-consuming and can also cause trouble for innovative businesses. Therefore, some businesses will use corruption to get priority over government officials over others. From the corruption view here, it could improve the speed of processing the innovation patent procedure, so the firms could further continue their plan until the launch of their innovation. According to Ayyagari et al. (2014), they also found that the possibility of innovative companies paying bribes to government officials is high. The research also stated the innovative company would pay more bribes to avoid government regulations and skipping some procedures such as introducing the product and examining the newly invented products. Based the arguments above, both stands are debatable and for Malaysia, researchers must focus and run the test by using Malaysia's data to determine whether the

corruption in Malaysia could enhance or impede the innovation.

2.2.2 The Role of Foreign Direct Investment (FDI) on Innovation Activities

Foreign direct investment (FDI) always plays an important part in financing the balance of payments in theory of a country as it had improved the country's output and exports. According to Mitic and Ivic (2016), FDI inflows plays a significant role on the innovation and export of goods and high-tech exports such as technology products, systems, services, and more. Besides that, Loukil (2020) noted that financial resources are the essential factor of technological development in a country. From that, it can be known that FDI inflows are such important toward innovation for a country. The amount of money investment will definitely determine the level of innovation of a country, and it is relatively important to developing countries like Malaysia. This is also supported by Jaiblai and Shenai (2019), they emphasized that adequate FDI is the inevitable condition to improve innovation. According to Shi and Li (2014), the research mentioned that there is a significant effect on the innovation production where the government can improve their country policy to incur more foreign investment to continue developing the innovation in the China's FDI. Moreover, according to Vaatanen, Podmetina, Aleksandrova, and Smirnova (2009), through their research stated the effect of FDI to the innovation in Russia is limited since the foreign companies could not perform well in research and development (R&D) in the country. They also mentioned the productivity of Russian R&D is low. From here, we can understand when the less foreign companies or FDI take place in the country, there will be an obstacle for the country's innovation development.

In the other side, Sivalogathan and Wu (2014) claimed that FDI may also lead to technology negative spillover effects because of the cost to acquire, transfer,

and use in a new location, and it may also be due to competition. This will cause the FDI to not have significant positive impact on host country's innovation development. They have stated the inflows of FDI may only have little benefits to the host country's innovation capability despite the overall innovation inputs and outputs. This is because the R&D active foreign firms continuous isolated innovation poles in the countries they invested in, which mostly are developing economies such as Malaysia.

2.2.3 The Role of Trade Openness on Innovation Activities

Many studies have drawn to the conclusion that trade openness has a positive impact on innovation development. According to Yanikkaya (2003), trading with developed countries brings large positive impact for technology development as it boosts the development of R&D through accelerating returns to innovation and allows producers to access larger markets. Besides that, Dannhauser (2017) suggested that trade activities have impact on innovation that is significant to economic growth. Furthermore, Chang, Kaltani and Loayza (2009) also denote that trade liberalization helps to improve productivity because of the exchange and sharing in technology as well as technical knowledge among the trading partners. There is evidence that the public policies to strengthen trade openness have a positive impact on the level of innovation of nation especially the nations with emerging economies, the effect will be more obvious (Dotta & Munyo, 2019). According to Udeagha and Ngepah (2020), trade openness can motivate innovation through high market access and competition to establish more entrepreneurship. Thus, the trade openness which is the exchange of goods and services has been supported that it brings direct positive impact to the level of innovation development.

There is lack of arguments that trade openness actually has a direct negative impact to the level of innovation development. However, some are against the

positive influence of trade openness that will affect the economic growth. According to Keho (2017), trade openness may negatively impact on economic growth by increasing inflation and lowering exchange rates, and this negative impact is mostly happened to countries that specialize in low- quality production. Besides that, from the research of Andersen and Babula (2008), they point out that the unclear causality of positive relationship between trade and economic growth could be endogenous. The authors also argued that there were confusing results with the measurement used in the estimation. From the arguments, we can say that the negative impact of trade openness on economic growth will indirectly affect the innovation development in a country as economic development and innovation are often highly correlated.

2.2.4 The Role of Human Capital on Innovation Activities

As innovation is mostly require skillful labours to perform especially specializes in certain sector. University graduates who normally assumed to be skilled labour that actually become labour force will be good to explain contribution of human capital to innovation of a country. Previous studies, Cammeraat, Samek, and Squicciarini (2021) claimed that skills are important factor to innovation in industries and countries. According to Senadjki, Ogbeibu, Yip, Au Yong, and Senadjki (2021), the rise in the number of university graduates may bring the improvement in the network of a knowledge-centered economy and increase the accessibility of creative ideas inflow. Senadjki et al. (2021) also stated that university graduates as driver of sustainable long-term innovation and contributor to the country's economic growth, they play a role in lifting the national innovation. Moreover, according to Alawamleh, Bani Ismail, Aqeel, and Kamal Jamal Alawamleh (2019), the research stated the contribution to the country's economic growth is come from the improvement of human capital, meanwhile the innovation improves as well when the new ideas keep on creating.

Nevertheless, Cammeraat et al. (2021) raised the opposite argument that why human capital with tertiary education does not correspond to the innovative activities of a country. This is due to tertiary education not being compulsory in building human capital that all skills matter to the same extent. There is also no information truly proven that different skills that may be important for innovation, even though raising in number of evidence showing that intermediate-skill workers and uncertified skills are also important for innovation and economic growth. Besides, Cammeraat et al. (2021) provided example to shows that increase in innovation output is not solely rely on high and upper intermediate skills (tertiary education), but the workforce as a whole. This is based on the evidence of a Swiss manufacturing firms suggests that the improve in product innovation when there is strong presence of apprentice-trained workers alongside university graduates. In other work, the workers with lower-level education are also important towards the innovation output.

2.3 Conceptual Framework

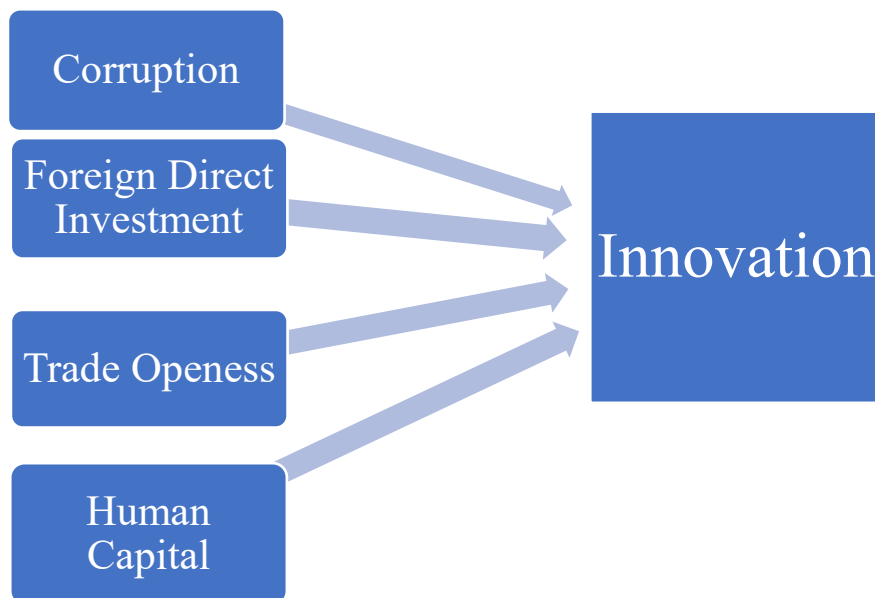


Figure 2.2: Proposed Conceptual Framework.

The Figure 2.2 shows the proposed conceptual framework to study the relationship between the dependent variable which is innovation, the independent variables which is corruption, and control variables included foreign direct investment (FDI), trade openness, and human capital.

Based on the Schumpeter theory discussed in the previous part, it shows the core definition of innovation and how important innovation is towards a country in terms of economy and development. While from the rent seeking theory, it shows that the misallocation of resources due to corruption may create a deadweight loss which offset the benefits of everyone in the economy. However, the “grease and sand the wheel” hypothesis shows both reasonable point of view on corruptions may bring positive impact and negative impact in term of growth of economy activities, development, firm performance as well as related to innovation activities. This shows both stand of support and contradict with the rent seeking theory. Thus, we make the innovation as the dependent variable in our research to investigate how the corruption can impact on the innovation level in Malaysia; whether it is negatively or positively impacted. Throughout this investigation between the relationship, we could know how the Malaysia’s governance and bureaucratic environment in economy activities which included innovation as innovate normally rely on administration and support from government.

Furthermore, there are another three control variables which are FDI, trade openness, and human capital which many researchers found out the relationship with the innovation. The relevant past studies were studied to review both perspectives of the independent variable and control variables toward the innovation. As there are arguments that corruption can indirectly affect the FDI either in positive or negative way, then we take FDI one of our control variables to investigate the relationship with innovation. FDI always plays a significant role in the innovation and export of high technology goods. Financial resources are an essential factor to enhance the innovation activities in a country. On the other side, if there is inefficient use of the

money from FDI for the development activities such as cost to acquire, transfer to new location, increase the competitiveness and the core innovation technology and skills does not share to the country which it is invested, this will cause the insignificant of FDI towards innovation of a country.

Besides that, trade openness is also another control variable to investigate the relationship with innovation. Trade openness is able to improve the innovation activities through bigger market access for the producers so that it can increase the profit gain with higher demand. The increase in competition due to trade openness also forces firms and entrepreneurs to continue innovate for better products. Trade openness also increases the sharing in technology and technical trade, this can enhance innovation, and this is even obvious in developing countries as they could get technology from advanced countries. However, trade openness may have negative impact on the economy sometimes due to increasing inflation and lower exchange rates. In addition, researchers also have arguments on the trade openness can bring a positive impact to country's development and economic growth is not reliable. Thus, trade openness becomes one of the control variables in our research to investigate the case of Malaysia.

The human capital with tertiary education which normally assume to be skillful is an important factor for innovation in industries and countries. Human capital may bring new creative ideas inflow and the improvement in the network of a knowledge-centered economy. Thus, human capital is essential in long-term sustainable growth as human capital is able to accelerate the innovation in a country. However, there is an opposite argument that there is no obvious evidence showing that human capital with tertiary education can improve innovation activities. As innovation output is not only rely on higher skills labour, instead it should be whole workforce. Overall, the proposed conceptual framework was formed to show how our independent variables and control variables link with the dependent variable.

2.4 Gap of Literature Review

Based on our research, we found out only few studies studied the relationship between corruption and innovation activities of a country or a region, and limited study are study in the case of Malaysia. For instance, the research focused in overseas, the research that studied the relationship between bribery and innovation in Latin American countries (Wellalage & Thrikawala, 2021) and the corruption would affect the innovation in Pakistan (Syed Muhammad Imran et al., 2020). Instead, most of the studies were focused on corruption and economic growth. For example, it is a study about how the corruption impact on economic growth in Malaysia by (Chua et al., 2015) and another research studied the corruption lower down the foreign direct investment (FDI) which also would further affect Malaysia's economic growth (Kapeli & Mohamed, 2015). Not only that, but many researchers have found out different stand on corruption to innovation in other countries as mentioned in previous part, either "grease or sand the wheel". This has become a gap for our research to fulfil as this research will investigate the relationship of corruption and innovation in the case of Malaysia. Besides that, the majority of the research was also studies on panel data which they are comparing different countries in a relatively shorter period. Besides, the result in the real world is infirm due to the fast changing of innovation development and corruption levels are also difference in developed and developing countries. Hence, our study can cover the gap by using time series analysis with 25 years data to find out the long run effect of corruption toward innovation activities in Malaysia over the time. Furthermore, many past studies only investigated the micro level which study the impact of corruption by firms. Our research is also able to fill up this notch by using macro based with the variables involved. Last but not least, this research also able to point out whether the corruption or rent seeking activity can speed up the bureaucratic procedure to increase the efficiency of government officials to reduce or overcome the red tape (excessive bureaucracy) hindrances then led to increase innovation or the other stand.

CHAPTER 3: METHODOLOGY

3.0 Introduction

The objective of this chapter is to express about the approaches that have been adopted. The data description, theoretical framework, econometric model, data analysis method, and diagnostic checks are all covered in this chapter. In this research, we are using secondary data from 1995 to 2019. The data description will also discuss the four independent variables which included corruption, foreign direct investment (FDI), trade openness, and human capital, and innovation as the dependent variables. In the theoretical framework, it provides a clear picture with basic set up models to show about the rent-seeking activities as well as and innovation. Then, we will form the econometric model. In terms of data analysis method, the tests used are unit root test included Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test, and Autoregressive Distributed Lag (ARDL) approach. Subsequently, we will perform four diagnostic checking Multicollinearity, Heteroscedasticity, Autocorrelation, Normality test, and CUSUMSQ test to make sure our model is free from econometric problems.

3.1 Data Description

Time series analysis is apply to determine the relationship between the independent variables (corruption, FDI, trade openness, and human capital) and dependent variable (innovation) in the case of Malaysia. The secondary data was collected from different channels for the year 1995 to 2019 based on yearly basis.

3.1.1 Dependent Variables and Measurements

Innovation

The dependent variables used in this study is innovation that measured by the total number of patent application by residents in Malaysia. This data was obtained from the official website of World Bank.

3.1.2 Independent Variables and Measurements

Corruption

In this study, the main independent variable is corruption which is measured by Corruption Perception Index (CPI) provided by Transparency International. The CPI data ranks the countries around the world based on how corrupt their public sector is supposed to be. The CPI is calculated based on 13 different external sources of data that were produced by the World Bank, The World Economic Forum, Private Risk and Consulting Companies, and Think Tanks. The score ranges from 1 to 100, where the lower CPI indicates the higher perceived corruption level while the higher CPI illustrates lower perceived corruption level (Transparency International, 2021).

Moreover, the expected relationship between corruption and innovation activities based on the measurement CPI and patent application is positive relationship in this research. As higher score in CPI indicates that a country is perceived to have lower corruption level. This is common for us to perceive that a clean governance or incorrupt government could lead to higher innovation. In other word, the lower the CPI will have lower innovation. Based on the research of Mahagaonkar (2008), he stated the research results confirmed that corruption brings negative effects on product innovation due to the financial access and higher in the cost of investment in innovation just for bribe. Not to mention, his research was focused on developing economies which is more

relatable with Malaysia as a developing country. In addition, the Pirtea, Sipos, and Ionescu (2019), also supporting the stand of “sand the wheel” which higher corruption will harm the innovation activities and their empirical results showed that corruption has negatively and significantly affected the firm’s innovation process in emerging countries. Therefore, the authors’ research is. Thus, this study provides the positive expected sign for the relationship between CPI and innovation in Malaysia which indicates higher CPI (lower corruption) can improve the innovation activities and vice versa.

∴ Let β_1 to be coefficient of CPI. With the expected positive sign, then it forms as: $+\beta_1$

Foreign Direct Investment (FDI)

FDI refers to the net inflows of foreign direct investment into Malaysia. In this case, the data of net inflows FDI is represented as a percentage of GDP that obtained from the World Bank. It involves equity capital, earnings reinvestment, long and short-term capital, as well as other capital. The net inflow of foreign direct investment comes from the inflow of new investment that obtains the management interest of at least 10 percent in any business entities in a nation and then deduct disinvestments.

In this research, FDI is expected to have positively affect the innovation activities as we believe it is reasonable to assume that FDI inflows to Malaysia may bring positive impacts on domestic innovations due to various advantage. For instance, increase the financial resources for innovation activities, exchange of technology and knowledge, and increase in competition lead to more creative ideas. According to Kinoshita (2000), he also claimed that FDI will have positively effect to innovation activities as the productivity improve. The author provided the reason of FDI can improve the productivity as well as firm’s research and development (R&D) due to the connection and training effects of technology. While the FDI can bring positive impacts to the whole

industry in innovation because of the foreign firms brought demonstration and competition effects to all firms in the industry. This means that firms in the industry get to exchange and share the similar technology that brought by different foreign firms and consistently generate new ideas to stay competitive in the industry lead to positive effects. Besides that, Cheung and Lin (2004) were researched on the impacts of FDI on patent applications in China, and they also believe that FDI inflow to China which as a developing country and majority of patent applications are from minor innovations could bring positive impacts on China's innovations. Ultimately, their results showed that the effect was proportionally large which were positive and significant. This can be a reference substance for Malaysia case. Hence, we expected a positive sign for the relationship between FDI and innovation activities (patent applications).

∴ Let β_2 to be coefficient of FDI. With the expected positive sign, then it forms as: $+\beta_2$

Trade Openness

In this study, we use trade variable to represent for trade openness. The data for trade variable was extracted from the World Bank which is the sum of exports and imports of goods and services measured as a proportion of GDP. In our study, we expected the trade openness to have positive relationship with the innovation activities. This means that the increase in trade openness will lead to higher innovation activities in Malaysia. If it is decrease, then the lower the innovation activities. It is reasonable for us to expect that the trade openness in Malaysia will positively associated with the innovation. Malaysia as a developing country which normally will have lower innovation activities, so that trading with other developed countries could help Malaysia to improve in innovation by getting better technology. According to the study of Dotta and Munyo (2019), their results showed that there is trade openness is positively affecting the level of innovation, and the effect is more obvious in developing countries. The authors supported those developing

countries can benefit the most from technology exchanged through international trade. Besides that, the findings of Almeida and Fernandes (2007) also showed the trade openness has strong positive association with technological innovation in industries and countries. Not to mention, their study was also focused on firm-level data in developing countries. Therefore, in our study we make the hypothesis that trade openness has positive impact on innovation activities as we believe Malaysia as a developing country can gain more benefits in innovation development through trade with other countries.

∴ Let β_3 to be coefficient of trade openness. With the expected positive sign, then it forms as: $+\beta_3$

Human Capital

For the human capital variable, the data used is labor force by tertiary educational attainment that obtained from the Department of Statistics Malaysia. Labor force by tertiary educational attainment refers to the employed person with at least pursuing undergraduate programs. In this study, human capital is expected to positively associated with the innovation activities. It means that the innovation activities in Malaysia would improve when there are more university graduates enter into workforce. It is rational for us to expect that human capital is positively related to innovation as the university graduates normally acquired knowledges, skills, and abilities that needed for research and development related activities and inventions. A prior study by Diebolt and Hippe (2019) suggested that human capital is the key driver for current regional innovation and economic development disparities in Europe. Their research found out that the human capital is the most relevant factor in explaining the patent applications per capita and current GDP per capita, which proposed that literacy is said to be the major factor. Besides, Dakhli and De Clercq (2004) also claimed that there is strong evidence to prove that human capital is having positive relationship with number of patents, level of R&D expenditures and high-technology export. Next, Van Uden, Knobens, and Vermeulen (2014) also

showed that there is positive relationship between human capital and innovation. In their study, formal training and slack time for employee were found to be favorable in promoting innovative output. As their study is focused on firm level in developing countries, we believe that Malaysia would also experience the same way, where human capital is positively related to innovation activities.

∴ Let β_4 to be coefficient of human capital. With the expected positive sign, then it forms as: $+\beta_4$

Table 3.1: Summary of Variables, Abbreviation, Expected Sign and Data Sources

Variable	Abbreviation	Variable	Expected Sign	Source
Dependent Variable				
Innovation	INN	Patent applications (Residents in Malaysia)	Positive	World Bank
Independent Variables				
Corruption	CPI	Corruption Perception Index (Index)	Positive	Transparency International
Foreign Direct Investment	FDI	Foreign direct investment, net inflows (% of GDP)	Positive	World Bank
Trade Openness	TRADE	Trade (% of GDP)	Positive	World Bank
Human Capital	HC	Labor force by tertiary educational attainment	Positive	Department of Statistic Malaysia

3.2 Theoretical Framework

To analyze rent-seeking and innovation, in our study refer to the basic theoretical framework and models from Aghion and Howitt (1998) and Chaudhry and Garner (2007). As mentioned, rent-seeking is also able to apply to bureaucratic corruption. Thus, this theoretical framework is to explain how innovation will be affected by the monopoly and labour and show that the corruption activities will take place for government to protect the monopolist in our study.

Firstly, the economy is populated by a consistently mass L of individuals with linear intertemporal preferences given by $u(y) = \int_0^{\infty} y_{\tau} e^{-r\tau} d\tau$, which the final output (consumption) good, and the rate of time preference of consumers that equals the interest rate are denoted by y and r respectively. Final output, y , is produced using an intermediate good, x , according to:

$$y = A_t x^{\alpha} \quad (3.1)$$

Where $0 < \alpha < 1$ and x is produced by an incumbent monopolist who is the pioneer of the last innovation. Every innovation increases A by the constant factor $\gamma > 1$, and the number of innovations that have occurred to date is represented by t . There will be no capital accumulation for the purpose of simplicity. The interpretation of economic innovation in the model is as follows: an innovation may be produced with a formal research and development (R&D) sector and represents a rise in the world technology frontier. On the other side, innovation can be imported from foreign countries if a country is not a world technology frontier. Thus, the innovation is considered as new technology of production to the domestic market. While the acceptance of economic innovations from foreign countries are normally modeled as being a deterministic process. It is because there are always some uncertainties involved in the adoption of technologies from foreign countries in reality. For instances, given its capital endowments and geographical attributes, how we can know

which technology is more suitable for a country? If the potential importance of tacit knowledge and learning-by-doing are provided, how exactly the production technology can be adopted? Then, the arrival of innovation is known as random process on condition that this process is not totally deterministic. Due to this reason, the Schumpeterian growth model for countries that possess little, if any, formal R&D sector^{7 8} will be introduced to explain the relationship between rent-seeking and innovation in the study. This will also give a more details explanation of the model how poor institutional quality and government can affect innovation with their abilities. Then, it will create an expectation to see that payoff of working on innovation activities would be low under a small innovation sector.

One unit flow of labour with an inelastic supply will be endowed to every individual in the economy. The labour can be used to produce intermediate goods, or it can be employed in the R&D sector. Hence, the model form as $L = x + n$, where the amount of labour utilized in the innovation sector is denoted by the n , the innovations will be randomly arrived at with a Poisson arrival rate $\lambda(\psi)n$, where $\psi > 0$ is the level of innovation blocking activities (IBA), determined by government and the function of λ refers to the productivity of labour in research. The assumption is that $\lambda(\psi) \geq 0$, $\lambda' < 0$, and $\lambda'' > 0$. The government will create an institutional atmosphere that is not conducive to economic change, such as poor law of order, weak intellectual property protection, and etc. when under the IBA. Not only that, but the government even could also implement a complexed and delayed approval processes for any new innovation project such as getting government license, slow down the bureaucratic process just to protect the current monopolist. Therefore, those “strategies” become the main obstacle for new innovator to bring their innovation to the market as difficulty in getting licenses or permits from the government even the new innovator has the similar technology with the incumbent monopolist. This caused the new innovation ideas tend

⁷ See Aghion et al., (2005) the Schumpeterian framework to model innovation or technology diffusion in developing countries.

⁸ See Aghion and Howitt (1998) for a more detailed explanation of this and what follows, concerning firms.

to be lower due to the restrictions.

Furthermore, assuming $A_t B_c(\psi)$ is the government's cost for adopting ψ , where β is a constant and $\beta > 0, c(0) = 0, c'(0) = 0, c' \geq 0, c'' \geq 0$. The cost of innovation blocking can be reflected by the institutional quality of a country, so that a country with stronger institutional quality would have higher value of β . With this assumption, the implementation cost of IBA is proportional to the productivity level, and it can be interpreted that the government has to hire a small size number of workers to implement ψ and this reflects in the wage cost or increase in complexity of IBA in the current innovation.

Besides that, assuming that a range of firms are involved in innovation activity. The firm which successfully innovates at first will become the monopolist in the intermediate sector before it gets replaced by another successful innovator next time. V_{t+1} is given by the assets equation in the following indicates the discounted expected value of discovering the next innovation, where π refers to the flow of profit of the intermediate goods to producer:

$$V_{t+1} = \frac{\pi_{t+1}}{r + \lambda(\Psi_{t+1})n_{t+1}} \quad (3.2)$$

Solving the profit-maximization problem of the incumbent monopolist could find out the π .

$$Max \pi_t = p_t(x)x - w_t x \quad (3.3)$$

The $p_t(x)$ is refers refers to the price of intermediate goods, while the wage is denoted by w_t , and p is necessary to be equal to the marginal product of x if the final production is assumed to be competitive. Next, the maximum fraction of final output that government can collect as rent is denoted by f . If the higher the institutional quality, the lower the f and increase in β as the f and β are the functions of the

institutional parameter. Meanwhile, the drop in the level of IBA will cause the improvement in the expected growth rate if the institutional quality is good. The level of rent-seeking equal to f will be chosen by the rent-seeking government, given that ψ , the number of labour that are dedicated to R&D and the growth rate are independent to f . However, the incentive of a government to carry out IBA may be affected by f , therefore, the growth will be affected indirectly through IBA by the government. If the fraction of output is less than f ⁹, a government will not have incentive to collect it. Now, the equation for the price of intermediate produced to the marginal product of x is formed as $p_t(x) = (1 - f)A_t\alpha x^{\alpha-1}$.

The government will collect a fraction of f after producing the output, then the balance will only go on the market. The solution for the incumbent's monopolist's profit-maximization problem refers to the level of x produced, as follows:

$$x_t = \left(\frac{\alpha^2(1-f)}{\frac{w_t}{A_t}} \right)^{\frac{1}{1-\alpha}} \quad (3.4)$$

$\pi_t = \left(\left[\frac{1}{\alpha} \right] - 1 \right) w_t x_t$ can be expressed as monopoly profits, while $\omega_t = w_t/A_t$ can be the productivity-adjusted wage, which function of ω can be implied by both x and π . The arbitrage condition for the labour market is as follows:

$$w_t = \lambda(\psi_t)V_{t+1} \quad (3.5)$$

This indicates that the expected value of a single unit of worker used in the innovation sector is same as the value of a unit of worker in manufacturing sector. Substituting it for V_{t+1} and using L represent the total labour supply, the two equations that characterize the equilibrium of the model will be formed as follows:

⁹ It may seem implausible if the level of rent-seeking has no effect on growth. f affects both firm's decision and the productivity parameter A as the steady state will be defined such that the number of worker devoted to R&D is fix across innovations and no direct impact of growth with the level of f .

$$\omega_t = \lambda(\psi_t) \frac{y\pi(\omega_{t+1})}{r+\lambda(\psi_{t+1})n_{t+1}} \quad (3.6)$$

$$L = n_t + x(\omega_t) \quad (3.7)$$

The ω is defined as steady state, and therefore x and n are independent of the level of innovation t , this made the variables are variables constant over time. At every new innovation, the wages, profit, and final output are scaled by γ . Given Equations (3.6) and (3.7), with n , x , and y can be solved for ω in terms of λ :

$$\omega^* = \left(\frac{r}{\lambda D} + \frac{L}{D}\right)^{\alpha-1} \quad (3.8)$$

Where

$$D = (\alpha^2(1-f))^{\frac{1}{1-\alpha}} [1 + \gamma \left(\frac{1}{\alpha} - 1\right)] \quad (3.9)$$

Then substitute Equation (3.8) into (3.4), we can get:

$$x = \left[\frac{r}{\lambda} + L\right] \left(1 + \lambda \left(\frac{1}{\alpha} - 1\right)\right)^{-1}$$

Look out that x and n are not a function of f . To present that, with a given t , the following constant:

$$\frac{\partial \omega}{\partial \lambda} > 0, \frac{\partial n}{\partial \lambda} > 0, \frac{\partial x}{\partial \lambda} < 0, \frac{\partial y}{\partial \lambda} < 0$$

As $\frac{\partial \lambda}{\partial \psi} < 0$, then show as following:

$$\frac{\partial \omega}{\partial \psi} < 0, \frac{\partial n}{\partial \psi} < 0, \frac{\partial x}{\partial \psi} > 0, \frac{\partial y}{\partial \psi} > 0$$

Hence, labours will leave the innovation sector and move into the final output production sector if the level of IBA increase. Also, the average growth rate in this economy in the steady-state can be shown as:

$$g = \lambda n \ln(\gamma) \tag{3.10}$$

This indicates that $\partial g / \partial \psi < 0$, hence, a raise in ψ will lead to reduction in both λ and n , which decreases the growth rate. This also means that a rise in ψ (rent-seeking activities or corruption, IBA) will cause the decrease of λ (labor's productivity) and n (number of labour involved in innovation activities). Hence, we determined the innovation in our study by putting in the main independent variable corruption, and other control variables included FDI, trade openness and human capital.

3.3 Econometric Model

The functional form of the model is constructed as follows:

Innovation = f (Corruption, Foreign Direct Investment, Trade Openness, Human Capital)

$$INN_t = f(CPI_t, FDI_t, TRADE_t, HC_t)$$

Log-linear model is used due to it provides more efficient results.

$$LNINN_t = \beta_0 + \beta_1 LNCPI_t + \beta_2 LNFDI_t + \beta_3 LNTRADE_t + \beta_4 LNHC_t + \mu_t$$

The log-linear model is used to standardize the data before we proceed to analyze the data. Besides, this form of model would also make it easier for us to interpret the results.

3.4 Data Analysis Method

In this study, Autoregressive Distributed Lag (ARDL) approach is used to examine the long run relationship between the independent variables (corruption, foreign direct investment (FDI), trade openness, and human capital) and dependent variable (innovation) in the case of Malaysia. However, the unit root test will be performed in order to guarantee that all the variables have achieved stationary.

3.4.1 Unit Root Test

The unit root test is also known as the “Stationarity Test” is a test to investigate whether a time series data is stationary or non-stationary. Gujarati (2004) suggested that a time series is stationary if its means, variance, and covariance do not change systematically over time, otherwise, the series is non-stationary. It is crucial to ensure the series is stationary as non-stationary series will suffer from spurious regression problem. Spurious regression problem occurs when we regress a non-stationary variable on another non-stationary variable, the statistical results suggested a high T-statistics and high R² even if two variables are totally not related. If the regression results with R² greater than Durbin-Watson statistic, then we should suspect there is a spurious regression problem (Granger & Newbold, 1974).

3.4.2 Augmented Dickey-Fuller (ADF)

One of the most widely used unit root tests is Augmented Dickey-Fuller (ADF) test. ADF test is the extension of Dickey Fuller (DF) test by adding the lagged of dependent variable to take care of possible serial correlation in the error terms and capture the dynamic series of the model.

The model with intercept and trend:

$$\Delta Y_t = \beta_0 + \beta_1 t + \gamma Y_{t-1} + \sum_{i=1}^p \alpha_i \Delta Y_{t-1} + \mu_t \quad (1)$$

The model with intercept and without trend:

$$\Delta Y_t = \beta_0 + \gamma Y_{t-1} + \sum_{i=1}^p \alpha_i \Delta Y_{t-1} + \mu_t \quad (2)$$

The hypothesis as shown below:

H_0 : There is unit root in the series (non-stationary)

H_1 : There is no unit root in the series (stationary)

Decision rule: Reject null hypothesis if p-value is less than the significance level, otherwise, do not reject.

3.4.3 Phillips-Perron (PP)

Apart from ADF test, Phillips-Perron (PP) test is also another methods to test the stationarity of a time series. PP test uses non-parametric approach to take care of the serial correlation in the error term without adding the lagged difference terms.

The hypothesis as shown below:

H_0 : There is unit root in the series (non-stationary)

H_1 : There is no unit root in the series (stationary)

Decision rule: Reject null hypothesis if p-value is less than the significance level, otherwise, do not reject.

3.4.4 Autoregressive Distributed Lag (ARDL) Approach

In this research, we are going to apply the ARDL methodology promoted by Pesaran and Shin (1995) to investigate the long run and short run relationship between the variables. The ARDL approach is also known as the bound cointegration testing method. The cointegration concept was first introduced by Granger (1981) then it was formalized by Engle and Granger (1987). Cointegration refers to the existence of a long run relationship or equilibrium between two or more time series data, even though they are non-stationary.

Nkoro and Uko (2016) claimed that most of the time series are non-stationary in the recent development in econometrics studies. This indicates that the results and features from different time series might vary. Hence, this is likely to see certain time series showing the function of diverging away from their mean over time, while others may converge to their mean over time. To overcome this issue, the ARDL approach has been a solution to detect the cointegration between the variables. This approach has a few benefits as compared to other tests. Firstly, ARDL does not require independent variables to be incorporated at the same order mainly at I (0) or I (1) which would be a problem in the Johansen and Juselius (JJ) test. Besides, the ARDL method is more efficient in the cases of small and restricted sample data. Lastly, it can present unbiased parameters for the model (Harris & Sollis, 2003).

The equation of ARDL bound test is as below:

$$\begin{aligned} \Delta LNINN_t = & \beta_0 + \beta_1 LNCPI_{t-1} + \beta_2 LNFDI_{t-1} + \beta_3 LNTRADE_{t-1} + \beta_4 LNHC_{t-1} \\ & + \sum_{i=0}^p \varphi_1 \Delta LNINN_{t-i} + \sum_{i=0}^p \varphi_2 \Delta LNCPI_{t-i} + \sum_{i=0}^p \varphi_3 \Delta LNFDI_{t-i} + \\ & \sum_{i=0}^p \varphi_4 \Delta LNTRADE_{t-i} + \sum_{i=0}^p \varphi_5 \Delta LNHC_{t-i} + \varepsilon_t \end{aligned}$$

The hypothesis is as below:

$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (No cointegration)

$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ (Cointegration)

For the decision rule, if the computed F-statistic of ARDL bound test is larger than the upper bound critical value, we can reject the null hypothesis and indicate that the model contains long run relationship. However, if the F- statistic is smaller than the lower bound critical value, we cannot reject the null hypothesis and indicate that it does not contain long run relationship. Besides, if the F-statistic falls between lower and upper critical bound, we can conclude that it is inconclusive.

3.5 Diagnostic Checking

If the model suffers from econometric problems such as multicollinearity, heteroscedasticity, autocorrelation, and others, the results will become biased and misleading. Thus, diagnostic checking is crucial to ensure the model free from problems of econometric. In this section, we will perform four diagnostic checking, which are multicollinearity, heteroscedasticity, autocorrelation, and normality.

3.5.1 Multicollinearity

In the multiple linear regression, multicollinearity is one of the econometric problems which happens when the independent variables are correlated with each other. Gujarati (2004) suggested 4 reasons that would causes multicollinearity problem. Firstly, the data collection method employed

whereby the researcher only collects a limited range of data. Secondly, there are some constraints on the population being sampled. Thirdly, model specification by adding polynomial terms into the model. The last one is the overdetermined model in which the number of explanatory variables is greater than the number of observations.

Next, there are few ways to detect multicollinearity problem. Firstly, high R² but few significant t ratios. When a model characterizes high R² and statistically significant F-ratio but most of the t-ratios are insignificant, we should suspect the problem of multicollinearity. Next, high pair-wise correlation among the explanatory variables (Mansfield & Helms, 1982). Lastly, the Variance Inflation Factor (VIF) and Tolerance Level (TOL). When VIF greater than 10 or TOL closer to 0, it indicates the model suffers from multicollinearity problem. The formula of VIF and TOL is shown as below:

$$VIF_i = \frac{1}{1 - R_i^2}$$

$$TOL = \frac{1}{VIF}$$

3.5.2 Heteroscedasticity

Heteroscedasticity refers to an econometric problem where the variances of the error term is not constant. In doing parametric or non- parametric regression, the most important assumption is the homogeneity of the error variances. By violating this assumption, it will adversely affect the efficiency of the estimators (Eubank & Thomas, 1993). Hence, it is crucial to check the existence of the heteroscedasticity. There are several tests like White test, Glejser test, Breusch-Pagan test, and Autoregressive Conditionally Heteroscedasticity (ARCH) test for assessing the existence of heteroscedasticity problem. In this research, we are

going to use ARCH test as it is available for data models of the time series.

The hypothesis of the test is show as below:

H_0 : There is no heteroscedasticity problem.

H_1 : There is heteroscedasticity problem.

Decision rule: Reject null hypothesis if p-value is less than the significance level, otherwise, do not reject.

3.5.3 Autocorrelation

Another econometric problem is autocorrelation, which refers to the correlation between the error terms. In the regression, the Classical Linear Regression Model (CLRM) believes that the autocorrelation does not occur in the error term, which $cov(\mu_i, \mu_j) = 0, i \neq j$. However, if the error terms are dependent, the problem of autocorrelation exists. Symbolically, $cov(\mu_i, \mu_j) \neq 0, i \neq j$. With the existence of autocorrelation, the OLS estimators are no longer efficient even if they are unbiased and coherent. The variance of the estimator would also understate which leads to the result of hypothesis testing no longer valid. Hence, it is important to detect autocorrelation in the time series. In this case, we will use Breusch-Godfrey Serial Correlation LM test to estimate the autocorrelation. Breusch-Godfrey Serial Correlation LM test is a general test of autocorrelation that allows for non-stochastic regressors and higher order autoregressive schemes.

The hypothesis of the test is show as below:

H_0 : There is no autocorrelation problem.

H_1 : There is autocorrelation problem.

Decision rule: Reject null hypothesis if p-value is smaller than the significance level, otherwise, do not reject.

3.5.4 Normality Test

Normality test is a statistical method apply for examine a model able to meets the normality assumption on the error term or not. Jarque-Bera test is the most widely used normality test because it is simple and straightforward. Jarque-Bera is a goodness-of-fit test of whether the skewness (S) and kurtosis (K) of the sample data is normally distributed. For a normally distributed variable, S=0 and K=3.

The formula of the test is shown as below:

$$JB = n \left[\frac{S^2}{6} + \frac{(K-3)^2}{24} \right]$$

The hypothesis of Jarque-Bera test is as below:

H_0 : The error term is normally distributed

H_1 : The error term is not normally distributed

Decision rule: Reject null hypothesis if p-value is smaller than the significance level, otherwise, do not reject.

3.5.5 CUSUMSQ Test

According to Turner (2010), CUSUM and CUSUMSQ test are applied to examine the model's stability and determines that it depends on the nature of structural change taking place. This applied on the observations at first and plotted against the breaking point. If the CUSUMSQ points plotted within the dynamic of straight line at the 5% significance level, then the parameters are stable.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

The importance of this chapter is to discuss the research methodology generating from the E-views software and interpreting the results. Firstly, we will conduct the Unit Root test such as Augmented Dickey Fuller (ADF) test and Philips Perron (PP) test in order to examine the stationarity among all the variables. Next, the long run relationship between the variables will then investigated using Autoregressive Distributed Lagged (ARDL) bound test. Finally, diagnostic tests like the ARCH test, serial correlation LM test, Jarque-Bera test, and stability test will be used in this research.

4.1 Unit Root Test

Augmented Dickey Fuller (ADF)

Table 4.1: Results of Augmented Dickey Fuller (ADF) test

Augmented Dickey Fuller (ADF)					
Variable	Level		First Difference		Order of Integration
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend	
LNINN	-1.8846 (0.3334)	-0.7397 (0.9578)	-5.1547 (0.0004)***	-1.7372 (0.6941)	I (1)
LNCPI	-2.7243 (0.0847)*	-2.5396 (0.3081)	-3.5068 (0.0182)**	-3.1492 (0.1254)	I (1)
LNTRADE	0.4123	-1.9580	-3.3713	-3.8235	I (1)

	(0.9792)	(0.5937)	(0.0230)**	(0.0337)**	
LNFDI	-5.0301 (0.0005)***	-4.9483 (0.0030)***	-	-	I (0)
LNHC	-2.4701 (0.1348)	-2.1518 (0.4931)	-4.4425 (0.0021)***	-4.5435 (0.0076)***	I (1)

Note: ***, **, and * denote significant at 1%, 5%, and 10% significance levels.

The t-statistic and p-value of each variable in the ADF test are shown in Table 4.1. Based on the result, we can conclude that the innovation and human capital are stationary at the first difference with 1% significance level. For the other two independent variables which is corruption and trade openness, the stationarity is achieved at the first difference with 5% significance level. Meanwhile, the foreign direct investment (FDI) is integrated at level with 1% significance level.

Phillips-Perron (PP)

Table 4.2: Results of Phillips-Perron (PP) test

Variable	Phillips-Perron (PP) Test				Order of Integration
	Level		First Difference		
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend	
LNINN	-1.9240 (0.3163)	-0.7452 (0.9572)	-5.1003 (0.0005)***	-5.2632 (0.0016)***	I (1)
LNCPI	-2.7502 (0.0806)*	-2.5396 (0.3081)	-4.7017 (0.0011)***	-4.7086 (0.0054)***	I (1)
LNTRADE	0.2066 (0.9672)	-1.9687 (0.5881)	-3.4155 (0.0210)**	-3.8480 (0.0321)**	I (1)
LNFDI	-5.3796 (0.0002)***	-5.2499 (0.0015)***	-	-	I (0)
LNHC	-2.8846	-2.1518	-4.4385	-4.6518	I (1)

(0.0620)* (0.4931) (0.0021)*** (0.0061)***

Note: ***, **, and * denote significant at 1%, 5%, and 10% significance levels.

Refer to Table 4.2, it shows the outcomes of PP test in level and first difference form for each variable. The result suggested us that the innovation, corruption, and human capital are stationary at the first difference with 1% significance level. For the trade openness, it achieved stationarity at first difference with 5% significance level. Lastly, only FDI is integrated at level with 1% significance level.

4.2 Autoregressive Distributed Lag (ARDL) Approach

From the results from ADF and PP test, it shows that the variables are integrated at the level and first difference form. Therefore, the ARDL method was carried out to examine the long run relationship between innovation and corruption, foreign direct investment, trade openness, and human capital.

Table 4.3: Results of ARDL Approach

Panel A: ARDL Bound Test for Cointegration		
Model	F-statistic	Conclusion
LNINN=f(LNCPI, LNFDI, LNTRADE, LNHC)	7.3962	
Optimal Lag	(3,2,2,2,2)	
Critical Value	I (0)	I (1)
1% significance level	4.28	5.84
5% significance level	3.06	4.22
10% significance level	2.53	3.56
Panel B: Long Run Elasticities		

Variable	Coefficient	T-statistic	Probability
LNCPI	-8.5280	-3.6194	0.0111**
LNFDI	1.0016	3.1398	0.0201**
LNTRADE	-5.0692	-2.7505	0.0333**
LNHC	-0.1656	-0.2396	0.8186

Panel C: Short Run Coefficient

Variable	Coefficient	T-statistic	Probability
D (LNCPI)	1.9688	7.3611	0.0003***
D (LNCPI (-1))	-0.6889	-2.6544	0.0378**
D (LNFDI)	-0.1798	-13.0470	0.0000***
D (LNFDI (-1))	0.0907	5.6198	0.0014***
D (LNTRADE)	3.0067	8.6528	0.0001***
D (LNTRADE (-1))	-1.6388	-5.8898	0.0011***
D (LNHC)	-0.0378	-0.1217	0.9071
D (LNHC (-1))	1.6348	4.8670	0.0028***
CointEq (-1)	-0.2995	9.0199	0.0001***

Table 4.3 shows the results of ARDL method. From Panel A, the ARDL bound test was conducted to see the long run relationship between innovation and its determinants. The optimal lag of ARDL (3,2,2,2,2) model is selected based on AIC criteria. The reasons that Akaike's Information Criteria (AIC) is being chosen rather than Bayesian Information Criteria (BIC) or Schwartz Information Criteria (SC) is that AIC is consistent and good at identifying the well-specified model asymptotically. Besides, when more additional parameters are included, the penalty for BIC is more than AIC (Prabhat, 2010). The computed F-statistic of 7.3962 in ARDL bound test is greater than the upper critical bound value of 5.84 at 1% significance level. Hence, the rejection of null hypothesis (no cointegration) suggests that the existence of long run relationship among corruption, foreign direct investment, trade openness, human capital, and innovation.

4.2.1 Long Run Elasticities

After getting the result of Panel B in Table 4.3, we can interpret the long-run elasticity of the model as below:

$$LNINN = B_0 + B_1(LNCPI) + B_2(LNFDI) + B_3(LNTRADE) + B_4(LNHC)$$

$$LNINN = 45.9512 - 8.5280LNCPI + 1.0016LNFDI - 5.0692LNTRADE - 0.1656LNHC$$

Based on the model above, the result of coefficient of Corruption Perception Index (CPI) is -8.5280. This can be indicated that, a 1% increase in the CPI in Malaysia would lower the patent applications of residents in Malaysia by 8.5280%, by holding other variables constant. The results have shown that the CPI has a long run relationship with innovation and it is significant at 5% level of significance. The higher the corruption, the higher the innovation. The result can be considered as ‘Grease the Wheel’ where the corruption can increase the innovation. It is possible the innovative company would pay bribes to government officials to avoid the procedure or regulations (Ayyagari et al., 2014). The companies can save their time, meanwhile can contribute to innovation as well.

From our results, it does not meet the positive expected sign we stated earlier. However, this are not completely surprising to happen in Malaysia case which as developing country and high crony-capitalism index. Crony-Capitalism (also known as cronyism) refers to an economic system where businesses privately partner with politician or party to obtain benefit, for example getting specific license and subsidies, tax deduction, and sometimes even changing public policy but in a legally “grey area” form (Anne, 2022). In the article of The

Economist (2022), Malaysia was ranked top 2 for highest crony-capitalism index among the worlds. Although this does not mean we can fully rely on this index to judges that Malaysia is a highly corrupted country, but this provided an indication that Malaysia's business environments are highly binding with politician and political party to gain larger scale benefits. In the study of Muhammad Faraz Riaz (2019) which focus on corruption and innovation in developing and emerging economies, he found the same negatively results in corruption perception index with nearly all types of innovation and innovative activities of companies. He claimed that companies would not be allowed to accelerate the bureaucratic process with petty corruption if there is relatively uncorrupt governance. The author also found that grand corruption fulfils the hypothesis of "greases the wheels" in developing and emerging economies mainly due to two possible reasons, firms got smoothen the process of bidding for public contracts. Then the firms able to obtain good profits through corruption and reinvestment into research and development (R&D), lead to higher productivity.

Next, the result of coefficient of foreign direct investment (FDI) is 1.0016, which indicates that on average, the patent applications of residents in Malaysia will increased by 1.0016% when the net inflows of FDI in Malaysia increased by 1%, *ceteris paribus*. The outcome suggested that the FDI has a significant relationship in long run with innovation at significance level of 5%. Research mentioned that FDI is a necessary condition for promoting innovation (Jaiblai & Shenai, 2019). This indicates Malaysia can improve the FDI performance to increase innovation. Our results also meet our expected sign and indicates that higher FDI in Malaysia will lead to higher innovation activities. This could be due to many reasons that support earlier. Malaysia as a developing country, surely there is lack of innovation partinnovation compared to other advanced and fast-growing countries. Hence, FDI may bring in technology and ideas from foreign to domestic markets and increase the domestic competition to be more innovative.

For the trade openness, it showed a negative coefficient of result, which is -5.0692. We can interpret the result as, when the trade of Malaysia increased by 1%, on average, the patent applications of residents in Malaysia will decreased by 5.0692%, *ceteris paribus*. There is a long run relationship between trade openness and innovation in Malaysia and it is significant at 5% significance level. The higher the trade openness, the lower the innovation in Malaysia. This is interesting our results did not meet our expected sign in the case of Malaysia as it is generally belief that trade openness can benefit the innovation, especially in the developing country. However, Keho (2017) cited the point of trade openness might be adversely affecting the economic growth by the regulations such as increasing in inflation, and this is commonly happened to low-quality production country. Kim (2011) also claimed that trade openness has a positive impact on economic growth in developed countries but adverse effects in developing countries. He further found that the linkage between trade and economic performance is affected by both sum of capital and productivity growth channels. This is enough for us to believe that this could be one of the reasons why trade openness is negatively correlated with innovation activities in Malaysia. Economic growth is surely able to affect the innovation performance as well as the whole business environment may affect the trade openness does not positively associate with the innovation activities.

Lastly, the result for human capital is quite unexpected for us. The coefficient is a negative sign (-0.1656), which did not meet our expected sign. Specifically, a 1% increase in the labor force by tertiary education would decrease the patent applications of residents in Malaysia by 0.1656%, *ceteris paribus*. However, the results show that the long-run relationship between capital and innovation in Malaysia is not significant. The result is in line with Senadjki et al. (2021) for the case in Africa, which showed that the impact of university graduates is statistically insignificant to the innovation and high-technology export. Mykhailyshyn, Kondur, & Serman. (2018) discovered that although university

graduates are the significant factor in contributing new ideas to the organizations in the future, but not all of them will become innovators or IT experts. Moreover, Lenihan, McGuirk, & Murphy (2019) further clarified that human capital as a driver of firm-level innovation is not fully captured by knowledges, whereby motivationally relevant elements of human capital such as job satisfaction, organizational commitment, and willingness to change also considered important to drive innovation.

4.3 Diagnostic Checking

4.3.1 Multicollinearity

To examine whether the model is suffering from the multicollinearity problem, correlation between the independent variables, and VIF have been used in this study.

Table 4.4 The Correlation between Pairs of Coefficients

Variable	LNCPI	LNFDI	LNTRADE	LNHC
LNCPI	1.0000	-	-	-
LNFDI	0.2759	1.0000	-	-
LNTRADE	0.2602	0.0654	1.0000	-
LNHC	-0.3982	-0.1270	-0.8650	1.0000

Table 4.5 Variance Inflation Factor Table

Variable	Centered VIF
LNCPI	1.6354
LNFDI	1.1239
LNTRADE	21.9006
LNHC	4.9612

According to the Table 4.4, the corruption perception index (CPI) has a weak positive correlation with foreign direct investment (FDI) and trade openness at 0.2759 and 0.2602, respectively. Next, trade openness and FDI are quite low and have a positive correlation of 0.0654. While human capital was having a weak negative correlation with CPI and FDI at -0.3982 and -0.1270, respectively. For human capital and trade openness, there is high negative correlation at -0.8650 between each other.

For table 4.5, it shows the centered VIF for each of the independent variables. Based on the results, the centered VIF for CPI, FDI, and human capital is less than 10 meanwhile only trade openness is greater than 10, which is 21.9006. As overall, we suspect that the problem of multicollinearity exists in our model as human capital and trade openness is negatively correlated with each other at a higher level. However, as there is high value of adjusted R-squared (99.47%) followed by much significant t-ratios, and low pair-wise correlation between other independent variables, the problem of multicollinearity should not be a concern in our model.

4.3.2 Heteroscedasticity

The ARCH test has been carried out to investigate the problem of heteroscedasticity. The null hypothesis indicates that there is no problem with heteroscedasticity, whereas the alternative hypothesis indicates that there is problem with heteroscedasticity.

Table 4.6: Results of ARCH test

ARCH test	
F-statistic	Probability
0.5991	0.4230

Based on the result above, the null hypothesis has not been rejected as the p-value which is 0.4230 is larger than the significance level of 10%, 5%, and 1%. Hence, it implies that the variances of the error term are constant.

4.3.3 Autocorrelation

The Breusch-Godfrey Serial Correlation LM test was utilized to estimate the autocorrelation problem in this investigation. The null hypothesis states that there is no problem with autocorrelation, whereas the alternative hypothesis states that there is a problem with autocorrelation.

Table 4.7: Results of B-G LM test

Breusch-Godfrey Serial Correlation LM test	
F-statistic	Probability
0.6345	0.0707

The result suggested us that we should not reject the null hypothesis because the p-value (0.0707) is more than the significant level of 1% and 5%. Therefore, the problem of autocorrelation has not detected in our model. As a result, the random error components, or disturbances are generated independently and identically.

4.3.4 Normality test

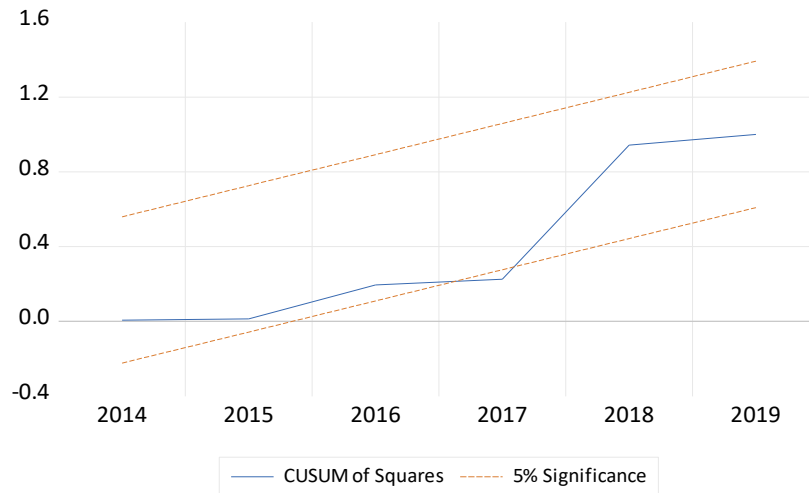
Jarque-Bera test has been carried out to see whether the model achieves the normality assumption on the error term. The null hypothesis indicates that the error term is normally distributed while the alternative hypothesis indicates that the error term is not normally distributed.

Table 4.8: Results of Jarque-Bera test

Normality test: Jarque-Bera test	
F-statistic	Probability
0.0752	0.9630

Based on the results in Table 4.8, the p-value of Jarque-Bera test is 0.9630, and it is larger than the significance level of 10%, 5%, and 1%. Hence, the null hypothesis should not be rejected, and we can summarize that the error term in the ARDL regression model is normally distributed.

4.3.5 CUSUM of Squares test



The figure above shows the results of CUSUM of squares test. The point of CUSUM of squares are fall within the straight line, except for year 2017 at the 5% level of significance. Hence, it indicates that the parameters are stable.

CHAPTER 5: CONCLUSION

5.0 Introduction

The objectives of this research project are to determine the effect of the corruption on innovation of Malaysia and examine the relationship between the control variables included trade openness, foreign direct investment (FDI), human capital, and innovation in the long-run. There is a fully utilized on the methodology that we analyse the impact of the corruption on the innovation activities in the Malaysia cases. In this chapter, the conclusion of our study, policy implication, the limitation and recommendation of will be discussed.

5.1 Summary of Study

As overall, the results from the Autoregressive Distributed Lag (ARDL) bound test showing that the innovation and independent variables in this analysis is cointegrated. This shows that the long run relationship exists among variables. By using ARDL method, the coefficients of corruption, foreign direct investment (FDI), trade openness, and human capital can be measured to examine the long run effect of these variables towards innovation.

Before ARDL method was used, the unit root test which is Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) test was conducted to test the stationarity of the variables. The results show that the innovation, corruption, trade openness, and human capital are stationary at first difference form meanwhile only FDI is integrated at level. Next, the ARDL method show us the results where there is long run relationship between some variables with innovation. Firstly, corruption perception

index (CPI) and trade openness are having negative relationship with innovation in the long run, and it is significant at 5% significance level. Next, a positive relationship was found between FDI and innovation at 5% significance level. It means the increase in the net inflows of FDI would boost up the innovation activities in Malaysia. For human capital, it was having a negative relationship with innovation in the long run, but it is statistically not significant. Lastly, some diagnostic checking was used to check the econometric problems. To see if our model has suffered from econometric problems, we have performed the ARCH, Breusch-Godfrey Serial Correlation LM, Jarque-Bera, and CUSUMSQ test. The outcome proven that our model is normally distributed and does not have the econometric problems, except for multicollinearity problem.

5.2 Policy Implication

This study mainly examining the impact of corruption, foreign direct investment (FDI), trade openness, and human capital on innovation level in Malaysia. Based on our study, we generated a clear picture for the relationship between the innovation with the independent variable and other control variables which included the FDI, trade openness, and human capital. This research is important as it provides the insight of how the corruption and other control variables impact on Malaysia's innovation performance in the long term (25years). This study pointed out several important issues that need the attention of the whole nation, mainly the government policymakers, companies' managers to implement policies and strategies for a sustainable and better innovation performance in Malaysia. Thus, this study enables the implementation of better policies and decisions that can improve the innovation performance of Malaysia at the same time with a sustainable development (lesser corruption).

Based on the result, we are using Malaysia's CPI data from 1995 to 2019 to run the test and found out that CPI negatively associate with innovation in Malaysia significantly. This indicates the higher the CPI score, the lower the innovation in

Malaysia. If a country gets a high score for CPI, it represents less corruption in the country. Since the CPI is negative to innovation in Malaysia, this implies the higher the corruption happens, the higher the innovation activities in Malaysia. This phenomenon is not good to see, as corruption is an illegal and negative activity and normally would not increase innovation. This result is known as 'Grease the wheel', where the increase in corruption can lead to improvement in innovation. For example, to illustrate this situation, there are some innovative companies that would like to establish their new products, but they need to go through the procedure and examination by the government authority. In order to be accepted and speed up the procedure, corruption might be the solution for them to achieve their goals. From here, we can see that corruption still can increase innovation but in an unhealthy way. Of course, in Malaysia we are still against the rise of corruption as it is an illegal and immoral activity yet bring harmful effect to a country as it continues. We do not want corruption to be continued just because it led to increase on innovation in Malaysia. This is definitely an unhealthy growth for Malaysia and not sustainable if the evil root of corruption in Malaysia does not stop. There are many countries' innovation performance is high and their corruption is low. For example, the neighbor country of Malaysia - Singapore. According to Transparency International (2022), the CPI score for Singapore in 2021 is 85 which is rank as 4th out of 180. Based on the Global Innovation Index 2021, Singapore was ranked as 8th out of 132 in Global Innovation Index 2021. Malaysia able to reduce or even eliminate corruption by learning the anti-corruption strategy from those countries are doing in anti-corruption.

Therefore, Malaysia should reflect on their system and governance in these issues to keep pursuing innovation efficiently without relying on illegal activity. Malaysia's government also must have the assertion in fighting corruption, a lot of time Malaysia's government does not follow closely the policies and strategies they implement in fighting the corruption. For example, keep the public sector honest, transparent, and accountable. Not only restricted to the public sector, and even the officer or politicians. Participation and keeping the public sector and policy transparent are very important principles in strengthening the institutional quality to fight against

corruption. According to Mitchell (1998), he claimed that policy makers must make sure the transparency when implementing policies. The government should ensure the policies are transparent enough and manage executively under laws and accessible to public in terms of sharing genuine information. One of the ways is the central government may require all the state parties to implement appropriate measures to improve the transparency of the public institutions, to make the information easily accessible and understandable to stakeholders. The procurement rules and processes, as well as administrative and other related regulations should reveal and easily accessible information available. Not only that, according to United Nations Office on Drugs and Crime (n.d.), the active participation of individuals and parties that not in the public sector such as community-based organization, non-governmental organizations could foster anti-corruption. On the other hand, public awareness is another essential key for a country to fight against corruption. When the public have enough awareness towards corruption, this will lead to a clean and uncorrupt governance. Hence, anticorruption campaigns should be put more emphasize in Malaysia so that Malaysian can have higher awareness against corruption. Raising awareness through the education system is also important to eliminate corruption in the long term. Formal anti-corruption education and knowledge should be nurtured in school to students so that the younger generation could know the harmful of corruption to a country.

A lot of time the missing in stringent control and assertion in fighting corruption, encourage the rampant of corruption. For instance, the case of Azam Baki as the head officer Malaysian Anti-Corruption Commission was lack of transparency and make clear. According to Perimbanayagam (2022), there is a pressure on the government by the Centre to Combat Corruption and Cronyism (C4) to set up a special force to investigate the Malaysia Anti-Corruption Commission (MACC) chief, Tan Sri Azam Baki about his purchased shares. In this case, we can see the person who was involved was the government high ranked officials and this incident also damaged the image of the country. This case also show Malaysia is still left behind in fighting corruption in some way. Hence, this caused the unhealthy growth of corruption lead to

innovation even the innovation can growth without corruption. A good quality institution and government should be accountable as well in terms of answerability for one's actions. This case showed that Malaysia public sector as well as government did not provide a good response in giving a clear cut and satisfy explanation to public. In short, Malaysia needs to have a more complete and consistent call-to-action in fighting corruption, make sure the transparency of public sector, the officials and politicians, and allow more participatory from outside of public sector. Strict enforcement by organizations such as MACC is also important towards bribery between businesses and other stakeholders such as officials and politicians. With that, the corruption can be reduced and create a better business environment to attract FDI and improve productivity then led to higher innovative activities.

Furthermore, the FDI has the significant positive relationship on the innovation based on our results. It means that the FDI is strongly affect the innovation in Malaysia. We also believe that the FDI for the country can improve the innovation of the country as well as boost the economic growth. It cannot be denied that the FDI is a crucial role in providing capital for investment, enhancing the job opportunities. In addition, countries are around the world with the competing with the limited pool of the foreign investment. Malaysia is one of the countries that struggles this crowd as it peruses to boost for the growth of foreign direct investment.

Therefore, Malaysia can improve the FDI of the country by implementing the focus investment-promotion activities. This is because a proactive approach can attract more agencies to task with the promoting FDI. These agencies must be able to convince and build the targeted investors in the relevant sectors as well as the companies. Moreover, Malaysia can also reassess the existing policy in the FDI. The government can rethink the FDI strategy due to considered long-term benefits for a more FDI friendly policy to compete with other countries especially in South-East Asia (SEA) region. In recent year, countries in SEA are doing good in attracting FDI, but Malaysia occurring of foreign companies moving out from Malaysia. According to Lim (2017), the factors of many companies moved out from Malaysia to other countries is because

the market environment in Malaysia is weak as there is a fall performance in demand and sales, mentioned by Dato' Sri Minister Mustapa, who is from International Trade and Industry. There is also a reason of the Covid-19 pandemic that caused Malaysia to implement the lock down. According to Malay Mail (2021), there was 9 foreign companies ending their operations in Malaysia due to the dropped in sales and demand that caused by the contraction of global economy. Thus, it is important for Malaysia to reassess the existing investment policy and strategies whether it is friendly enough for investors in long term, to bring positive impact on innovation. Lastly, Malaysia's government should also stable down the unstable political environment happening in recent years. This is important for investors to invest in a country with stable political environment in avoiding the political risk. At the end, Malaysia can increase the FDI from other countries and propel the Malaysia's innovation as well as economy further.

In addition, the trade openness of Malaysia towards the innovation is a negative relationship based on our results. However, there is a significant relationship between the trade openness with the innovation in Malaysia. Based on our review of relevant past studies, trade openness mostly will have significant positive impact on innovation. In our analysis of Malaysia case, there is significant negative relationship of trade openness with the innovation which indicates that when Malaysia has higher trade openness, the lower in innovation performance and vice versa. Supposing the trade able to promotes innovation through increasing the efficiency as it will increase the competitive of the market and facilitate the innovations. Thus, in the case of Malaysia, the government should avoid of negative relationship of trade openness and innovation. Which shown us that the trade openness might bring some impact such as local unemployment as hire cheaper labour from foreign country or brain drain which our skilful workers leaving the country. Not only that, it might be also Malaysia's trade openness were losing based on the graph we showed in Chapter 1.

First thing first, Malaysia needs to improve the competitiveness in term of the productivity and technology not limited only in information and communication technology (ICT) even can be agriculture. Through giving more support towards the

domestic business to increase their productivity. Hence, it can enhance Malaysia competitiveness in trading with other countries, and wisely leverage on Regional Comprehensive Economic Partnership (RCEP) to improve the trade of the country. If Malaysia does not enhance the country's competitiveness, it will caused lose in trade with other countries that provide similar product and services such as Indonesia, Thailand and more. Then it led to low performance in the innovation due to lack of strong technology, resources, capital, and skilful human capital. The improvement in competitiveness of trade can bring positive impact to innovation so it leads to more sustainable development which improve the innovation with increase in trade.

Last but not least, the result shows that human capital has a negative but insignificant relationship with innovation of Malaysia. This means that Malaysia's innovation performance does not affect by the human capital. Nonetheless, we could not deny that human capital is one of the key drivers for growth a country. Thus, Malaysia governments and companies should work together in lifting the skills and knowledges of labours. Government can enhance more skilful human capital by reshaping and improving the education system cater for industrial revolution 4.0 instead of still using old method. Other than that, incentive for firms to cultivate more skilful workers. This is important in elevate the standard of human capital in Malaysia so that Malaysia can be more competitiveness in global market.

5.3 Limitation of Study

This research has certain drawbacks, which will be discussed in the following paragraphs. It is important for researchers to highlight the weak points and faults of this study so that researchers can learn from it and find the proper ways to improve or enhance these limitations when conducting future studies.

The first limitation that we realised is the sample size for some variables are less. The variables are including corruption and patent application which is innovation. For information, in order for us to run the ARDL test, we need to have at least of 25 sample size or 25 years data as minimum for the test to run a reliable result. Based on the data we found in Malaysia, we only managed to get the data for exactly 25 years. Therefore, this caused us can only use the smaller sample size for all other variables. We consider this as a limitation because if we can have more data to run the test, mostly we could run the result that are more meaningful for future researchers. Therefore, it is better to have more than 25 years data when collecting the data.

Another limitation is the independent variables that used to capture the effect on Malaysia's innovation might not be comprehensive. In this research, we are using the corruption, FDI, trade openness, and human capital to study the effect on innovation. However, innovation will be affected by some other important factors. In this study, only factors were used to study on the impact on innovation, where there is a possible of other factors such economy conditions and supply of technological affect the innovation too as well as other macroeconomic factors are not considered.

5.4 Recommendations of the Study

After stated the limitations of the study, there are some recommendations could be given based on the limitations in order for researchers to improve for the research that will be established in the future. To address the issue of small in sample size for the ARDL, the recommendation is to extend the period data in future and adding more independent variables. As mentioned earlier, researchers need a minimum of 25 sample size to run the ARDL. It is better if the researchers can get the data with larger sample size and more independent variables. This can increase the accuracy as larger data size or taking more factors to enhance the study.

Moreover, another recommendation is the researchers can overcome the limitation in data by breaking down the variables into more details. For instances, the researcher can consider using the data of research and development (R&D) expenditure and patent application for innovation input and output, which R&D expenditure represent the innovation input and patent application represent output. By doing so, the limitation of lack of data toward single variable able to overcome with more available data for study. Besides that, the researcher can also consider adding in more different independent variables such as competitive and economic condition. The reason of this is to find out how the innovation being affected when different factors or variables is applied. At the same time, this will also help those people who wish to find the journals that are different sectors and variables. All of this would reduce the limitation of this research and provide more insight to reader.

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APPENDICES

Appendix 4.1: ARDL Long Run Form and Bounds Test

ARDL Long Run Form and Bounds Test
 Dependent Variable: D(LNINN)
 Selected Model: ARDL(3, 2, 2, 2, 2)
 Case 2: Restricted Constant and No Trend
 Date: 04/01/22 Time: 12:52
 Sample: 1995 2019
 Included observations: 22

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.76108	3.326583	-4.136701	0.0061
LNINN(-1)*	0.299471	0.107923	2.774852	0.0322
LNCPI(-1)	2.553884	0.707635	3.609039	0.0112
LNFDI(-1)	-0.299939	0.072960	-4.111000	0.0063
LNHC(-1)	0.049585	0.195792	0.253254	0.8085
LNTRADE(-1)	1.518067	0.338052	4.490636	0.0041
D(LNINN(-1))	-0.384643	0.218347	-1.761615	0.1286
D(LNINN(-2))	-0.995716	0.199633	-4.987732	0.0025
D(LNCPI)	1.968848	0.479331	4.107488	0.0063
D(LNCPI(-1))	-0.688925	0.436337	-1.578883	0.1654
D(LNFDI)	-0.179772	0.026543	-6.772795	0.0005
D(LNFDI(-1))	0.090696	0.030352	2.988123	0.0244
D(LNHC)	-0.037820	0.720781	-0.052471	0.9599
D(LNHC(-1))	1.634823	0.669806	2.440743	0.0504
D(LNTRADE)	3.006732	0.599960	5.011552	0.0024
D(LNTRADE(-1))	-1.638849	0.460183	-3.561299	0.0119

* p-value incompatible with t-Bounds distribution.

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCPI	-8.527976	2.356179	-3.619409	0.0111
LNFDI	1.001563	0.318985	3.139843	0.0201
LNHC	-0.165575	0.690974	-0.239626	0.8186
LNTRADE	-5.069156	1.842980	-2.750522	0.0333
C	45.95124	16.97831	2.706468	0.0353

$$EC = LNINN - (-8.5280 * LNCPI + 1.0016 * LNFDI - 0.1656 * LNHC - 5.0692 * LNTRADE + 45.9512)$$

F-Bounds Test				
Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic k	7.396208 4	Asymptotic: n=1000		
		10%	2.2	3.09
		5%	2.56	3.49
		2.5%	2.88	3.87
Actual Sample Size	22	Finite Sample: n=35		
		10%	2.46	3.46
		5%	2.947	4.088
		1%	4.093	5.532
		Finite Sample: n=30		
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

Appendix 4.2: Error Correction Regression

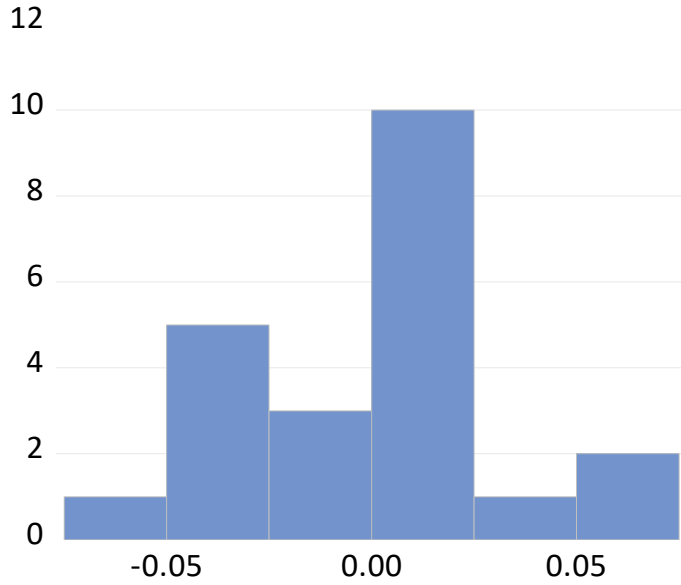
ARDL Error Correction Regression
 Dependent Variable: D(LNINN)
 Selected Model: ARDL(3, 2, 2, 2, 2)
 Case 2: Restricted Constant and No Trend
 Date: 04/01/22 Time: 12:53
 Sample: 1995 2019
 Included observations: 22

ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINN(-1))	-0.384643	0.139836	-2.750660	0.0333
D(LNINN(-2))	-0.995716	0.131693	-7.560901	0.0003
D(LNCPI)	1.968848	0.267467	7.361092	0.0003
D(LNCPI(-1))	-0.688925	0.259538	-2.654427	0.0378
D(LNFDI)	-0.179772	0.013779	-13.04700	0.0000
D(LNFDI(-1))	0.090696	0.016139	5.619789	0.0014
D(LNHC)	-0.037820	0.310708	-0.121723	0.9071
D(LNHC(-1))	1.634823	0.335898	4.867020	0.0028
D(LNTRADE)	3.006732	0.347486	8.652813	0.0001
D(LNTRADE(-1))	-1.638849	0.278250	-5.889836	0.0011
CointEq(-1)*	-0.299471	0.033201	9.019883	0.0001
R-squared	0.953593	Mean dependent var	0.081316	
Adjusted R-squared	0.911404	S.D. dependent var	0.145760	
S.E. of regression	0.043386	Akaike info criterion	-3.130528	
Sum squared resid	0.020705	Schwarz criterion	-2.585007	
Log likelihood	45.43581	Hannan-Quinn criter.	-3.002020	
Durbin-Watson stat	1.904273			

* p-value incompatible with t-Bounds distribution.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.396208	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Appendix 4.3: Jarque-Bera Normality Test



Series: Residuals	
Sample 1998 2019	
Observations 22	
Mean	-9.69e-15
Median	0.000962
Maximum	0.066674
Minimum	-0.061573
Std. Dev.	0.031400
Skewness	0.126708
Kurtosis	2.866322
Jarque-Bera	0.075249
Probability	0.963074

Appendix 4.4: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.634480	Prob. F(2,4)	0.5763
Obs*R-squared	5.298411	Prob. Chi-Square(2)	0.0707

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 04/01/22 Time: 12:55
Sample: 1998 2019
Included observations: 22
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINN(-1)	0.111651	0.241702	0.461937	0.6681
LNINN(-2)	0.139083	0.287315	0.484079	0.6536
LNINN(-3)	-0.245231	0.304603	-0.805085	0.4659
LNCPI	-0.572316	0.728545	-0.785561	0.4760
LNCPI(-1)	0.063744	0.536043	0.118916	0.9111
LNCPI(-2)	-0.335544	0.553261	-0.606483	0.5769
LNFDI	0.016263	0.033614	0.483823	0.6538
LNFDI(-1)	-0.000924	0.033145	-0.027888	0.9791
LNFDI(-2)	0.034714	0.044774	0.775314	0.4814
LNHC	-0.217243	0.793529	-0.273769	0.7978
LNHC(-1)	-0.265757	0.944894	-0.281256	0.7925
LNHC(-2)	0.257678	0.767880	0.335571	0.7541
LNTRADE	-0.849037	0.994462	-0.853765	0.4413
LNTRADE(-1)	0.679847	0.985437	0.689894	0.5282
LNTRADE(-2)	-0.255383	0.544557	-0.468973	0.6635
C	5.173863	5.937335	0.871412	0.4327
RESID(-1)	-0.303003	0.669015	-0.452909	0.6741
RESID(-2)	-1.426724	1.270563	-1.122907	0.3243
R-squared	0.240837	Mean dependent var	-9.69E-15	
Adjusted R-squared	-2.985606	S.D. dependent var	0.031400	
S.E. of regression	0.062687	Akaike info criterion	-2.769703	
Sum squared resid	0.015719	Schwarz criterion	-1.877032	
Log likelihood	48.46674	Hannan-Quinn criter.	-2.559417	
F-statistic	0.074645	Durbin-Watson stat	2.110984	
Prob(F-statistic)	0.999959			

Appendix 4.5: ARCH Test

Heteroskedasticity Test: ARCH

F-statistic	0.599100	Prob. F(1,19)	0.4484
Obs*R-squared	0.641922	Prob. Chi-Square(1)	0.4230

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 04/01/22 Time: 12:56

Sample (adjusted): 1999 2019

Included observations: 21 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001135	0.000369	3.077623	0.0062
RESID^2(-1)	-0.175137	0.226270	-0.774015	0.4484
R-squared	0.030568	Mean dependent var		0.000965
Adjusted R-squared	-0.020455	S.D. dependent var		0.001344
S.E. of regression	0.001357	Akaike info criterion		-10.27607
Sum squared resid	3.50E-05	Schwarz criterion		-10.17660
Log likelihood	109.8988	Hannan-Quinn criter.		-10.25448
F-statistic	0.599100	Durbin-Watson stat		2.081595
Prob(F-statistic)	0.448446			

Appendix 4.6: Correlation Matrix

	LNCPI	LNFDI	LNTRADE	LNHC
LNCPI	1.000000	0.275924	0.260221	-0.398206
LNFDI	0.275924	1.000000	0.065397	-0.127028
LNTRADE	0.260221	0.065397	1.000000	-0.865024
LNHC	-0.398206	-0.127028	-0.865024	1.000000

Appendix 4.7: Variance Inflation Factors Appendix: Correlation Matrix

Variance Inflation Factors
Date: 04/25/22 Time: 13:06
Sample: 1995 2019
Included observations: 24

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
LNINN(-1)	0.028593	1334.814	19.13427
LNCPPI	0.466373	1375.516	1.635410
LNFDI	0.001153	2.537849	1.123850
LNHC	0.086142	5982.254	21.90056
LNTRADE	0.117217	3568.655	4.961199
C	9.983656	11515.19	NA