THE RELATIONSHIP BETWEEN TERTIARY EDUCATION AND ECONOMIC GROWTH IN MALAYSIA

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DECLARATION

We hereby declare that:

(1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the reference to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the research project.

(4) The word count of this research project is 13 944.

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroscedasticity
BLUE	Best Linear Unbiased Estimator
ER	Employment Rate
EViews	Econometrics Views
GDP	Gross Domestic Product
GER	Gross Enrolment Ratio
GMM	Generalized Method of Moments
GNI	Gross National Income
ISIC	International Standard Industrial Classification
LRN	Low-Reynolds-number Model
NEP	New Economic Policy
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PA	Patents Application
PMR	*Penilaian Menengah Rendah*
PT3	*Pentaksiran Tingkatan 3*
PTR	Pupil-Teacher Ratio
RESET	Regression Equation Specification Error
SAARC	South Asian Association for Regional Cooperation
SIC	Schwartz Information Criterion
SPM	*Sijil Pelajaran Malaysia*
TN50	*Transformasi Nasional 2050*

UNESCO	United Nations Educational, Scientific and Cultural Organization
UPSR	*Ujian Pencapaian Sekolah Rendah*
VAR	Vector Autoregression Model
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor

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PREFACE

The research is conducted under the title of The Relationship between Tertiary Education and Economic Growth in Malaysia. Education is a very important aspect in improving living standard. As such education is link very closely with the economic growth of a country by bolstering the work force and providing the knowledge required to produce innovative inventions. Even with increasing budget allocated by the government, education standards do not perform well prompting the government to cut its budget. Thus, this research is essential to shed some light onto the current situation of the education system and its effect towards growth as well as letting the readers understand the education system in Malaysia.

ABSTARCT

This research attempts to identify the relationship between tertiary education and economic growth in Malaysia which encompasses the variables Government Expenditure for Tertiary, Gross Enrolment Ratio for Tertiary, Pupil-Teacher Ratio for Tertiary, Employment Rate for Degree Graduates and Patent Application. This research is to identify the relationship between tertiary education and economic growth in Malaysia despite many previous studies proving its relationship as positive relationship. However, some researchers found it is negative relationship between tertiary education and economic growth. This research is conducted with a sample size of 35 and the data is processed by Ordinary Least Square method to identify the relationship with the help of Eviews. The data is collected from the period of 1982 to 2016. Reliability of the model is tested and the results are favourable. Results of the research coincide with the purpose of this research. It is found that most variables have a positive relationship with economic growth. However, government expenditure has a negative relationship with economic growth which is anticipated in this research.

CHAPTER 1: INTRODUCTION

1.1 Overview

The Asia Region has been slow in terms of education as most of the countries are affected by war as well as being colonized by other countries limiting their economic growth as well affecting their development in education. As such they experience a boom in their economy especially the Asian countries that are able to produce more specialised labour. A high rate of human capital investment in Southeast Asia has made those countries to enjoy the benefits of rapid growth. A study by Anne Booth (2003) found that Southeast Asian economies invested heavily in education at an early stage causes significant inequality of human capital investments between those in Northeast Asia and those in Southeast Asia. In fact, economic growth in Southeast Asia is far behind Northeast Asia as human capital investments in Southeast Asia started late compare to Northeast Asia.

The augmented models of Solow by Mankiw, Romer and Weil (1992) as well as Romer's model (1990) are one of many theoretical approaches showing the relationship between human capital raised by education in relation with economic performance. The presence of such evidence has encouraged developing countries to focus on education that includes human development skills such as innovative abilities. As such implementing a holistic method is a way to strengthen the education from childhood all the way to tertiary education.

1.2 Education in Malaysia

The political and economy conditions were unstable in Malaysia during the independence of Malaysian in year 1957. The Malaysia government introduced controlling procedures for education sector, for example the government-owned schools that lasted until middle of year 1990s. In year 1970, the New Economic Policy (NEP) has greatly shaped the education system in Malaysia. As an important source of economic growth, the investments in education by government are important.

Between year 1970 and year 1975, the number of enrolment in public university nearly doubled. However, the demand for university education was not met causing a large amount of teenagers from 19 to 24 years old to seek for overseas university education. According to the result of vast expansion on tertiary education, government projected a percentage of Gross Domestic Product (GDP) increased from 9% in year 1970 to 13% in year 1990. However, the number of enrolment between year 1970 and year 1990 has only increased from 1% to 3%. (Barro, 1991)

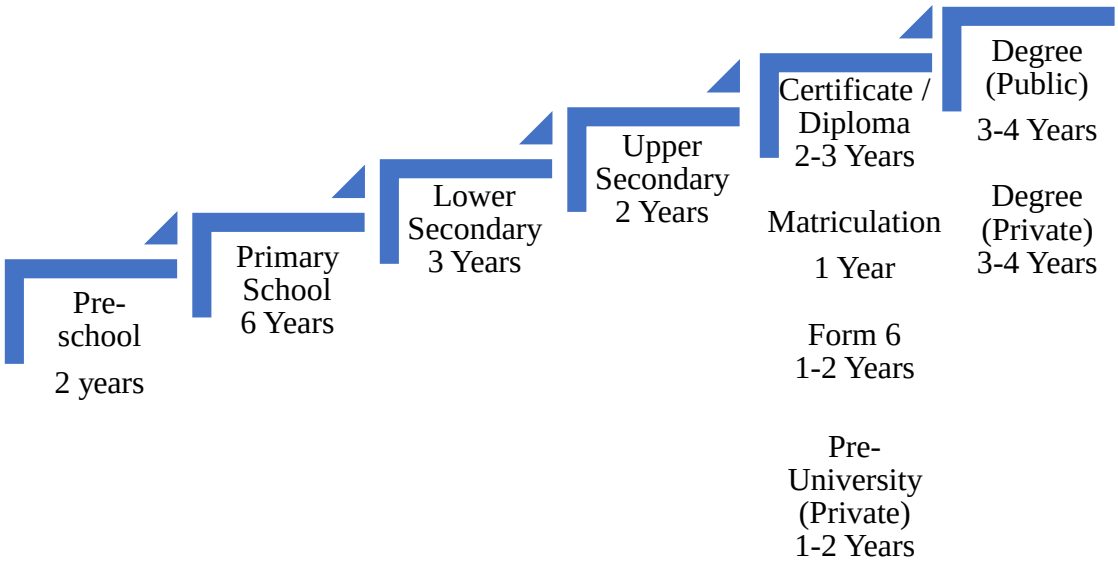
The government policy open education to the private sector and also encouraged private institutions to support the education in Malaysia in the middle of year 1990. Malaysia government also advised private institutions in setting up the educational and training institutions in order to organize twinning programs and preparatory courses as well as meeting regulatory standard. This policy succeeded in reducing the number of students who seek for overseas university education from 60,000 in year 1985 to 52,000 in year 1990. As in year 2016, there were 414 private colleges, 37 private universities, 10 private university-colleges, 1 public university-college, 10 foreign branch campus and 20 public universities in Malaysia.

1.2.1 Education System in Malaysia

Education in Malaysia starts from the age 4 to 6 in preschool and progress into compulsory primary school which is from 7 to 12. Then education in Malaysia progresses into secondary education for teens from 13 to 17 years of age, divided into two lower and upper categories where the first 3 years are in the lower category and the last two years are of the upper category where students can choose whether to continue their studies in the arts or sciences stream. Pre-university studies generally takes up to 1 to 2 years depending on the type as there are many (as shown in figure 1.1). Finally, the chain to end for the majority of students at university level education which takes up to 3 to 4 years depending on the course taken. As indicated by the Ministry of Education (20141a), roughly 5,120,802 understudies were committed over each of the three school levels, with 2,704,046 understudies enlisted in grade school alone. All Malaysian youngsters from the age of 6 years-old are compulsory to enter into free primary school education provided by the government.

Apart from that, all levels of education are operated based on the practice of national curriculum and school calendar set by the Minister of Education with the objective of developing international citizens with strong national identity through the understanding of their country history by achieving a higher aspiration in future. As indicated by Cole (2009), primary and secondary educations are proportionate to affect the labor productivity while tertiary education is proportionated to influence future technology innovation. As all levels of education have been leaving distinctive measured consequences for advancement and identifying with various causal components, the impacts of each levels of education on improvement should be considered independently.

Figure 1.1: Education System in Malaysia



Source: Ministry of Education Malaysia

Primary

In 2003, Ministry of Education Malaysia had applied a compulsory regulation for all youngsters to have their primary education while home-based teaching is allowed with

the permission given by Ministry of Education otherwise lawsuits will be taken towards those who do not abide by the law. With such approach, the essential level enlistment has been almost all inclusive for as far back as decades. In 2011, Malaysia accomplished 94% of enlistment at the primary level.

In view of Malaysia Education Blueprint 2013-2025 (Ministry of Education Malaysia, 2013) has demonstrated that the level of youngsters who drop out from primary school had additionally decreased from 3% to 0.2% in 1989 and 2011 respectively. In the last year of primary school, students are required to take the *Ujian Pencapaian Sekolah Rendah* (UPSR, Primary School Achievement Test) to testify their qualification to secondary school education.

Lower Secondary

Lower Secondary Education is the advanced edition of primary education, it continues the basic programs in previous stage by more subject-focused in teaching with specialize teachers of their filed. Notwithstanding, the enlistment is near widespread with a 98.8% gross enlistment rate and 96.4% of net enlistment rate in 2014 (Clark, 2014). The proportion of the work with optional or advanced education likewise expanded from 37% out of 1982 to 58% out of 2012 as per the information found in World Bank. Students are required to take the *Pentaksiran Tingkatan* 3 (PT3), which was known as *Penilaian Menengah Rendah* (PMR) formerly upon the completion of the lower secondary education. In order to proceed to upper secondary education, the examinations in lower secondary education must be passed and the outcomes will indicate their future path ways by spilled them into different stream such as arts or science stream, technical and vocational stream or religious stream by referring to their results.

Upper Secondary

Upper secondary education is a level of education that student need to acquire after they sat for PT3 examination. During Form 4, student can choose the fields of study that

mentioned above based on their PT3 result. According to Malaysia Education Blueprint 2013-2025, Malaysia has the extreme enhancement in education where the registration rate has been increased from 45% in the 1980s to 78% in 2011 (Ministry of Education Malaysia, 2013). All the students of upper secondary are compulsory to take *Sijil Pelajaran Malaysia* (SPM) in order to graduate from secondary education. The SPM is conducted by the Malaysian Examination Syndicate. Students are required to get a pass in the subject of "*Bahasa Melayu*" and "*Sejarah*" in order to get the certificate.

Pre-Tertiary

The SPM is very important for the entrance of pre-tertiary. Students are required to achieve certain requirement in order to get an offer from the institutions which offer pre-tertiary courses. There are few types of pre-tertiary in Malaysia, which are Form Six, Foundation, Matriculation, Diploma and A-Level. Before enter into tertiary education, all the student required to go through 1 or 2 years of pre-tertiary education. The examination of the pre-tertiary which are Foundation, Diploma, Matriculation and Form Six will be conducted at every semester. In addition, students who further their pre-tertiary education with Form Six will get a certificate *Sijil Tinggi Persekolahan* Malaysia upon the completion of study.

Tertiary

Tertiary education in Malaysia includes the programs of bachelor degree, master degree and philosophy of doctorial. By 2020, Malaysia pursues to reach its goal of becoming a nation with high-income and a global education hub according to Vision 2020. In order to accomplish this goal, the education and development of quality graduates have to be strengthened and 40% of net enrolment of tertiary education has to be reached. Lately, Malaysia has been highlighting the quality of research development and the major universities' quantity. This is made known by the high investment from government on tertiary education level in which the annual government expenditure in 2014 was approximately about 7.7%.

According to the UNESCO benchmark, the expenditure on Malaysia's higher education level is the highest as compared to the other Asian developing countries such as Thailand. In the midst of the universities in Malaysia, there are five universities being

given the status of "Research University". This is because there will be further funding from government and autonomy will be increased. The five research universities include University of Technology, Malaysia, Universiti Putra Malaysia, Universiti Sains Malaysia, University of Malaya and National University of Malaysia.

1.2.2 National Education Blueprint

The Malaysian Government has launched the Malaysian Education Blueprint in order to find out the current situations and the improvements as well as the shortcomings of the blueprint. This way they are able to analyse and revise the effects of the implementation of the policies made by the government. The aim of this blueprint for tertiary education is to make a system that will rank the universities among the world leading systems. The blueprint will update and propose changes to realize this goal.

The goal of the blueprint is to push graduates to be "job-creators" rather than "job-seekers" and change their mind sets to be more concerned to the output rather than the input. Other than that, this model also encourages that universities to have their own autonomy rather than highly regulated by MoE in a centralized system. Instead of relying on the government, all of the stake holders have a shared responsibility for higher education resources. Recognizing the need of every student is different the government has design technology-enabled innovations to design as well as suit to the education for all the students. Finally, public and private universities are no longer separated and are more open in order to harmonize with each other achieving a better system through sharing results of trial and error. The blueprint is expected to achieve its objective in 2025 as the blueprint is deemed as a success if 2.5 million more students annual growth in 2025 from 1.4 million students in 2015. Compared to the National Education Blueprint back in 2007-2010 which only can be described as laying down the foundation for the future, focusing on reinforcing the teaching quality of teaching as well as providing more opportunity to students creating a diverse environment for students to study. This phase from 2007 – 2010 focus on preparing to accept an influx of student without compromising the quality of education delivered to the students.

1.3 Problem Statement

Vision 2020 also known as *Wawasan 2020* was a vision that being implemented by former Prime Minister Tun Dr. Mahathir bin Mohamad which has one of the objective of becoming the nation with an education system with world class rank. Government of Malaysia has invested large amount money to education as expenditure needed in education as 2020 was only 5 years to go. However, the return from this investment was not as good as desired whereby the education in Malaysia was bring found that it was still not as good as other countries as compared with those countries which used lower expenditure. This also indicates that Malaysia may have problem managing their finances efficiently.

According to Universita 21 (2017), Malaysia has been reported as one of the highest countries in term of fund allocated to education. Nevertheless, it also reported that Malaysia is one of the country that having the lowest return on the investment from education. Through this report, we found that Malaysia is being ranked 11th out of 50 in term of resources that contributed in education path. However, the report showed that Malaysia is being ranked 39th out of 50 in term of output of the education.

TN50 also known as *Transformasi Nasional 2050* is an initiative that being launched by the Prime Minister of Malaysia, Dato' Sri Haji Mohammad Najib bin Tun Haji Abdul Razak to plan for the future of the Malaysia in the period of year 2020 to year 2050. It was launched to make Malaysia a developed country in terms of economic development, citizen well-being and innovation. As mentioned above, education could bring a huge impact toward economic growth directly and indirectly. Therefore, a good plan towards the education in Malaysia is mandatory.

From the data collected and incidents mentioned clearly showed that Malaysia has suffered from the mismanagement of fund in education. Total budget operating expenditure in budget of 2015 and 2016 showed a decreased of RM2.4 billion spent on our education. The reason for the cutting in budget is to encourage public university to meet target or key performance indicator as well as improving their effective use of allocated funds. This is not a wise decision because a reduction of budget is detrimental to the operations of a university. Universities need the financial freedom to continue their researches in order to come out with new innovations. The path of innovations

comes with discovery and in the end improving its efficiency of the innovation. However, in the process it is inevitable that a lot of money will be spent on research.

Besides that, there are a lot of studies being conducted by researchers showing the effects of education toward economic growth. Different researchers have their own researched data and results which came along with different interpretation on the results found. Negative relationship between education and economic growth was found by Abdullah (2013) whereby it also reaffirmed the result found by two of the more well-known researchers in this field, Barro and Lee (2010). Conversely, there is a positive relationship between education and economic growth in Malaysia according to Islam *et al* (2016). Such different result from different researchers indicate that the relationship between education and economic growth remain uncertain. Therefore, we would like to reaffirm the relationship between education and economic growth in Malaysia.

In addition, based on the previous researches, education brings an impact toward economic growth indirectly through innovation. According to Pelinescu (2014), as there is increase in growth when the duration of school is increased by a year especially in countries that are developing technologically as innovative capacity rises therefore increasing their qualification which in turn increasing the GDP per capita as more products are being created and consumed.

In conclusion, it is important to identify the impact that brought by education toward Malaysia economic growth regardless in a direct or indirect way. This is crucial as the results found could ensure the government in avoiding the problem of misappropriate of fund, as education may bring a huge impact toward economic growth where economic sustainability is one of the objectives in TN50 as well as Vision 2020.

1.4 Research Objectives

After the completion of this research, the research objective will be accomplished. The aim of this research is to analysis the factors of tertiary education toward economic growth comprehensively.

1.4.1 General Objective

Education plays an important role to promote economic growth because theoretically it will increase human capital, improve the transmission of knowledge as well as inspire new innovations. Therefore, this research is to examine how tertiary education affecting economic growth in Malaysia.

1.4.2 Specific Objectives

This search has narrowed down its scope by only focusing on the tertiary education either direct force or indirect force. The major intention is to identify the relationship between economic growth in Malaysia and educational factors including government expenditure, gross enrolment rate and pupil-teacher ratio which representing direct forces whereby employment rate and patent application are representing indirect forces. Hence, the specific objectives of this research are as follow:

1. To examine the relationship between government expenditure and economic growth.
2. To examine the relationship between gross enrolment ratio and economic growth.
3. To examine the relationship between pupil-teacher ratio and economic growth.
4. To examine the relationship between employment rate and economic growth.
5. To examine the relationship between patent application and economic growth.

1.5 Research Questions

A few research questions are formed in order to accomplish the specified objective above. The research questions are as follows:

i. Does the government expenditure affect economic growth significantly?

ii. Does gross enrolment ratio affect economic growth significantly?

iii. Does pupil-teacher ratio affect economic growth significantly?

iv. Does employment rate affect economic growth significantly?

v. Does patent application affect economic growth significantly?

1.6 Hypotheses

A hypothesis is hypothesizing the relationship between multiple variables logically in the form of statement. In this research, the null and alternative hypotheses of each exogenous variable are being recognized as follow:

1.6.1 Government Expenditure for Tertiary

H_0 : There is no relationship between government expenditure on tertiary education and economic growth.

H_1 : There is a relationship between government expenditure on tertiary education and economic growth.

1.6.2 Gross Enrolment Ratio for Tertiary

H_0 : There is no relationship between gross enrolment ratio and economic growth.

H_1 : There is a relationship between gross enrolment ratio and economic growth.

1.6.3 Pupil-Teacher Ratio for Tertiary

H_0 : There is no relationship between pupil-teacher ratio and economic growth.

H_1 : There is a relationship between pupil-teacher ratio and economic growth.

1.6.4 Employment Rate for Degree Graduates

H_0 : There is no relationship between employment rate and economic growth.

H_1 : There is a relationship between employment rate and economic growth.

1.6.5 Patent Application

H_0 : There is no relationship between patent application and economic growth.

H_1 : There is a relationship between patent application and economic growth.

1.7 Significance of Study

A lot of studies were being conducted to observe the relationship between tertiary education and economic growth of a country. Majority of the studies especially from Barro (1991) who done numerous of papers indicated that there is a significant positive relationship between tertiary education and economic growth. However, there are still a number of researchers like Abdullah (2013) found that tertiary education and economic growth are negative related. Other than that, most of the studies only stressed on the effect of education toward economic growth directly where they had omitted the possibility of indirect effect of education toward economic growth.

In this research, a more accurate relationship between tertiary education and economic growth in Malaysia could be generated. This is because effects of education toward economic growth directly and indirectly were being underlined in this study in order to produce a more precise result. Patent application was being used to examine the effects of education toward economic growth indirectly. Meanwhile, gross enrolment ratios for tertiary, pupil-teacher ratio for tertiary and current education expenditure for tertiary were being employed to study the impact of education toward economic growth directly.

Through this research, government is allowed to allocate fund efficiently and effectively in order to be free from the problem of misappropriate fund. Besides, it could also help to enhance the economic sustainability. Hence, Malaysia can become a nation with a high economic growth with greater competition.

1.8 Chapter Layout

The structure of this research has been divided into five chapters. The chapter one is talking about the overview of this research which is the background of this research, problem statement, objective, and hypothesis of this research. Chapter two is presenting about literature review for all the variables. Following by chapter three, it is to explain the methodology of our research. However, chapter four is presenting t our findings and the analysis of our research. Lastly, chapter five is present about the conclusion and policy implication of our research.

Chapter 2: Literature Review

2.1 Introduction

Studies on growth has been consistently conducted by various researchers especially Barro (1991) who has done the most number of studies as well as institutions and this research would like to explore the relationship between education and economic growth with countless of papers disproving each other. In this research, the variables include patent application, employment rate of degree graduates involved in Research and development. The key aspects of this research would focus on the significances of said variables and their relationship with economic growth.

2.2 Education and Economic Growth

Education has played a key factor in improving the living standards of the populace by qualifying lower class income to be able to apply a medium – high income job and thus improving their life. A study done by Benavot (1989) has pointed out that education may have a negative impact on the growth of an economy as more and more education are not willing to work a job deemed lower class at that time and are unable to find jobs suitable to their level of education. According to Colcough (1982), Irizarry (1980) and Turnham (1970), these papers includes gender for a higher accuracy as women start to fight for their rights during 1980's as more women are educated included into the data for unbiased model.

Another study done by Judson (1995) studies the relationship between costs of education that is different in time as well as different nations and other variables such as currency and GDP. The study found that of human capital stock is significant out the human capital accumulation using different models including an extended Solow model. Loening (2005) has found that the education has a positive impact on the long-term growth in Guatemala with data from Banco de Guatemala and variables such as participation of primary, secondary and tertiary education against gross domestic product. The study suggested that Guatemala needs to close the gap between its physical

labour as well as their skilled labour as their economy is more susceptible from external shocks due to internal conflicts in the country.

Paper by Loening (2005) has determined that education has constituted at least half in the country's growth in the period of 50 years and is a key component to growth. This study able to find such relationship despite the limited data and used models derived from Barro (2001) to supplement his research using variables such as average schooling years as well as time-series data obtained from the period of 1950 to 2002. Kong (2007) found that the relationship between education and growth rate measured in by employment rate and enrollment rate of primary all the way to tertiary education. The study showed that there is significant relationship between the two factors in the long run. Yusof (2008) has determined that both mentioned variables are significant suggesting that development in education has played an essential role in the progress of the Malaysian economy. The study used cross sectional data collected from various government agencies such as the Bank Negara Malaysia.

A study done by Barro (2013) found that growth is positively related to the average schooling years. The study suggested that it is positively related because labour force with higher education would complement with higher level of technology as time progresses, while longer and higher level of education in females does not contribute to the country's growth suggests that the female labour force is fully utilized. The study uses data collected from well over 100 countries compiled from the United Nations, updated from 1960 to 1995. Barro (2013) insist that the data used should be wide and not targeted to developed country despite the quality of data obtained from the less developed countries because the policy and other factors among the developed countries are too constricted to make pin point conjectures.

After studying the relationship between education and economic growth, a study conducted by Hanif (2016) aimed to identify the pattern of domestic product growth using the Cobb-Douglas series which compared three different proxies of human capital for SAARC countries to see whether higher proxy has higher impact on growth. The study finds that tertiary education has the largest impact on growth as compared to secondary and primary education when using variables such as Education and GDP with data collected from the World Development Indicator from 1960 to 2013. Dufrechou (2016) collected data from 22 high income OCED countries and upper middle income

countries at a 5 year internal from 1970 to 2000 and regressed using the GMM regression model as well as Hierarchical Linear Model to counter concerns coming from the correlation between schooling and economic growth. The two methods allow Dufrechou (2016) to identify the split of tertiary skill profile that influence between two countries with different level of income.

2.3 Direct Force of Tertiary Education toward Economic Growth

Direct force of tertiary education is those factors that generated directly through tertiary education which will bring an impact toward economic growth. Review of literature on the factors that being mentioned in previous chapter are as follow.

2.3.1 Government Expenditure

Gwartney (1998) found there is positive relationship between government expenditure and economic growth. Government expenditure has rose accordingly when Malaysia has moved towards economic freedom and open market. However, Sindha (1998) enhanced it further by realising a positive relationship between government expenditure on tertiary education and economic growth in Malaysia from year 1950 to 1992.

According to Krystou and Labys (2006) stated that education is an important catalyst for human capital and influences a country's economic growth. With this in mind, government should invest increasingly in education because of its contribution to economic growth whether it is directly or indirectly. Kakar (2011) supports the finding as the study found significant relationship between GDP and labour force participation with variables such as technical progress, capital stock labour force and human capital which can be attribute by level of education from the data collected. The study concluded that the government must pay attention in increasing its education quality and invest more money into improving education sector that will benefit the country's economy. After examining exports and education in Malaysian's economic development by using VECM and Granger causality test. A study by Afzal (2009) found that there is a casual relation between education and economic growth. The paper used time series data collected from 'Pakistan Economic Survey and "Annual reports of State Bank of

Pakistan". Different number of data collected around 10 different indicator of education and as well as labour stock and capital stock is used in the model. The study recommended that more funds should be invested into education especially tertiary education to allow the economic situation to progress at a faster rate.

Maitra (2012) studied the relationship between spending on education and health sector with increasing GDP of 12 different countries in Asia. Majority of countries namely Fiji, Kiribati, Maldives, Nepal, Singapore, Bangladesh, Sri Lanka, Tonga and Vanuatu has a positive relationship with education and GDP. However, the study also found that Philippines has a negative relationship with education and GDP while Malaysia and Korea does not find any significance between the education and GDP. Maitra (2012) stressed that spending on education and health does not immediately show on the country's GDP and the increase on GDP may vary depending on the country as well as its major economic activity.

Mekdad (2014) found that the result coincides with the initial hypothesis that spending on education will positively affect the economic growth in Algeria after using the variables Real Gross National Product (GDP), Capital (K), Labor (L), Expenditure on Education (SEDU) subjecting them to Ordinary Least Squares (OLS) and Johansen Co-integration test and Causality Test. Education is a casual force in economic growth, education will only produce its impact in its long-term and this study may have omitted some important variables.

Another study done by Mercan (2014) found that there is a positive relationship between education expenditure and economic growth. Factoring variables, real domestic product and expenditure on education from the year 1979-2013 supplemented by data from The World Bank and Dickey-Fuller test is applied to regress the data. Mercan (2014) concluded that the Turkish Government should concentrate on increasing the expenditure on tertiary education in order to enhance the economy dynamically by sharing and transfer of knowledge between institutions. A study by Mallick (2015) investigated the relationship between education expenditure and economic growth from 1951 to 2012 using the bivariate VAR model. Data are collected from Indiastat.com from 1951 to 2012 which sources the data from different governmental departments. The results from the study shows that the expenditure has effect on growth until the 10th period and anymore increase after the 10th yet growth does not impact expenditure on

education with the paper concluding that the government should increase its spending in education. This is further supported by another paper done by Mallick (2015) studying the same variables but on a larger scale encompassing 14 countries in Asia as well as panel vector error correction in both short and long term shows a positive relationship of education expenditure and economic growth, concluding the same as the mentioned previously that the country in question needs to invest more into education. The researcher ultimately recommend that there are more value in investing in education as a developing scheme for that country's economy to ensure that the people in that particular country are skilled and therefore are able to attain better and higher paying jobs. This is further supported by Dufrechou (2016) that studied the relationship between tertiary education on growth and income per capita in high and upper middle income countries from 1970 to 2010. The study showed that growth and income per capita is affected by tertiary education depending on how much the government encourages tertiary students, especially when a high percentage of enrolment in technological and scientific careers emerge as a determinant of economic factors when compared to other skills.

A research done by Stefan (2016) has investigated the relationship education expenditure on economic growth. The study found that all of the factors are significant as for the limitation of this study is that as it develops the regression model needs to be developed as well. Undeveloped regions of different level of education will cause difference in growth in regions especially if that country has large space and vast difference in population yet education still plays a key role.

2.3.2 Enrolment Ratio

Abbas (2001) stated that enrolment rate can measure current human capital stock and then cross-referenced to reflect future human stock through the accumulated flows of schooling. Besides, Van Leeuwen (2007) confidently stated that enrolment rate is preferred due to factor of convenience. It is commonly used ratio and the statistics are easily access whether it be from sources locally or internationally. Convenience is an important tool to this research due to time being limited. Accessibility is also another factor which makes this enrolment ratio so appealing.

However, a study by Shaihani (2011) focused on the impact of education level on growth during the time period 1978-2007 found that tertiary education has a negative relationship with growth whereas secondary education has a positive relationship with growth in the short term after subjecting the data from The World Bank using autoregressive distributed lag modelling. The study suggested that the government should increase the enrolment rate into tertiary education as well as introducing policies that will increase innovation to stimulate economic growth and generate more job opportunity to adapt the increased enrolment rate.

Another study by Oluwatobi (2011) found that there is a significance relation between tertiary enrolment rate and economic growth which Oluwatobi (2011) recommended that the government needs to increase the spending in education and aggressively fund education due to slow tertiary enrolment rate. A study conducted by Mariana (2015) showed that there is a positive relationship between numbers of students on economic growth. As for undeveloped and developed countries benefit from increased level of tertiary education as evidence by a study conducted by Wang and Liu (2016) leading countries like China to invest more in education. Both studies included enrolment ratio and economical scale as well as including periods before and after educational reforms which then suggested that this will bring equal and balanced development in China.

2.3.3 Pupil-Teacher Ratio

Student teacher ratio is number of students per teacher or according the average number of students a teacher instructs in a school (Graue & Rauscher, 2009). In the examination, researchers have concentrated on teacher-student interaction as an important aspect of a good education and academic achievement (Graue *et al.*, 2009). Pupil-teacher ratio is able to reflect the quantitative information in education which could also affect the outcome of the quality of education.

A study done by Barro (1991) has found a positive relationship between quantity in education and economic growth. Besides, this result was further support by the research done by Mankiw *et al.*, (1992). Other than that, Hanushek (1995) has also found that, the quantity of education supply could bring a positive impact toward the economic growth after he gathered the studies from researchers from difference region.

Besides, Benhabib and Spiegel (1992) has also found the similar result found that higher the education quantity, greater the economic growth. These studies were more likeliness to stress on the interactions between teacher and pupil in order to achieve a better education output as well as higher performance from the students.

In addition, a study done by Croll and Hastings (1996) has concluded that teacher would have more chances to communicate with each of the students which can give an influence to the student more specifically in order to achieve greater education performance and thus bring an impact toward the economic growth. Besides, Croll and Hastings (1996) also stated that small class size actually gives teachers the opportunity to spend more time with each student which more specifically influences their learning and scholarly achievement. Besides, Cooray (2009) has found that the relationship between pupil-teacher ratio would be significant only through the interaction between pupil-teacher ratio and enrolment ratio. However, this result is vary depending on the development of country. Nevertheless, Climent and Cabrillana (2012) has found that there is no relationship between pupil-teacher ratio and economic growth after they making the ratio in constant.

2.4 Indirect Force of Tertiary Education toward Economic Growth

Indirect force of tertiary education is those factors that generated indirectly through tertiary education which will bring an impact toward economic growth. Review of literature on the factors that being mentioned in previous chapter are as follow.

2.4.1 Patents Application

Patents and innovation are important aspect of a country because it signifies that people are constantly creating new innovative products to be made and sold that will boost the economy as well as a monopoly on the technology for the first decade giving new firms more time to grow with a more stable foundation. The number of patents of registered with more than 850 000 patents registered OECD (2004). However, the prerequisite condition that is the inventor may need to be very educated and there is a need to examine that whether that innovations and patents may be a factor. This factor also has it

flaws as the products registered are in bad poor quality and also it acts a counter incentive for universities to actually come out with a patent. The study used secondary data obtained from the Ministry of Education.

Another study by Wang (2015) used time series data as well as applying LRN model, vector autoregressive (VAR) model with the goal in mind of using patents and trademark statistics are used to measure innovation as well as essential role as a force of economic growth. The study suggested long-run relationship between innovation and economic growth are significantly influenced by two world wars.

A study by VijuRaghupathi (2017) suggested that there is a positive association between real minimum wages and number of patents applications prompting government to splurge more on education. The research used data from OCED 2000 to 2010 as well as variables such as GDP, GNI, Labour cost index and development as well as educational components of the economy. The study is limited by its consideration of a small segment of economic and innovation indicator. The researcher suggested that education system integrate more social skills as well as enough technical skills for the workplace as more employer desire employees to have the ability to adapt and create new ideas as well as have impeccable sense of responsibility.

Another research by Albert (2009) comprising of 72 countries spanning from 1981-2000 found that the effective patents rights have greater influence on growth speed in patent-intensive industry. Patent has a stronger influence during the 90's both encouraging to factor accumulation and technological progress. The study is done with database that included four panels of ISIC manufacturing industry in up to 71 different countries.

Aghion (2009) conducted a study on the relationship between patent which is a measure for innovation and growth by using data collected from U.S Department of Commerce as well as variables such as number of patents registered per thousand people and education related research spending found that patents effect economical growth postively. Aghio (2009) stated that nearer to the technological frontier may benefit more from research and development from states that are far from the techonological frontier and money spend in either four or two year college program will increase the number of patents registered. However, a four year college program will create shocks more so than a two year college program.

A paper by Varsakelis (2006) whose goal is to find evidence to support the hypothesis of the higher of investment into improving the quality of education the higher innovation activity used a sample obtained from 29 different countries and tested the variation using panel-data methodology using variables, number of patents and quality of education as well as quality of governmental facilities. The selected variables act as a proxy to measure the dependent and exogenous variable found that the result of the research supported Varsakelis (2006) initial hypothesis and recommended that more resources should be allocated to increase the quality of education to create a pool of skilled human resources as well as supply of high quality innovation output. The study used data obtained from the World Intellectual Property Organization as well as data from Third International Mathematics and Science Study.

According to the study of Salih (2016), the relationship found between patent applications will affect economic growth positively but economic growth will not affect the number of patent applicants which is created by higher level of technological innovation which increases the productivity of the country. The results is obtained by GMM modelling using data obtained from 23 OCED countries with variables such as R&D expenditure and growth. Nevertheless, according to Sinha (2007), there have no relationship between patent applications and economic growth in South Korea by using time-series analysis but there is two-way causality relationship between the two variables in Japan.

2.4.1 Employment Rate

A paper by Lim (2016) found that the rate of employment in Malaysia is low at 3% in 2016 however there is evidence that there is case of over qualified graduates taken jobs that they are more than qualified to as well as the disproportional distribution of jobs in East and West Malaysia. The paper found that there is significant relationship between employment rate and growth and emphasize in job creating to keep the unemployment rate down using the data collected from Labour force survey as well as the cooperation of the national Department of Statistics. Brown (2003) also highlights that better educated applicants are more desirable to employers prompting more and more people to get themselves educated resulting the opportunity cost to increase as jobs are harder to get due to fierce competition. The result is obtained from the OCED education database.

This is further supported by Varghese (1988) which stressed the importance of education in getting employed in a modern society where private and public sector prefer employees with degrees compared to those without. As a saturation of educated workforce is created, those educated is no longer guaranteed employment and those uneducated are weeded out immediately. The results are obtained from the data collected from Director General of Employment and Training of India and studying the pattern of the data. Moreover a study by Levine (2013) shows there are negative relationship between unemployment rate and economic growth .The real GDP shows a difference from potential GDP when there is a high rate of unemployment which is now referred as an output gap from data obtained from U.S Bureau of Economical Analysis National Income and Product Accounts.

2.5 Conclusion

The purpose of this review is to see the changes of education's influence on growth in the past year as well as setting a benchmark expectation of the empirical result in this research. Most of the studies done by other researchers showed that education and economic growth are significant to each other and also recommended that government should increase their spending into education to improve the quality of education. However, education will only work in the long run and the government should have a comprehensive plan in increasing their investment into education.

Along with this, government that wish to increase their growth should actively increase their enrolment rate into tertiary education that has the most significance to increase growth despite some contradictory results to ensure that average income of their citizens will increase. This further leaves an inquiry that some country's growth has a negative relationship with education due to the nature of their economy that is mostly agrarian or the economy is not dynamic enough.

Therefore, a further readdress is needed to reiterate the relationship of education and growth especially in developing countries where their economy is still growing and evolving. Helping developing countries to set a direction to enhancing their economy is important in any country as to prevent any discord and any breakdown of the social system.

Chapter 3: Methodology

3.1 Introduction

This chapter describes the overall research methodology being used in along the research. The research is conducted by attaining essential data for empirical testing with appropriate methodology to ensure sound and accurate result.

3.2 Data Collection Method

The objective of this research is to study the relationship between tertiary education and economic growth in Malaysia. To observe the effect of direct force of education, this research employs government expenditure on tertiary education, enrolment ratio on tertiary education and pupil-teacher ratio on tertiary education. However, patent application and employment rate degree graduates are used to examine the indirect force of education. To study the relationship between the variables, hypothesis testing will be conducted and result will be produced.

Quantitative research comprises of studies in which data concerned can be examined and its findings are more readily to be interpreted. During the process of secondary data analysis, the researchers are not participating in the process of data collection (Russell, 2001). Therefore, secondary data is more suitable to be used in this study as compared to primary data.

To acquire the secondary data, World Data Bank and Department of Statistics Malaysia are used for support. The sampling that employs in the research covers total of 35 years from 1982 to 2016 and data is obtained on annually basis. Consequently, a total of 35 observations will be analysed in this research. After arranging the raw data accordingly in spreadsheet, the data is ready to be used for further study.

3.3 Econometric Model

This study proposes an empirical model that estimates Malaysia's economic growth as a function of gross enrolment ratio for tertiary, pupil-teacher ratio for tertiary, current

education expenditure for tertiary, researcher and technician in R&D and patent application. The functional form of the model was constructed as follow:

Economic Growth = f(gross enrolment ratio for tertiary, pupil-teacher ratio for tertiary, education expenditure for tertiary, patent application, employment rate for degree graduates) [3.1]

$$\ln GDPPC_t = f(GER_t, \ln PTR_t, GOV_t, \ln PA_t, ER_t) \quad [3.2]$$

3.4 Econometric Techniques

Instead of using a complicated method, OLS regression is the most appropriate method to study a relationship between endogenous variable and exogenous variables. It was able to identify the causal relationship between dependent variable and exogenous variables directly. Besides, OLS regression is an effective way to diagnostically check all data and suitable resolutions for the detected problems (Jung and Lei, 2012).

According to Gauss-Markov theorem, there is a few characteristics that must be fulfilled before employing OLS regression model. First and foremost, the model must be linear in parameters. Precisely, the endogenous variable is measured in a linear function by a specified set of exogenous variables with residual. Besides, it is also important that sample are randomly picked need to be observed. The number of observations shall not be smaller than the number of estimated parameters to observe an accurate result. To make sure the existence of unilateral causal relationship between endogenous variable and exogenous variables, the dependent variable must not be stochastic. In summation, the value of exogenous variables are constant. Other assumptions such as no multicollinearity, homoscedasticity, no autocorrelation, normality of error terms and model specification must be observed before applying OLS regression.

In order to attain Best Linear Unbiased Estimator (BLUE) properties, the assumptions are needed to fulfil. It was explained by the Gauss-Markov theorem. Firstly, minimum variance in the empirical results is achievable in order to get the best indicator which will lead to obtain the precise and constant results. Second, the model is in linear

form if the estimated parameter is same with the true parameter. When the characteristics are observed, the estimated parameter is the unbiased estimator of true parameter. In other word, the mean value of estimator in repeated sampling is equal to the true parameter which describe the relationship between *x* and *y*.

The application of Econometric Views (EViews) is the most appropriate application to be used to study the relationship between economic growth and tertiary education as the data is time series data. The results from EViews are more accurate as compared to other applications.

In addition, EViews allowed us to conduct diagnostic checking test in order to identify whether the model is suffered from the problem of muticollinearity, heteroscedasticity, autocorrelation, specification bias and normality.

3.4.1 Multicollinearity

Multicollinearity occurs when there are two or more exogenous variables in the model are correlated and redundant information is generated about the response. The occurrence of this problem will lead to a large variances and covariance thus affect the significant of t-statistics. It reduces the consistency of the data information and thus confusing and biased results will be observed. There is no special way to detect this problem. However, there are few rules to be fulfilled:

The first way to detect multicollinearity problem is high R-squared but less significant t-ratios. It shows that there is a correlation between explanatory variables when high R-squared but insignificant on most of the explanatory variables.

To find whether which explanatory variable are correlated, the high Pair-Wise Correlation coefficients test will be carried out. This is aim to identify which explanatory variables have the highest covariance. The benchmark to determine high risk of multicollinearity is when the coefficient more than 0.8.

Last but not least, the study estimates the relationship between the exogenous variables by employing the highest coefficient among other explanatory variables. Then, obtain the value of R-squared for each of them. Variance Inflation Factor (VIF) is employed to test the sternness of multicollinearity. VIF is defined as follow:

$$VIF = \frac{1}{1 - R^2_{x_1 x_2}}$$

The variables are found to be highly correlated if the value of VIF is equal of more than 10. It also indicates that there is a serious multicollinearity problem in the model.

3.4.2 Normality of Error Terms

The function of normality test is to examine whether the data set is likely to be normally distributed. Jacque-Bera test is the most commonly been used by the researchers to check whether the data fulfilled the assumption of normality. Jacque-Bera test is chi-squared distributed in a standard pattern with two degrees of freedom where is it just the sum of squares of two patterned independent standardized normal. It uses the sample of skewness and kurtosis of normal distribution as base. Jacque-Bera test is used to measure that whether the variables omitted are small and at best random. It will be carried out as below:

H_0: Error terms are normally distributed

H_1: Error terms are not normally distributed

The test statistic of Jacque-Bera will be computed as below:

$$JB = \frac{n}{6}\left[S^2 + \frac{1}{4}(K-3)^2\right]$$

Where,

n	=	Number of observations
S	=	Sample of Skewness
K	=	Sample of Kurtosis

Therefore, if the p-value is smaller than significance level which is 0.05, the null hypothesis will be rejected. It means that the error terms in the model are not normally distributed.

3.4.3 Model Specification

Model specification test is to check whether the model has specified correctly. Leaving out relevant variables, including irrelevant variable, wrong functional form used are the common reasons that making a model suffer from model misspecification problem. When a model is suffer from model misspecification problem, the model might also suffer from the heteroscedasticity and autocorrelation problem and making the model become biased and generate an inconsistent outcome. Ramsey RESET will be used to determine whether the model is suffered from model misspecification problem. Ramsey RESET test is to check whether the endogenous variable can be explained by non-leinar combinations of fitted values. Ramsey RESET test will be carried out as below:

H_0: Model is correctly specified

H_1: Model is incorrectly specified

Test statistic is determined by using R^2 of both estimated restricted and unrestricted model. The test statistic for Ramsey RESET is computed as below:

$$F = \frac{(R^2_{unrestricted} - R^2_{restricted}) \div (k_{unrestricted} - k_{restricted})}{(1 - R^2_{unrestricted}) \div (n - k_{unrestricted})}$$

Where,

k	=	Number of explanatory variables
n	=	Number of observations

F table can be used to obtain the critical value of Ramsey RESET test:

$$F_{\alpha,2,n-3}$$

Where,

α	=	Significance level
n	=	Number of observations

Null hypothesis will be rejected if the value of test statistics computed is greater than critical value. Hence, it can be concluded the model is suffered from model misspecification problem.

3.4.4 Autocorrelation

Autocorrelation is defined by that error terms for various observations are independently and identically distributed. It also means that an error term that distributed independently for a period is not related to the previous period without taking sign of size of the error term into the account. Else, the model will not fulfil the assumption of independence of error term. Autocorrelation will a common problem for time series data. Hence, inaccurate outcome will be generated as the distribution of the coefficient will be affected by increasing the variance of the distribution.

There are two categories of autocorrelation problem which are pure serial correlation and impure serial correlation. Pure serial correlation happens due to distribution of error term, whereby impure serial correlation happens due to specification bias. Durbin-Watson test will be carried out to determine the autocorrelation problem and working as shown below:

H_0: There is no autocorrelation problem

H_1: there is autocorrelation problem

Test statistic for Durbin-Watson will be computed as below:

$$\hat{\rho} = \frac{\sum(\mu_t - \mu_{t-1})}{\sum \hat{\mu}_t^2}$$

Where,

$\hat{\rho}$	=	Estimated serial correlation coefficient
μ_t	=	Error term
$\hat{\mu}_t$	=	Estimated error term

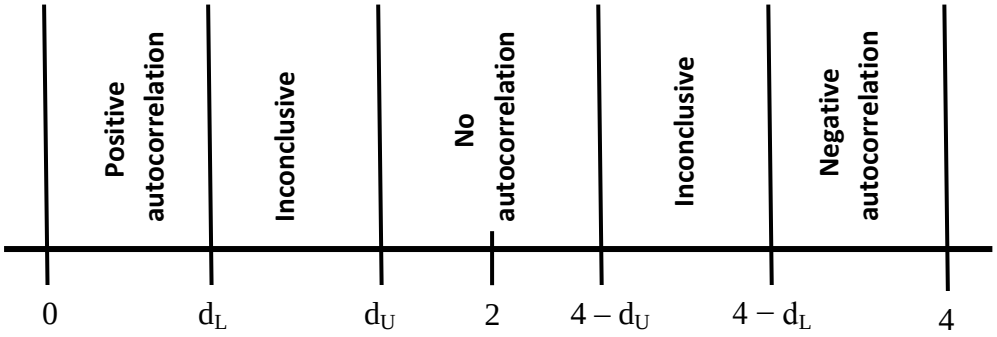
Null hypothesis will be rejected when the p-value is smaller than the significant level 0.05. It also means that there is a autocorrelation problem occur in the regression model. Hence, it can be categorized that the model is suffer from pure serial correlation. In order to determine the type of serial correlation, Durbin-Watson statistic would be used and as computed as below:

$$d = \frac{\sum(\mu_t - \mu_{t-1})^2}{\sum(\hat{\mu}_t^2)}, \qquad d = 2(1 - \hat{\rho})$$

Where,

d	=	Durbin-Watson statistic
μ_t	=	Error term
$\hat{\mu}_t$	=	Estimated error term
$\hat{\rho}$	=	Estimated serial correlation coefficient

The figure below shows types of serial correlation and region of it fall onto by using Durbin-Watson test statistic:



Where,

d_L = Lower d critical value

d_U = Upper d critical value

In order to identify the lower and upper critical value from Durbin-Watson table, there is few elements are needed to be known such as *k* (number of exogenous variables without taking intercept into account), *n* (number of observations) and α (significant level). Null hypothesis will be rejected if the test statistics is smaller than d_L or greater than 4 - d_L. Besides that, null hypothesis will be accepted when the test statistic computed is between d_U and $4 - d_U$, otherwise inconclusive.

Nevertheless, it is hard for Durbin-Watson test to identify higher order autoregressive model of endogenous variable and residuals. For example, higher order of correlation is a common problem for time series data as the residuals for a certain period might be affected by the residuals of previous period. In a result, the result conclude through Durbin-Watson test might be inconclusive. Therefore, Breusch-Godfrey LM test will be applied for further diagnostic checking. The procedure of the test is as follow:

H_0: There is no autocorrelation problem

H_1: There is autocorrelation problem

The critical value of Breusch-Godfrey LM test is computed as below:

$$X_u^2 = X_{\alpha,p}^2$$

X^2	=	Chi-squared
α	=	Level of significance
p	=	Fitted lagged lane

The test statistic of Breusch-Godfrey LM test is computed as below:

$$Test\ Statistic = (n - p)R^2$$

Where,

n	=	Number of observations
p	=	Fitted lagged lane
R^2	=	R-squared

The advantage of applying Breusch-Pagan LM test is it is appropriate in testing higher order of serial correlation. First step of the test is determining the best fitted lagged lane (p) by computing the lowest Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC). The formulas are as below:

$$AIC = \left(\frac{2n}{n - k - 1}\right)k - 2\ln(L)$$

$$SIC = k\ln(n) - 2\ln(L)$$

Where,

n	=	Number of observations
k	=	Number of explanatory variables
L	=	Maximized value of Log-likehood

After computing AIC and SIC, critical value can be found by using chi-squared table. If the test statistic is greater than critical value, it can be concluded that there is no autocorrelation problem, otherwise do not reject null hypothesis.

3.4.5 Heteroscedasticity

Assumption of homoscedasticity assumed that error term of a model is normally distributed with zero mean value and has a variance of σ^2. In addition, the assumption will not be fulfilled when the error term does not consist a constant variance whereby it will be defined as heteroscedasticity.

Heteroscedasticity happens due to a few reasons. First, the sample data set was obtained from a variety of background which will lead to the appearance of outliers. Second, error in measurement and model misspecification would cause heteroscedasticity problem. Incorrect feedback obtained from the respondents will cause the variable being measured inaccurately. Wrongly specified model such as wrong data transformation, incorrect functional form and excluding relevant variables would cause the model suffer from heteroscedasticity problem.

OLS estimator will no longer remain BLUE when the regression model suffers from heteroscedasticity problem. Heteroscedasticity problem will cause standard error to be biased. Other than that, t test and F test will tend to have greater variance as compared to the actual variance. Hence, bias confidence interval and test hypothesis will be observed and thus the results will be inaccurate.

In order to identify the problem of heteroscedasticity, Autoregressive Conditional Heteroscedasticity (ARCH) test will be applied. The process of diagnostic checking will be carried out as below:

H_0: There is no heteroscedasticity problem

H_1: There is heteroscedasticity problem

The critical value of ARCH would be obtained as below:

$$X_u^2 = X_{\alpha,k}^2$$

Where,

X^2	=	Chi-squared
α	=	Level of significance
k	=	number of exogenous variables

The test statistic for ARCH test will be computed as below:

$$Test\ statistics = nR^2$$

Where,

n	=	number of observations
R^2	=	R-squared

Null hypothesis will be rejected if the test is greater than the critical value or the p-value is smaller than significant level 0.05. Otherwise, it can be conclude that the model is not suffer from heteroscedasticity problem.

3.5 Conclusion

This chapter has determined all the significant measurement and statistical tests. Data is all collected from World Data Bank. The sample size of 35 is appropriate and sufficient. OLS regression model is then formed for empirical checking and diagnostic checking will be carried out according the methodology as discussed earlier. All explanation on empirical testing results computed from EViews will be interpreted in the next chapter.

Chapter 4: Results and Interpretations

4.1 Overview

All necessary data is collected for series of testing and empirical testing. In this chapter, the empirical result will be interpreted as extracted from the EViews program.

4.2 Model estimation and interpretation

An econometric model is used to determine the relationship between economic growth with growth enrolment ratio for tertiary, pupil-teacher ratio for tertiary, education expenditure for tertiary and patent application.

$$lnGDP_t = \beta_0 + \beta_1 GOV_t + \beta_2 GER_t + \beta_4 PTR_t + \beta_3 lnPA_t + \beta_5 ER_t + \varepsilon_t \quad (4.1)$$

Where,

Model 4.1 is the model where GDP is estimated by using force of education, which is government expenditure, gross enrolment rate, patent application and pupil-teacher ratio. In order to minimize the variance in measurement, the data from patent application and pupil-teacher ratio are transformed into logarithm form. Below shows the result extracted from the econometrics model:

Table 4.1: Empirical Result of OLS Regression Model

Variable	Coefficient
Intercept	7.0728
Patent Application	0.1830
Pupil-Teacher Ratio	0.0029
Education Expenditure	-0.0198
Gross Enrolment Ratio	0.0177
Employment Rate	0.0778

Table 4.1 shows the regression output obtained from EViews 10

The results are interpreted as below:

$$lnGDP_t = 7.0728 - 0.0198GOV_t + 0.0177GER_t + 0.0029lnPTR_t + 0.1830lnPA_t + 0.0778ER_t + \varepsilon_t \quad (4.2)$$

Based on model 4.2, the research is able to interpret the estimator of parameters. Assuming all exogenous variables are equal to zero, the GDP in Malaysia is equal to 7.0728%. Every 1% increase in gross enrolment rate, on average, GDP in Malaysia will increase by 0.0177% when holding other variables constant. Besides, GDP in Malaysia is estimated to increase by 0.1830% for every 1% increase in patent application when other variables remain constant. For every 1% increase in pupil-teacher ratio, on average, GDP in Malaysia will increase by 0.0029% while other variables remain constant. In addition, for every 1% increase on employment rate, on average, GDP will increase by 0.0778% while holding other variables constant. Nevertheless, GDP in Malaysia will reduce by 0.0198%, on average, for every 1% increase in government expenditure, *ceteris paribus*.

According to the result above, it is possible to infer the anticipated sign of each exogenous variable to find whether there are any consistency with other theories and findings of other researchers. The results indicate that government expenditure is negatively related with economic growth in Malaysia. However, gross enrolment ratio, patent application, pupil-teacher ratio and employment rate have a positive relationship with economic growth in Malaysia.

According to Gwartney (1998) government spending is positive with economic growth as Malaysia gravitated towards economic freedom and open market. This is because increased government spending gives university more allocation to better prepare their students as well as increasing the standard of their curriculum. Growth will increase as more technical advancements are made and higher income labours are produced to help contribute growth (Dufrechou, 2016). However, this research produced result that is inconsistent as previous researchers as the expected sign is negative. The result produced is anticipated as it is supported by the problem statement in Chapter 1.The negative expected sign is caused by the mismanagement of funds by universities

causing a lower output despite higher government expenditure into education which includes the increase of funds into tertiary education. The performance of tertiary education institutions may suffer even further now that the government decreased its spending into education

From the results above, gross enrolment rate has a positive relationship with economic growth. This is supported by Oluwatobi (2011) where a higher enrolment rate may have an increase labour force that will help the economy to grow. Under developed country may benefit from increased higher enrolment rate as more labour force are created according to Wang and Liu (2016) as it is found that gross enrolment rate has a positive effect on growth. The result is consistent with the findings of previous researchers with positive sign. Malaysia leads the South East Asia region in terms of enrolment rate. As such the Malaysian Government plans to increase its tertiary education rate from 36% to 53% by 2025 with the implementation of National Higher Education Strategic Plan 2007-2020 by increasing the number of vocational seats as well as opening of massive online courses that are easily accessible as well as improving and increasing the curriculum standard to a global standard to a higher level in both quality and quantity.

On the other hand, it is found that patent application has a positive expected sign which is consistent with the results done by past researcher such as a research done by Salih (2016) found that there is positive relationship between patent application and growth. The researcher hypothesize that increasing patent application is a signal that more innovation is created leading to increase of productivity in that particular country. This is further supported by Varsakelis (2006) who suggest that more spending is applied to increase the patent application as there is evidence that patent application is positively related to economic growth. The Malaysian government realising the potential of patent application on economic growth has tighten its patents law in 2016 as well as streamlining the process of applying for a patent filing and the any claims on copyright infringement so help protect content and products made. This move will motivate more and more people to continue to innovate and increase the market competitiveness

According to Graue, Rauscher & Sherfinski (2009), there is a positive relationship between pupil-teacher ratio between economic growth as there is more interaction between students and teachers to produce a better result. Such hypothesis is

supported by Hanushek (1995), who also found that there is a positive relationship in terms of pupil teacher ratio and economic growth. However, from the result above the expected sign is negative different from research done in the past. Despite the result obtained from the model, past researchers such as Croll and Hastings (1996) as well as Cooray (2009) stressed the need for teachers to spend more time with students to influence their performance in learning in order to achieve such results. Higher number of teacher ratio compared to students makes sure that each individual students have enough guidance and attention from the teachers to progress in their academic journey. However, Malaysia has suffered from a shortage of teachers and has been increasing the number of teachers throughout the years to fill the gap created by a very high number of retired teachers.

Employment rate has an expected positive sign as show in results above as supported by Brown (2003) stating that higher educated candidates has a better chance to be employed by employers. This is further supported by Varghese (1988) that private and public sector are more interested in hiring applicants with a degree than those without. The result obtain is same as past researches. Efforts has been made by the Malaysian government to increase the economic growth by conducting partnership with job seeker agencies such as Jobstreet as well as providing assistance to increase the qualifications and skills set of graduates to help bolster the economy. Career Fairs are also being held in major cities of every state with the support of the government to help graduates to market themselves to the employers as well as provide a platform for the employers to find fresh talents in the labour market.

4.3 Hypothesis Testing

Hypothesis testing is conducted to test the significance of the exogenous variable in affecting the GDP. A few hypothesis test is conducted based on result from table 4.1.

4.3.1 T-test

This test is used to determine the significance of exogenous variables individually on GDP. The results are shown in table 4.2.

Table 4.2 Summary of T-test

Exogenous variables	P-value	α	Decision	Conclusion
Patent Application	0.0076	0.05	Reject H_0	Significant
Pupil-Teacher Ratio	0.8475	0.05	Do not reject H_0	Insignificant
Education Expenditure	0.0182	0.05	Reject H_0	Significant
Gross Enrolment Ratio	0.0193	0.05	Reject H_0	Significant
Employment Rate	0.0018	0.05	Reject H_0	Significant

Table 4.2 shows the results of each exogenous variable at significance level of 0.05. The result is taken by comparing the p-value with $\alpha = 0.05$. The null hypothesis states that there is no significant relationship between GDP and each exogenous variable. Therefore, the research should reject the null hypothesis when p-value is less than 0.05. According to table 4.2, all exogenous variables included in the model are significant except pupil-teacher ratio. Therefore, further testing is needed to prevent specification bias.

4.3.2 F-test

F-test is applied to determine the significance of the regression model. In another to say that, it shows how suitable this research formed the regression model and the significance of the overall exogenous variables in affecting GDP in Malaysia. The information has been gathered for F-test and as shows in table 4.3

Table 4.3: Summary of F-test

F-statistic	73.1178
P-value	0.0000

Result of F-test is obtained based on the OLS regression model and being shown in table 4.3. The null hypothesis assumes that the overall exogenous variables are not significant whereby alternative hypothesis indicates there is at least one exogenous variable is

different from zero. It shows that the null hypothesis is incorrect when the p-value is smaller than significance level of 0.05. Null hypothesis is rejected in this research based on table 4.3. It is because the p-value (0.0000) is smaller than 0.05. Hence, it can be concluded that there is at least one exogenous variable is significant in explaining GDP in Malaysia.

4.3.3 Goodness of Fit

Table 4.4: Summary of Goodness of Fit

R-squared, R^2	0.9336
Adjusted R-squared, $\bar{R}^2$	0.9208

According to table 4.4, R^2 being found is 0.9336. It shows that there is about 93.36% of total variation in the GDP can be explained by the total variation in the exogenous variables. Besides, the $\bar{R}^2$ of the regression is found as 0.9208. It indicates that there is about 92.08% of total variation in the GDP can be explained by the total variation in the exogenous variables after taking degree of freedom into account. According to the results shown above, there is enough evidence to conclude that the model is a good fit model.

4.3.4 Standard Error of Mean

Standard error of mean denotes to the standard deviation of the distribution sample mean taken from population. Easy to say that, the lower the standard error, the higher representative of sample will be in a population. Below are the procedures this research used to check how representable the sample from the population is.

Table 4.5: Summary of Standard Error of Mean

Standard error of regression	0.1614
Mean dependent variable	8.4447

Table 4.5 shows the summary of standard error of mean which is obtained from the result that created in table 4.1. The computation of error-to-mean ratio is as follows:

$$\text{Standard error-to-mean ratio} = \frac{\text{Standard error of regression}}{\text{Mean dependent variable}}$$

$$= \frac{0.1614}{8.4447}$$

$$= 0.0191$$

According to the figure that computed above, error-to-mean ratio of 0.0191 is small enough to indicate that the sample in this research is representable to the population. Other way to say that, sample size of 35 is big enough to get minimum standard error, ultimately precise empirical results. Thus, the observations are adequately to explain GDP in Malaysia.

4.4 Diagnostic Checking

As mentioned in chapter 3, there is 5 diagnostic checking will be carried out by using regression model 4.2. The results have been generated through EViews and as shows below.

4.4.1 Multicollinearity

This search has applying number of diagnostic checking to check whether there is correlation between exogenous variables. First, multicollinearity problem might exist if the result found high R^2 but low significant t-ratio. The result as shown below:

Table 4.6: Empirical Result of OLS Regression Model

R^2	0.9336
Exogenous variable	**p-value**
Patent Application	0.0076
Pupil-Teacher Ratio	0.8475
Education Expenditure	0.0182
Gross Enrolment Ratio	0.0193
Employment Rate	0.0018

After running the data through EViews program, the empirical result is produced and shown in table 4.6. Based on the table, it clearly shows that patent application, education expenditure, gross enrolment rate and employment rate have a significant t-ratio. However, pupil-teacher ratio is not significant in explaining GDP in Malaysia. Nevertheless, high R^2 of 0.9336 indicates that the exogenous variables that being used are able to explain GDP in Malaysia. Hence, high R^2 and low significant t-ratio indicate that there might be a multicollinearity problem in the regression model. To further testing on the multicollinearity problem, Pair-Wise Correlation test will be carried out and result as shown below:

Table 4.7: Empirical Result of Pair-Wise Correlation test

	GOV	ER	LNGDP	GER	LNPA	PTR
GOV	1.000000	0.552019	0.540730	0.776213	0.625770	0.523449
ER	0.552019	1.000000	0.925344	0.784464	0.896107	0.327496
LNGDP	0.540730	0.925344	1.000000	0.848774	0.931809	0.432459
GER	0.776213	0.784464	0.848774	1.000000	0.851106	0.626802
LNPA	0.625770	0.896107	0.931809	0.851106	1.000000	0.452814
PTR	0.523449	0.327496	0.432459	0.626802	0.452814	1.000000

Table 4.7 shows that there is a high correlation between employment rate with patent application and gross enrolment ratio with patent application. To determine how serious multicollinearity problem among these variables is, VIF will be conducted. If the VIF being computed is more than 10, it indicates that there is a serious multicollinearity problem.

The revised R^2 of 0.8030 is computed when patent application is set as endogenous variable and employment rate as exogenous variable. The VIF is calculated as below:

$$VIF = \frac{1}{1 - R^2}$$

$$VIF = \frac{1}{1 - 0.8030}$$

$$VIF = 5.7614$$

The revised R^2 of 0.7244 is generated when patent application is set as endogenous variable and gross enrolment ratio as exogenous variable. The VIF is calculated as below:

$$VIF = \frac{1}{1 - R^2}$$

$$VIF = \frac{1}{1 - 0.7244}$$

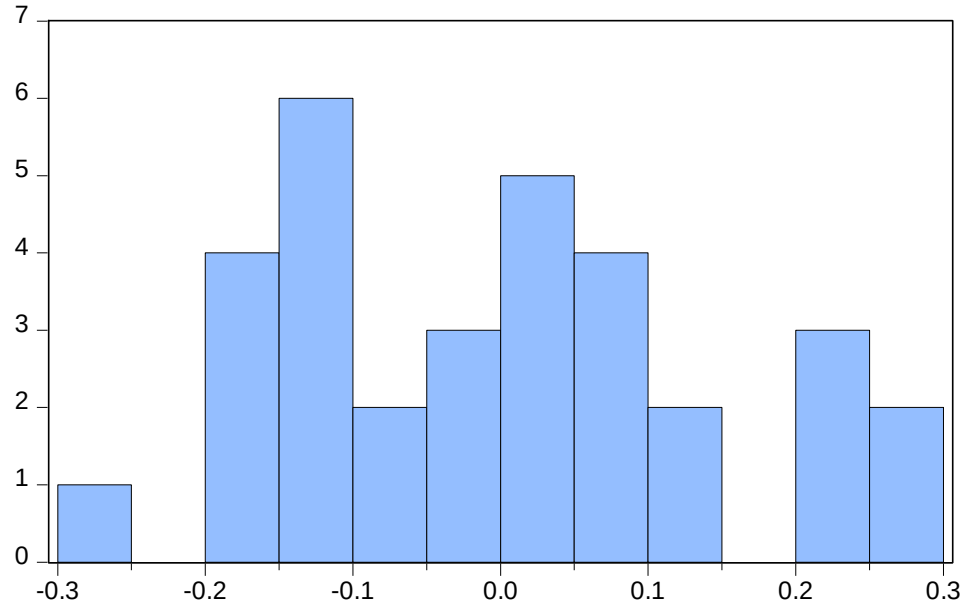
$$VIF = 3.6284$$

Based on the computation above, VIF of 5.7614 and 3.6284 is smaller than the benchmark of 10. Hence, it shows that the multicollinearity problem is not serious in the regression model.

4.4.2 Testing of Normality of Error Terms

The study on the assumption of normality of error terms was fulfilled. Below show the result of the conducted Jarque-Bera test:

Graph 4.1 Normality Graph of Jarque-Bera test



The normality distribution for all data is shown as Graph 4.1. According to the graph above, there have an expectation which there have no normal distribution of error term. Table 4.8 shows that the error terms are normally distribution.

Table 4.8: Jarque-Bera test's empirical result

Skewness	0.3623
Kurtosis	2.2833
P-value	0.5003

Skewness is a measurement of symmetry of the distribution. Since the skewness (0.3623) falls between -0.5 and 0.5, the distribution is approximately symmetric. Besides, Kurtosis is a measurement of the peak and sharpness of the distribution curve. The Kurtosis for those 5 indicates are normally distribute to error terms because of the rule of thumb. According to the table, Kurtosis (2.2833) showing that the distribution is an approximate normal Kurtosis.

According to the hypothesis testing, the null hypothesis not rejected because the p-value (0.5003) is larger than the significant level of 0.05. Therefore, it can conclude that those error terms are normally distribution in the model.

4.4.3 Testing of Model Specification

The model specification test is required in this study to identify whether the model is correctly specified. Any excluding out important variable, including irrelevant variable or incorrect functional form may cause the model to be misspecified. Thus, Ramsey RESET Test is being carried out to check whether the model is correctly specified. The empirical result is as below:

Table 4.9: Ramsey RESET Test's Empirical Result

p-value	0.1102

The result of Ramsey RESET Test is being display in the table above. Reject null hypothesis when the p-value for the model is less than the significance level of 0.05, otherwise do not reject the null hypothesis. According to the generated result, p-value of 0.1102 is greater than 0.05. Thus, there is enough evidence to conclude that the regression model is specified correctly at significance level of 0.05.

4.4.4 Testing of Autocorrelation

Autocorrelation testing is to determine the error term whether is exogenously or endogenously distributed in the regression model. There are some tests have been carried out. Determine whether there is autocorrelation problem in the model by applying Durbin-Watson test. The process of the Durbin-Watson test is showed as below. Firstly, with 35 observations (n), 5 explanatory variables (k) and significant level of 0.05. Based on the observations, explanatory variables and significant level, it has known the lower critical value (d_L) is 1.160 and upper critical value (d_U) is 1.803. The figure 4.1 is showing the categories of autocorrelation.

Figure 4.1: Categories of Autocorrelation

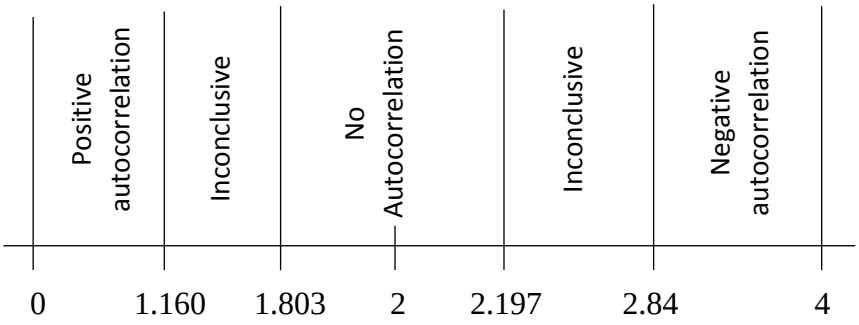


Figure 4.1 is to determine the autocorrelation problem belongs to which category. It is needed to compare with the result of OLS regression.

Table 4.10: Empirical Result of OLS Regression Model

Durbin-Watson test statistics	1.5093

According to the Table 4.10, autocorrelation problem is existed in this model. The test statistic of 1.5093 falls between 1.160 (d_L) and 1.803 (d_U) which is inconclusive. In order to further testing the result, Breusch-Godfrey Serial Correlation LM test is used to identify on the effect.

Table 4.11: Empirical Result of Breusch-Godfrey Serial Correlation LM Test

P-value	0.2997

According to the Table 4.11, do not reject null hypothesis since the p-value of 0.2997 is greater than the significant level of 0.05. Thus, there is sufficient evidence to conclude that there is no autocorrelation problem in this model.

4.4.5 Testing of Heteroscedasticity

ARCH test was applied in order to detect the problem of heteroscedasticity. Below show the empirical result:

Table 4.12: ARCH test empirical result

Observation x R-squared (nR^2)	2.6217
P-value	0.1054

According to the table above, we do not reject the null hypothesis because the p-value is larger than 0.05. Since p-value (0.1054) is larger than the significance level of 0.05, there is no sufficient evidence to conclude that there is a heteroscedasticity problem in the model.

4.5 Conclusion

In this chapter, this research has completely run through all the hypothesis testing and diagnostic checking. According to the result that obtained from EView program, all the important and significant exogenous variable such as government expenditure, gross enrolment rate, patent application and employment rate were included in the regression model that explaining economic growth in Malaysia except pupil-teacher ratio. Moreover, the result obtain show that the variables are in-conjecture with result from past researchers except for government expenditure on tertiary education. Based on the diagnostic checking result, there is inconclusive on Durbin-Watson test. However, there is no autocorrelation problem after using Breusch-Godfrey Serial Correlation LM test.

CHAPTER 5: DISCUSSION, CONCLUSION AND POLICY IMPLICATIONS

5.1 Overview

This chapter summarizes the empirical results and discusses the major findings reflected in Chapter four. Nonetheless, the policy implications, limitation of this research paper and recommendations for further study will also be comprised in this chapter. The conclusion for overall research paper will be included in the last session of this chapter.

5.2 Summary of Statistical Analyses

The major concern problem would be the relationship between factors in education that directly and indirectly affecting the economic growth in Malaysia. In this case, the variation in factors of education tends to be everyone's attention, especially the government, as tertiary education brings positive impacts to the future development of economy all around the world. This is why there are many researchers tried to study the effect of education in term of innovation toward economic growth in different countries.

In order to study the relationship of these factors in education toward economic growth accurately, this research is meant to define whether, government expenditure, gross enrolment rate, patent application, pupil teacher ratio and employment rate are either significantly playing an essential role in affecting the education toward economic growth in Malaysia. Besides, it is also part of the research's interest to know that those variables in education could bring whether positive effects or negative effects to the economic growth in a county.

Based on the previous chapters, this research paper has successfully proven that those factors in education have significant relationship with economic growth. Yet, the expected signs for each exogenous variable are consistent with the theories discussed in Chapter two except for pupil teacher ratio variable which show insignificant relationship with economic growth. Firstly, government expenditure in education directly affects

economic growth because skilled labour always came with higher education level may adopt high technology easily. Therefore, higher government expenditure in education may garden more skill labour in order to contribute toward economic growth. Education is significantly affecting the economic growth. Consequently, it has been affected when government expenditure in education is reduced will indirectly lower down number of scholar.

Besides, results indicate that gross enrolment rate also plays an important role in affecting education toward economic growth. As government increase enrolment ratio will increase the innovation to stimulate economic growth and generate more job opportunity to adapt the increased enrolment rate. Thus, enrolment rate will increase the number of scholar by having a positive relationship on economic growth.

Moreover, the patents application in education may directly affect economic growth in a country. As patent application may create productivity in new innovative products to be exported that will boost the economy as well as monopoly of technology. In addition, effective patent rights have greater influence on economic growth in patent intensive-industry by encouraging factor accumulation and technology progress. Thus, the patents application is a strong determinant of education.

Besides, the results indicate that employment rate also plays an important role in affecting education toward economic growth. As educated applicants are more desirable to employers as the opportunity cost to increase as jobs are harder to get due to fierce competition. Therefore, employment rate will directly affect the education on economic growth.

Lastly, the empirical result shows a negative relationship between pupil teacher ratio and education. Pupil teacher ratio might not be a relevant variable as it only indicate the average number of pupils per teacher which excluded the fact that scholar being successfully graduate and contribute as skilled labor forces toward economic growth.

All the data obtained are secondary data, from two different sources which are World Bank Group website and Index Mundi. Those data obtained is based on a unique global partnership fighting poverty worldwide through sustainable solutions. The

sampling period started from year 1982 to 2016 which is total 35 years. As the type of data gathered is on yearly basis, there are 35 observations to be tested in this research.

Many tests are conducted using the E-Views software to examine the empirical study. First of all, this research had set a significance level of 0.05 for all the diagnostic checking. Then, the multicollinearity problem is detected through the high Pair-Wise Correlation coefficients and VIF formula. Results have shown that there is low multicollinearity problem amongst the exogenous variables. Thus, there is enough evidence to prove that the error terms in the model are normally distributed according to the results found after conducting the Jacque-Bera test. Satisfactory result of the Ramsey RESET test shows the regression model is specified correctly

Moreover, unsatisfactory outcome were observed from Durbin-Watson test that detected the problems of autocorrelation problem in the regression model. In this case, the OLS estimator will be inefficient due to the underestimated variances. It will also affect the estimator to become biased and inconsistent therefore it is no longer BLUE.

However, there is no autocorrelation problem in the variables detected in the model by using Breusch-Godfrey LM test. On the other hand, the ARCH test is used to test the heteroscedasticity problem and there is no heteroscedasticity problem. Thus, there is enough evidence to conclude that the error terms are homoscedasticity. In short, the conclusion will be OLS estimators are BLUE and regression model is representable to the real results.

5.3 Policy Implication of Study

According to previous chapter, the empirical studies have given a signal to acquire a clearer image in construct suitable implication of study. Government expenditure for tertiary education has been shown in negative relationship with economic growth which is different with the studies that being conducted by the other researchers. This tends to obstruct the efficiency of fund management of government toward tertiary education and thus affect the performance of economic growth.

Mismanagement of fund for a country might cause high opportunity cost for the particular country especially for a developing country like Malaysia. A developing country need to manage its fund effectively and efficiently in order to smoothen the

development of the country and achieve the vision and mission that being set by the government.

Besides, efficient and effective fund management strategy will increase the confidence of investor regardless foreign investor or local investor which will strengthen the economics of the country and thus higher economic growth. However, this research found that Malaysia is suffered from the problem of misallocation of fund and this might one of the reasons that cause the negative relationship between government expenditure for tertiary education and economic growth. Therefore, government plays an important role when allocating funds to various departments. Government must not allocate excessive fund during budgeting that being conducted every year in order to improve the efficiency and effectiveness of the fund allocated.

5.4 Limitation of Study

This research has been conducted for few months. Limitation of study is inescapable. The first problem confronted in this research was the data resources. Theoretically, at least 30 sample sizes must be collected for statistic testing in order to obtain accurate result. However, there were many data were missing within the period. Additional efforts have been taken to get the data from other databases. Unfortunately, this would not give a great impact toward this research. As a result, 35 observations have been collected to determine the significance between economic growth with direct and indirect forces of tertiary education. Besides, study regarding relationship tertiary education and economic growth is not common in the past studies. Most of the studies that conducted by the researchers were combining all stages of education instead of tertiary education only which is the main focus of this research. Therefore, it is difficult to gather the information and journals regarding tertiary education.

5.5 Recommendations for Future Research

There are some suggestions for future researchers to take as a reference. First, future researchers are encouraged to use longer time for the research. This research completed by around a year. Since the time period for this research is no enough, the difficultly to

find appropriate information and journals was caused. Therefore, researchers should take a longer time in order to find more suitable information and journals to support the findings. Besides, there were many data were missing within the period in this research. Future researchers also encouraged to find the missing data by other possible ways.

Next, there was only a country data collected for the research which is Malaysia. The suggestion for future researchers is researchers could collect data from other country for the research on the same exogenous variable. The comparison between countries with Malaysia can be done in order to find out the performance of the countries and the success factors. Future researchers encouraged to analyse the countries of underdeveloped. This is because there have many researchers do their research on the developed or developing countries and the underdeveloped countries are forgotten. The research on underdeveloped countries may help the countries to improve the education system.

Other than the exogenous variable that this research used, future researcher should add in other variables that are relevant with the tertiary education. For example, intake rate, staff compensation, trained lecturer for tertiary education and literacy rate. These exogenous variables are also the determinants of education that effect economic growth. Future researchers are suggested to use other methodologies to run the test. Therefore, future researchers may get more accurate result from these variables.

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Appendices

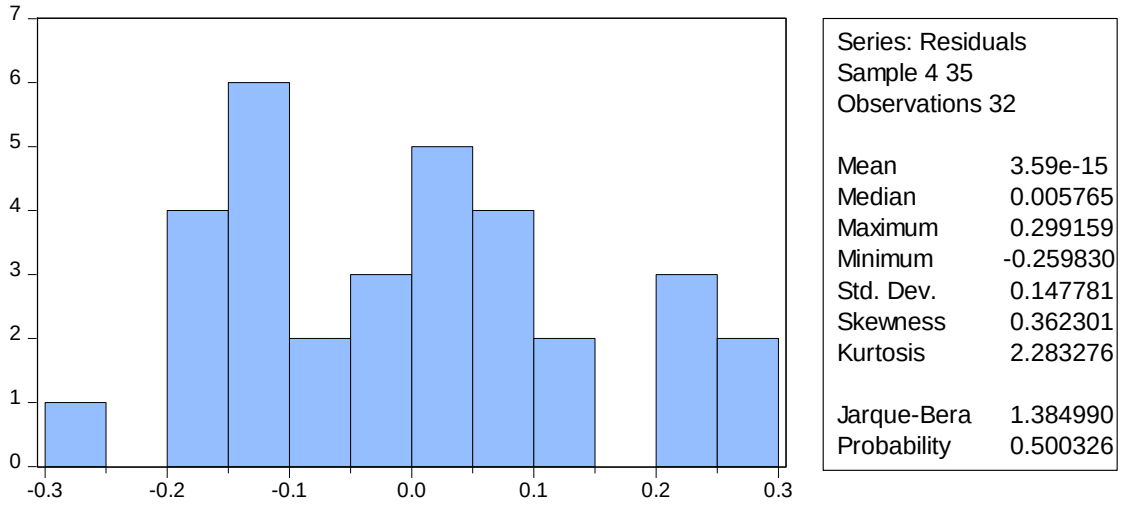
Appendix 4.1: Empirical Results of OLS Regression Model

Dependent Variable: LNGDP
Method: Least Squares
Date: 02/28/18 Time: 21:50
Sample (adjusted): 4 35
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.072844	0.305889	23.12229	0.0000
LNPA	0.182950	0.063199	2.894825	0.0076
PTR	0.002873	0.014794	0.194237	0.8475
GOV	-0.019777	0.007848	-2.519824	0.0182
GER	0.017725	0.007108	2.493745	0.0193
ER	0.077821	0.022349	3.482110	0.0018

R-squared	0.933604	Mean dependent var	8.444675
Adjusted R-squared	0.920835	S.D. dependent var	0.573518
S.E. of regression	0.161366	Akaike info criterion	-0.642921
Sum squared resid	0.677015	Schwarz criterion	-0.368096
Log likelihood	16.28674	Hannan-Quinn criter.	-0.551824
F-statistic	73.11783	Durbin-Watson stat	1.509291
Prob(F-statistic)	0.000000		

Appendix 4.2: Empirical Result of Jacque-Bera Test



Appendix 4.3: Empirical Result of Breusch-Godfrey Serial Correlation LM Test

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

F-statistic	0.977302	Prob. F(2,24)	0.3908
Obs*R-squared	2.409874	Prob. Chi-Square(2)	0.2997

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/28/18 Time: 21:52
Sample: 4 35
Included observations: 32
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.017026	0.326625	0.052127	0.9589
LNPA	0.003054	0.063350	0.048208	0.9619
PTR	-0.002808	0.015276	-0.183821	0.8557
GOV	0.000330	0.008757	0.037740	0.9702
GER	0.000109	0.007486	0.014598	0.9885
ER	-0.000897	0.022391	-0.040064	0.9684
RESID(-1)	0.251533	0.207727	1.210882	0.2377
RESID(-2)	-0.182669	0.222590	-0.820653	0.4199

R-squared	0.075309	Mean dependent var	3.59E-15
Adjusted R-squared	-0.194393	S.D. dependent var	0.147781
S.E. of regression	0.161507	Akaike info criterion	-0.596216
Sum squared resid	0.626030	Schwarz criterion	-0.229782
Log likelihood	17.53946	Hannan-Quinn criter.	-0.474754
F-statistic	0.279229	Durbin-Watson stat	1.935486
Prob(F-statistic)	0.955982		

Appendix 4.4: Empirical Result of ARCH test

Heteroskedasticity Test: ARCH

F-statistic	2.679084	Prob. F(1,29)	0.1125
Obs*R-squared	2.621654	Prob. Chi-Square(1)	0.1054

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/28/18 Time: 21:52
Sample (adjusted): 5 35
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.014032	0.005739	2.444932	0.0208
RESID^2(-1)	0.289221	0.176700	1.636791	0.1125

R-squared	0.084569	Mean dependent var	0.020347
Adjusted R-squared	0.053003	S.D. dependent var	0.024311
S.E. of regression	0.023658	Akaike info criterion	-4.587903
Sum squared resid	0.016231	Schwarz criterion	-4.495388
Log likelihood	73.11250	Hannan-Quinn criter.	-4.557746
F-statistic	2.679084	Durbin-Watson stat	2.145021
Prob(F-statistic)	0.112482		

Apendix 4.5: Empirical Result of Ramsey RESET Test

Ramsey RESET Test
Equation: UNTITLED
Specification: LNGDP C LNPA PTR GOV GER ER
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.656204	25	0.1102
F-statistic	2.743013	(1, 25)	0.1102
Likelihood ratio	3.331462	1	0.0680

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.066938	1	0.066938
Restricted SSR	0.677015	26	0.026039
Unrestricted SSR	0.610077	25	0.024403

LR test summary:

	Value
Restricted LogL	16.28674
Unrestricted LogL	17.95247

Unrestricted Test Equation:
Dependent Variable: LNGDP
Method: Least Squares
Date: 02/28/18 Time: 21:53
Sample: 4 35
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.605918	7.661038	-0.731744	0.4711
LNPA	-0.523597	0.430971	-1.214924	0.2357
PTR	0.004370	0.014350	0.304548	0.7632
GOV	0.066831	0.052842	1.264736	0.2176
GER	-0.060958	0.048003	-1.269861	0.2158
ER	-0.279679	0.216936	-1.289222	0.2091
FITTED^2	0.252381	0.152385	1.656204	0.1102

R-squared	0.940169	Mean dependent var	8.444675
Adjusted R-squared	0.925809	S.D. dependent var	0.573518
S.E. of regression	0.156215	Akaike info criterion	-0.684529
Sum squared resid	0.610077	Schwarz criterion	-0.363900
Log likelihood	17.95247	Hannan-Quinn criter.	-0.578250
F-statistic	65.47348	Durbin-Watson stat	1.442954
Prob(F-statistic)	0.000000		