The Effects Of Human Capital And Technology On Multifactor Productivity In Malaysia

by

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A research project submitted in partial fulfillment of the requirements for the degree of
Master of Business Administration (Engineering Management)

Faculty of Applied and Human Sciences
UNIVERSITI MALAYSIA PERLIS

2022

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ACKNOWLEDGEMENT

First and foremost, I would like to express sincerely to my supervisor, Dr Noorazeela binti Zainol Abidin for her constant advice, patience, motivation, enthusiasm and immense knowledge. With her guidance, it helped me in the research and also writing the project report.

Next, I am also indebted to my project coordinator, Dr Wan Suhana Wan Daud for her endless knowledge, advice, support, reminding the dateline and patience in writing and experimenting.

Last but not least, I would like to thank my family and friends for their continuous support during the making of this project report.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PAGE

LIST OF ABBREVIATIONS

MFP	Multifactor Productivity
YOS	Year of Schooling
R&D	Research and Development
HS	High Skill
SEMS	Semi-Skill
ILO	International Labour Organization
MPC	Malaysia Productivity Corporation
ICT	Informational and Communication Technology
IR	Industrial Revolution
ARDL	Autoregressive Distributed Lag
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Square

LIST OF SYMBOLS

Y	Output (GDP)
K	Capital
L	Labour
A	Solow Residual, MFP

Kesan Modal Manusia Dan Teknologi Terhadap Produktiviti Pelbagai Faktor Di Malaysia

ABSTRAK

Walaupun berlaku peningkatan dalam purata tahun bersekolah, namun begitu, didapati sumbangan MFP mangalami penurunan. Seterusnya, didapati bahawa jumlah perkerja mahir dalam sesebuah negara juga tidak semestinya dapat menyumbang kepada MFP. Tambahan juga, mamandangkan negara menuju ke arah revolusi industri 4.0, namun perbelanjaan dalam sector R&D adalah masih rendah dan ini dapat menjejaskan sumbangan kepada MFP. Oleh itu, kajian ini bertujuan untuk menganalisis kesan modal manusia dan teknologi terhadap productiviti pelbagai faktor (MFP) di Malaysia pada tahun 1990 ke tahun 2020. Kajian ini menggunakan kaedah *Autoregressive Distributed Lag* (ARDL) yang nenunjukan kesan dalam jangka masa pendek dan panjang. Hasil kajian menunjukan bahawa pemboleh ubah R&D adalah signifikan dan positif kepada MFP dalam jangka masa pendek dan panjang. Seterusnya, pemboleh ubah buruh mahir juga adalah positif terhadap MFP dalam jangka masa panjang tetapi memberi kesan negatif yang signifikan dalam jangka masa pendek. Seterusnya, pemboleh ubah buruh separa mahir dan pendidikan memberi kesan yang signifikan dan positif terhadap MFP dalam jangka masa pendek tetapi memberi kesan negatif yang signifikan kepada MFP dalam jangka masa panjang. Oleh yang demikian, penggubal dasar seharusanya memberi tumpuan yang lebih kepada sistem pendidikan dengan menyediakan lebih banyak bantuan pendidikan di Malaysia. Selain itu, kerajaan juga perlu memberi lebih banyak bnatuan atau subsidi kepada majikan untuk melaksanakan program latihan dan pembangunan supaya dapat meningkatkan kemahiran buruh. Di samping itu, kerajaan juga perlu memperuntukkan perbelanjaan dalam penyelidikan dan pembangunan (R&D) yang lebih tinggi agar dapat menghasilkan teknologi yang lebih terkini dan secara tidak langsung dapat menyumbang kepada peningkatan productiviti di Malaysia.

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ABSTRACT

Although mean years of schooling in Malaysia is increasing, the MFP growth is not affected by it. Meanwhile, the increase of number of skilled labour in the country also did not influence the growth of MFP. Furthermore, as the country is moving forward to Industrial Revolution 4.0, it is found that the expenditure of the R&D sector is still low that has affected the growth of MFP. Therefore, the purpose of this study is to analyze the effect of human capital and technology on multifactor productivity (MFP) in Malaysia from the year 1990 to 2020 by using Autoregressive Distributed Lag (ARDL) method that will shows the result in long-run and short-run. The results have shown that variable R&D is significant and positively impact to MFP in long-run and short-run. Then, the variable ratio of high skill labour is found significant and positively impact the MFP in long-run but negative impact on MFP in short-run. Next, variables semi-skill labour and education has found significant and positive impact on MFP in short-run but negative on MFP in long-run. Thus, policymakers have to give more focus on the educational system in Malaysia by preparing more initiative and aids to the educational system in Malaysia. In addition, government should have giving more aids and subsidies to employer to promote training and development program which will increase the labour skills. Besides that, government also has to allocated more expenditure in research and development (R&D) where it can promote creation and innovation of new and updated technologies and also indirectly contribute to the growth of productivity in Malaysia.

CHAPTER 1 : INTRODUCTION

1.1 Introduction

This chapter will be included the background of the study, the problem of the statement, research questions, research objectives, the scope of the study, the significance of the study and thesis structure.

1.2 Background of Study

The background of the study is to discuss the major idea of the study by explaining some of the important terms and focus of the study.

1.2.1 Multifactor Productivity (MFP)

Multifactor productivity or also known as total factor productivity is the part of output unaccountable by the total of inputs used in production (Comin, 2010) or other word explain that the changes in multifactor productivity (MFP) reflects the total effectiveness of labour and capital inputs in the production (OECD, 2019). Since the MFP is not regulated by the general labour and capital, then MFP can be determined by technological change and technology efficiency (Abidin & Shaari, 2021; Akinlo & Adejumo, 2016). Technological change can be defined as the development of new products and technology that can improve the productivity of the production process that will eventually improve the output. Innovation is one of the examples that can be used to explain technological change where innovation help to find and develop a new and novel product, method and technology to enhance the productivity of production which also

will lower the cost of production. Meanwhile, technology efficiency can be explained by the effectiveness of inputs to increase the outputs using the same inputs from the previous date. For example, the year of schooling of citizens, labour skills, the adaptive capability of the labour, human resource development, etc. can be the measure to calculate the technical efficiency that results in the MFP.

On another note, researchers also conclude that there are determinants of MFP. Jajri (2007) in his article said that there are determinants of MFP that can be grouped into different conceptual variables, education and training of the workforce, economic restructuring, capital structure, technical progress, and demand intensity. Therefore, by those determinants, a model which includes capital per GDP or investment rate, export and import per GDP, percentage of foreign-owned companies, annual manufacturing sector output growth, and percentage of labour force acquired tertiary education. Ahmed and Bhatti (2020) also propose that from his finding that drivers of MFP are adoption and diffusion of information and communication technology (ICT), human capital, R&D expenditure, domestic and foreign R&D spillovers, fiscal policy, financial development, foreign direct investment, openness to trade, physical infrastructure, and institutional quality. Kim & Loayza (2019) also stated that several factors influence the MFP which includes innovation, education, market efficiency, physical infrastructure and institutional infrastructure.

Malaysia as a developing country takes serious action on the increasing MFP, as according to the Malaysia Productivity Corporation (MPC) (2019), a higher contribution MFP can contribute to achieving higher standard of living which is correlated to economic growth in general. According to the same report from MPC (2019) stated that higher

growth of MFP is crucial in all of Malaysia's major economic sectors to attain the main objective of becoming a high-income country. According to the MPC (2020), the contribution of the MFP in the total economic growth has increased from the previous year of 2018 of 24 percent compared to capital 58 percent to 54 percent while capital declining to a contribution of 28 percent only. Whereas, the labour contribution maintain at 18 percent throughout both years. This shows that the influence of MFP on economic growth is growing significantly which cannot be missed out especially for a country that is currently under rapid development and growth such as Malaysia.

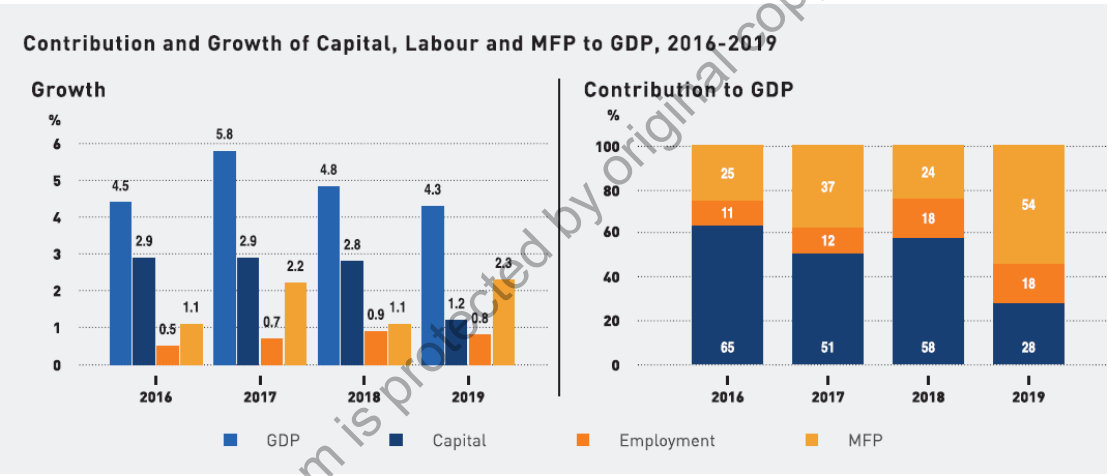

Figure 1.1 The Factor of Production Contribution to Economic Growth, 2016 – 2020
Source: Malaysia Productivity Corporation National Productivity Performance Report

Therefore, research on a particular country like Malaysia which is currently in rapid development is crucial so that policymakers and organizations in Malaysia can take proactive action on increasing the MFP. Figure 1.2 shows the growth of MFP of Malaysia from the year 1999 to 2021 based on data at The Conference Broad. It shows that the MFP of Malaysia is decreasing from the year 1999 which is 3.5 to -4.6 in the year 2020. Bear in mind that in the year 2020 the pandemic and movement control ordinance announced by the Malaysian government hugely impact to productivity of all major economic sectors in Malaysia and also the educational system which is the main

contribution of MFP. However, in general, the trend of MFP of Malaysia is decreasing and hover around -0.8 and 1.1 which is low and described as according to The Conference Board, the factors of low growth rate of MFP in a country is due to the lack of demand for merchandise and also difficulty in producing a new creation in the country.

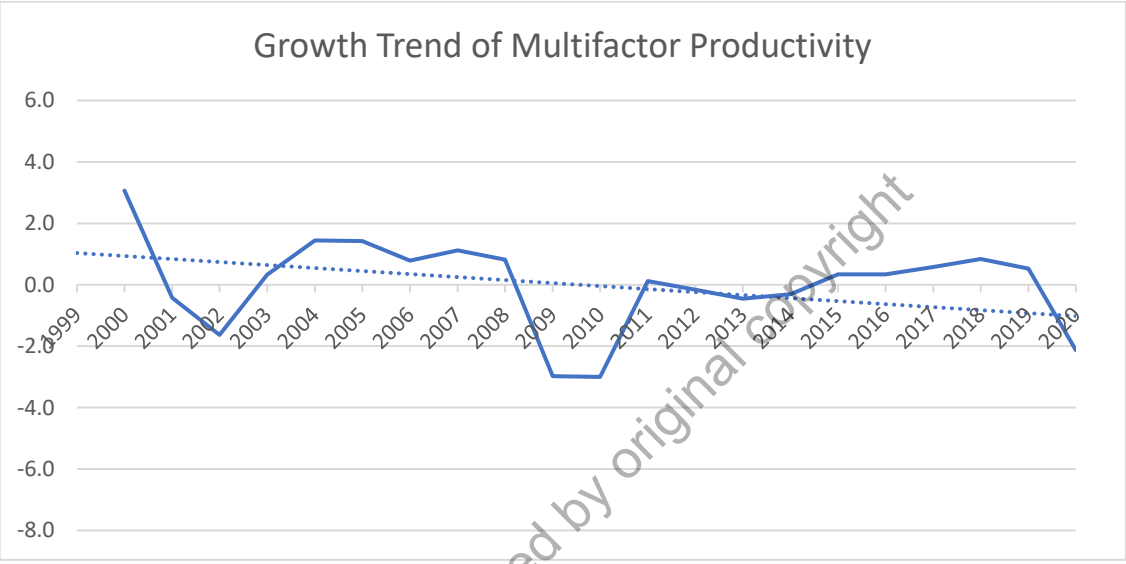

Figure 1.2 Growth Trend of Multifactor Productivity of Malaysia (1990 - 2021)
Source: The Conference Board

1.2.2 Technology

With the presence of Industrial 4.0, adoption from the industries progress slowly. With the help of R&D and better quality of human capital, the adoption of IR 4.0 in the industry will be accelerated. This situation will increase the productivity of the country and will also lower the production cost. New technology such as the Internet of Things (IoT), 5G connectivity, robotics and artificial intelligence can be developed through better R&D and also high adaptive skills from the labour which they can adopt the new knowledge to the working environment and also innovate new technology, technique and knowledge to increase the productivity of their current production process.

According to Figure 1.3, it shows that Malaysia gross domestic expenditure on research and experimental development (GERD) from the year 2016 to 2020 which shows a growth annually from 2.53 to 2.82. This shows that the Malaysian government has become more focused on R&D inside a country that has proved to be influenced by the growth of productivity and also the economy in general through various past research papers.

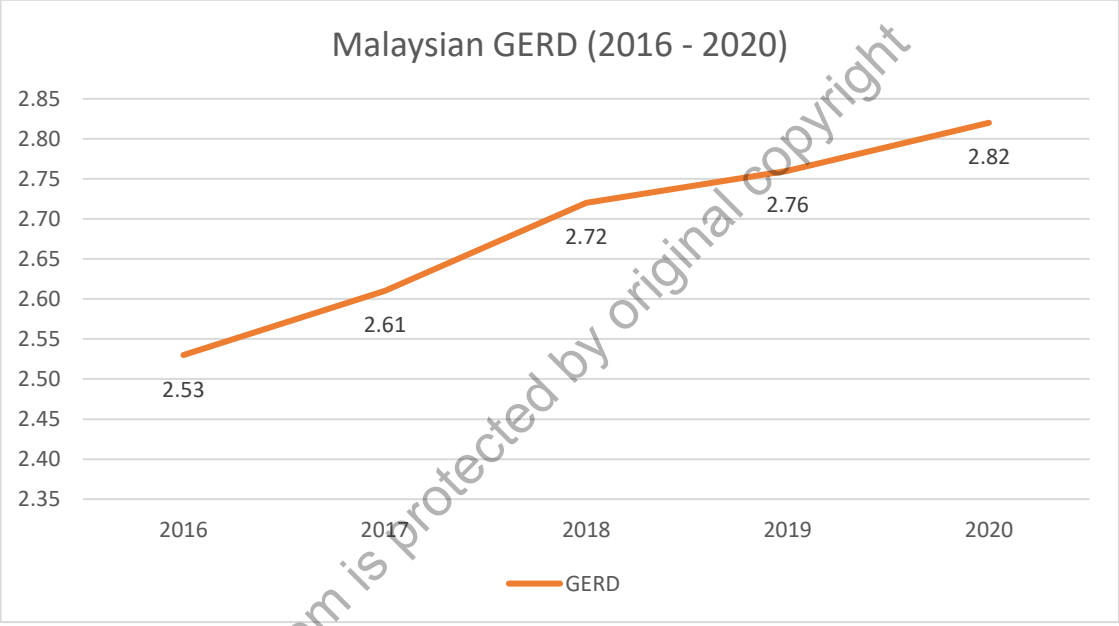

Figure 1.3 Malaysian GERD (2016 - 2020)
Source: The World Bank

Therefore, R&D expenditure is important as a developing country to increase their innovative skill hence increasing the MFP in general. According to Coe and Helpman (1995), MFP is highly influenced by the domestic R&D expenditure and will be increased when the domestic R&D expenditure increase. This statement has also been agreed by another researcher who found out the high spending in R&D especially domestically will increase the multifactor productivity in the short-run and long-run (Bravo-Ortega & García Marín, 2011). Based on the research done in Taiwan by Wang and Tsai (2004), they also found out that there is a significant contribution of R&D expenditure to the

productivity of Taiwanese manufacturing firms. Besides that, the relationship of R&D expenditure and human capital also had been discovered by a lot of researchers as they all agreed that increasing of R&D expenditure and human capital in general will result in increasing the MFP has been found (Mc Morrow et al., 2010; Salim et al., 2020; Tsamadias et al., 2019).

1.2.3 Human Capital

Since the contribution of R&D is significant toward the MFP and human capital is one of the important determinants of the R&D, human capital influences toward MFP cannot be ignored. Human capital can be described as the main force for an organization's economic growth as most of the researchers found that there are long-run and short-run relationship between human capital and MFP mainly from the aspect of education and quality of the labour. According to Teixeira and Fortuna (2004), human capital stock or in other words mean years of schooling is important to explain Portuguese productivity compared to innovation. This shows that there is a crucial relationship relating the MFP and human capital especially education together and this has also been proved by another research that also states that education has a crucial role in economic growth (Mohamed Arabi & Suliman Abdalla, 2013). Education is very important for the development of human resources. With a good education system, a human resource can easily learn new knowledge and develop new skills based on those basic skills such as reading, math and science. School is also always the main medium for a student to learn basic knowledge and social skill. Based on previous research, years of schooling have a significant impact on the development of human capital that will influence the economic growth of a country (Benhabib & Spiegel, 1994; Pelinescu, 2015).

According to Figure 1.4 the year of schooling in Malaysia from 1990 to 2020 shows a general uptrend. However, from the year 2000 to the year 2005, the mean years of schooling in Malaysia decreased from 8.6 to 7.6. This is due to the fact of according to Malaysia Education For All End Decade Review Report 2000-2015 (2015), there are approximately hundred thousands of primary-school-age children and two hundred and fifty thousand of youth that could continue secondary education are unaccounted for. All of these school-age children are not accounted is due to some of them are home-schooled and also some of them attended alternative educational centres that are not registered with the Ministry of Education in Malaysia such as Tahfiz Religious Schools. The enforcement of the Education Act 550 in 2003 which depicts that all Malaysian parents must make sure that their children when they reach the age of six and above, they have access to primary education and above improved the mean of years of schooling in Malaysia where from 2005 onward, the mean years of schooling are increasing gradually from 7.6 to 10.4 in the recent year 2020.

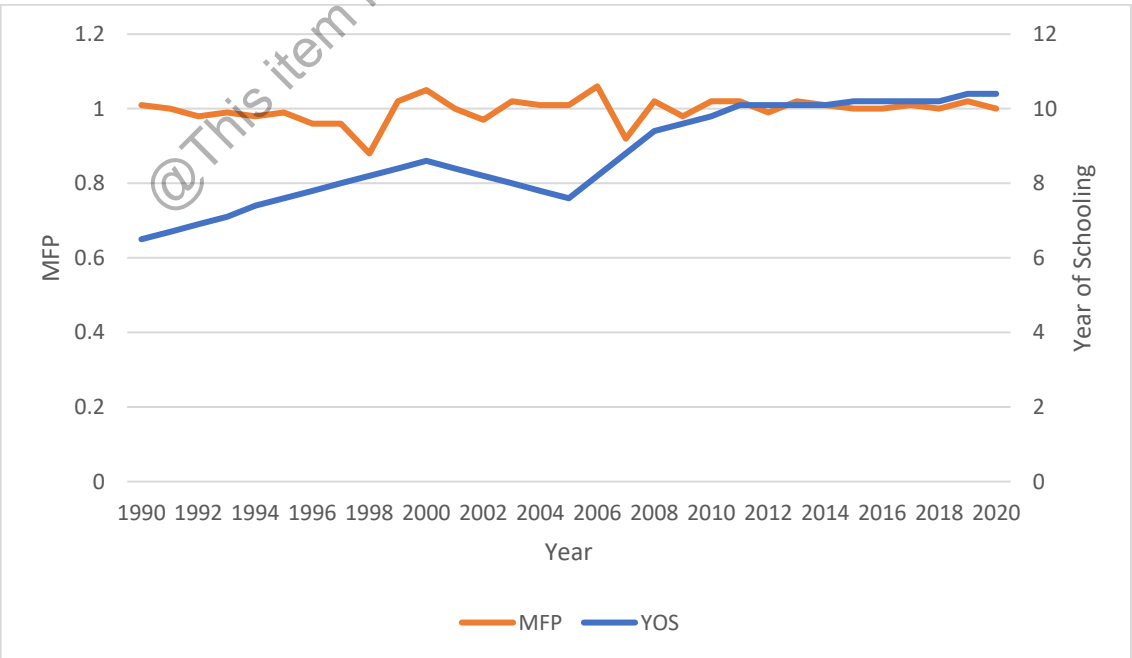

Figure 1.4 MFP and Year of Schooling 1990 – 2020
Source: UNESCO

Besides education, the quality of labour mainly by their skills had a huge influence on MFP. Labour skills can be divided into three low categories, medium, and high skill labour. These standards are based on the standard set up by the International Labour Organization (ILO) in which they divide the labour according to their occupation broad skill level. There are two mainly used standards which are ISCO-08 and ISCO-88 which all feature on the ILO website. According to Figure 1.6, the total employment in Malaysia is growing gradually from the year 2001 to the year 2020 and the number of high skilled labour is also increased along with the total number of employments. However, when looking from Figure 1.6 ratio of high skill labour and semi-skilled labour, the ratio of high skilled labour is increasing gradually from 0.24 to 0.28 whereas the ratio of semi-skilled labour decreased from 0.65 to 0.60. This shows that Malaysia is getting more developed toward a high-income country which has been shown by other countries that are currently in a high-income economy stage such as Singapore which has a high ratio of high skilled labour in their country.

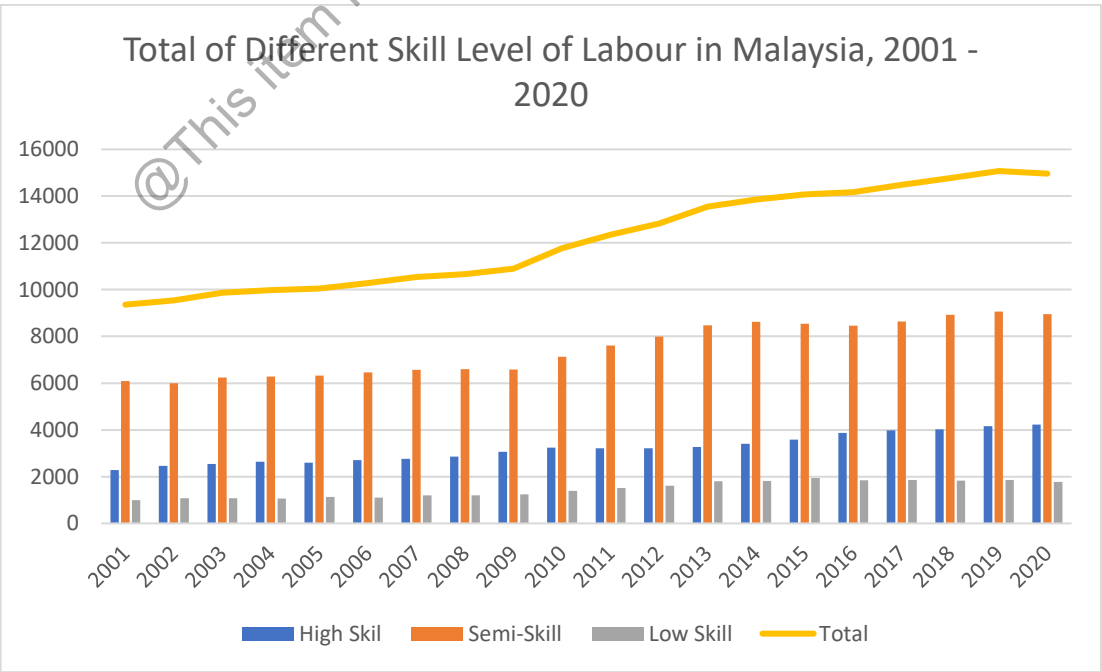

Figure 1.5 Total of Different Skill Level of Labour in Malaysia, 2001 – 2020
Source: International Labour Organization (ILO)

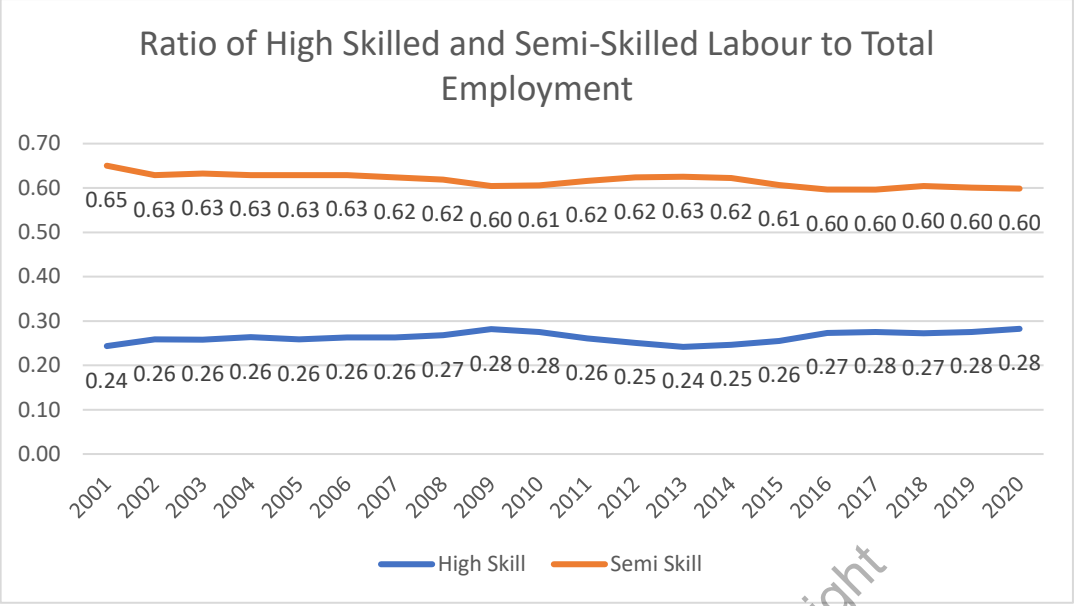

Figure 1.6 Ratio of High Skilled and Semi-Skilled Labour to Total Employment
Source: International Labour Organization (ILO)

The importance of labour skills is crucial as it is the main indicator that shows where that an individual use their knowledge and skill that can contribute to the growth of the economy. Besides that, it is important that an individual that has great knowledge and skill may not contribute to the productivity of the organization whereby the occupation of an individual will surely show how that individual uses his or her knowledge and skills in the real working environment. Furthermore, occupation or the working environment has also been categorized as one of the mediums for learning new skills by the concept of learn-by-doing besides school and universities. Vandenbussche et al. (2006) using a theoretical model found that skilled labour has a high influence on MFP. This statement also had been proved by Ahmed (2006) whom found that there is a contribution of skilled labour to the productivity of the manufacturing sector. As education implant requires knowledge to the human resource, it is important to the particular individual to use and implement this learnt knowledge and skill to the industry so that their performance can contribute to the growth and total production of the country.

1.3 Problem Statement

Nowadays, the Malaysian year of schooling is increasing thanks to the modernization of the educational system and increasing life quality of Malaysian. However, the recent data shows that the increase of years of schooling in Malaysia did not show a significant influence on the MFP. From the logical perspective, as the individual has more time in school, college or university, there should be more knowledge and skills that can be learnt by the individual in those places. Knowledge and skills are crucial for an individual to become productive in his or her workplace as the knowledge and skills can help to detect problems, solve problems, create a new way for production and many more productivity enhancement measure. However, papers found different result from the effect of the human capital proxied by years of schooling by Benhabib and Spiegel (1994) that shows in their research when doing cross-country estimate of the years of schooling for an individual did not have a significant impact in the growth of an economy which is closely related to the MFP. Fang (2018) also supported the statement that according to her research, when adding normalized scores to growth regressions, the education quantity which proxied by years of schooling is insignificant which suggest that education quantity is negatively affect MFP growth. Therefore, there is a need for research to study the effect of education on the MFP as to show the significance of education to MFP in Malaysia.

Besides education, labour skills also take an important role in the human capital factors of the MFP. With the addition of labour skills together with years of schooling, the study of the influence of human capital on MFP can be fully understood. The labour shows how well the labour uses their knowledge and skill in the working environment and also how they can contribute to the productivity of the country while working in

different occupations that require different skill sets. This is important that it shows the labour use their knowledge and skills learned in the school to the production of their work rather than the only the education that they obtain in the school as some of them maybe not working related to their professional and what they had studied for in the working environment. According to Ahmed (2006) research, it shows that the effect of skilled labour on MFP is small but it is significant to compare to semi-skilled labour. However, based on data shows that, the ratio of high skilled labour increases every year which is supposed to correlate to the increase of the MFP in general. This is shown by a research done by Sami and El Bedawy (2020) which stated that labour skill did not impact the MFP as arrival of skilled labor in the organization has non-significant impact on overall MFP. High skilled labour such as managers, engineers and technicians which they are commonly assigned to have high decision-making power on the production rate and focus of their company which is related to the productivity of the general output of a country. They are supposed to have a higher influence on the growth of the MFP which in reality, does not shows a significant effect on it. Therefore, the relationship of labour skills to the MFP of Malaysia should be studied.

Next, technology is one of the main determinants of MFP based on various articles (Jajri, 2007; Kim & Loayza, 2019; Mc Morrow et al., 2010) and R&D is one of the main researched indicators for the technical factors in the research. R&D is important to the productivity growth of a country as with the R&D, more frontier technology and technique will be discovered and developed to enhance the productivity of the country. Some determinants can consider as the R&D of the country that can influence productivity, such as spillover of foreign R&D and innovation index. However, the one that can bring the most influence to domestic products is the government R&D

expenditure. This also has been proved by Salim et al. (2020) said that the R&D in terms of R&D expenditure had a significant positive impact on the MFP in the long run. Government R&D expenditure is the main source of initiative and way to induce R&D in the country that will thrive the productivity of the country. Although the expenditure of R&D in Malaysia is increasing annually, the increase of MFP is not significant as anticipated. It same goes for the creation of the technologies from Malaysia also outdated compared to other countries technology. For example, the development of the electric car in European countries and also China have matured whereas in Malaysia, the development of hybrid car still in the development stage which the vehicle still could not fully utilize 100% from electricity to power the vehicle. Therefore, to find out the influence of the technology on the MFP, government R&D expenditure must be studied.

It is worth to mention also, most of the research on effect of variables such as human capital and technology on MFP is done by using panel method such as Malmquist productivity index approach (Danquah & Amankwah-Amoah, 2017), fixed effect model (FEM) (Oyinlola et al., 2021), two-way fixed-effect Benhasis-Spigel model (Du et al., 2017) and many more panel method to analyze the effect of variables on MFP. However, for the purpose of this study, Autoregressive Distributed Lag (ARDL) method will be used to find the impact of human capital and technology on MFP. By using ARDL model, impact of each variable in long-run and short-run can be tested to provide more insight for this knowledge.

Besides that, most of the past literature papers studied on growth for MFP is using panel data which consist of more than one set of data from different country or organization (Männasoo et al., 2018; Tsamadias et al., 2019; Webster, 2013). However,

this study focusses on a time-series data specific in Malaysia to study the effect of human capital and technology on MFP.

In a nutshell, the issue that has been found on education to MFP has been found which stated that the increases of the mean years of schooling does not impact the growth of MFP in Malaysia. Then, the increase of labour skills also did not corelated to the growth of MFP in Malaysia. Furthermore, the expenditure on R&D is found not enough and does not have significant impact on MFP in Malaysia. The past literature also suggested that there are gaps on the methodology use for similar research and also most of the past research is focusing on panel data rather than time-series data.

1.4 Research Questions

Based on the problem statement, a few questions can be derived as followed:

i. Does education have any effect on MFP in Malaysia?

ii. Does labour skill have an effect on MFP in Malaysia?

iii. Does technology contribute to MFP in Malaysia?

1.5 Research Objectives

The objectives of this research are to find out the effect of human capital and technology on multifactor productivity in Malaysia by using the ARDL model. Therefore, specific objectives can be derived as follows:

i. To investigate the effect of education on MFP in Malaysia.

ii. To examine the effect of labour skill on MFP in Malaysia.

iii. To investigate the contribution of technology on MFP in Malaysia.

1.6 Scope of the Study

The scope of the study will focus on the number of people in a different year of schooling based on the data retrieved from the World Bank from the year 1990 to 2020 and also data of the number of people with high skill and medium skill from the International Labour Organization (ILO) in the same period. In addition, the government expenses to R&D activities have also been collected from UNESCO Institute for Statistics (UIS). Furthermore, data of Malaysia's MFP has also been collected from the Conference Broad from the year 1990 to 2020. All of the data collected from these sites will be tested in the ARDL model to test the long-run and short-run relationship between MFP and other variables.

The variables that consist in this research are the independent variables which are year of schooling, the ratio of semi-skill and high skill labour, and the percentage of the government expenditure on R&D. Then the dependent variable is multifactor productivity (MFP).

1.7 Significance of Study

Most of the researchers research the larger scale of the continental such as ASEAN or ASEAN +3 which is combining all data and information from the country like Singapore, Thailand, Indonesia, etc. to the researches. However, this study will be focusing on Malaysia only as the background of the study. Malaysia as an independent country has its unique human capital, social diversity and ways to disperse its capital on technology advancement activities which cannot be summed up together with other country's especially those countries which are category high-income such as Japan, Singapore, Korea, etc. according to OCED. Therefore, research on the individual country is needed as there is unique characteristic from a country that cannot be compared to another country even its neighbour country.

Most of the researchers doing the studies only on the year of schooling data from their scope of studies only but in this study will be focusing on the education together with the labour skill data in Malaysia influences to MFP. This is to find out the number of people in different year schoolings and also with the labour skills which is medium-skilled and high skilled. It is important to study the relationship between labour skills especially medium and high skilled labour rather than just depending on the number of years of schooling. Skilled labour is more important as education only did not reflect the true potential of the human capital as skilled labour has more experience in productivity induced activity such as manufacturing and service provided. Thus, with the addition of labour skills, the influences of human capital on MFP can be measured properly.

Besides that, R&D expenditure is also the main focus of this study from the technology point of view. Most of the researchers focus on innovation and ICT in the

countries rather than the spending of R&D in the countries. R&D investment has been recognized as an crucial determinant in productivity as the knowledge, which can be created and learned through R&D of industry or education will contribute to produce innovations or process innovation which will result in nationwide productivity increase (Wang & Tsai, 2004). This shows that R&D is the foundation of all innovation that will happen after it and also other development of new ICT technology. Therefore, it is crucial to understand the relationship between the R&D expenditure on MFP.

This study also used the Autoregressive Distributed Lag (ARDL) model to test the significance of long-run and short-run for these two variables to MFP. ARDL is one of the best models to analyze an economic scenario such as MFP. ARDL can show the influence of the variable in the long-term effect and also short-term effect which is important for this study since the effect of these two variables will not affect immediately as they will influence the MFP for is a longer period (Chetty, 2018). One of the benefits of the ARDL test that is crucial to this study is that the test is more robust and performs better for a smaller sample size of data.

On the other hand, this study also aimed to help the policymakers to develop appropriate policy on education, skill development for employees and also the R&D in Malaysia. Policy to improve education in Malaysia should be done to achieve more productivity in general as education is one of the key factors and determinants of the MFP. More quality education and updated knowledge are needed to implement in the current education system in Malaysia so that more qualified and better knowledge and skilled labour can be born through education in school and university. Subsidies and capital should be more into the educational system of Malaysia so that Malaysian citizens can

have better and more chances to get high-quality education in school and also outside the school such as workshops and also private educational system, thus enhancing the general quality of the human capital of Malaysia.

Policy focused on the importance of the high-skilled labour in the industry also can be developed as the labour skill is the key component that influences the MFP of the country. Policymakers can introduce more workshops and provide more training and develop a program for the existing labour so that they can learn new knowledge and skill and also upgrade their skill to cooperate with the newer technologies and procedures in the future as the country is leading more toward industrial 4.0. Another contribution to the policymaker is to promote more R&D activities in Malaysia to produce more new technologies in Malaysia. Malaysian government can increase their expenditure on R&D so that more capital can insert into developing new technologies through innovation and creation. Policymakers also can increase the number of R&D personnel in the industry and also in universities where most of the ideas and technologies were created.

To promote human capital and R&D in Malaysia, policymakers from Malaysia should upgrade the institution for R&D and supply them with modern infrastructure and equipment. Various awareness campaigns and programs should be done to promote the importance of human capital and R&D for increasing productivity in different organizations and educational institutions in Malaysia. Besides, policymakers also have to strengthen the link and relationship between the industries and universities so that more knowledge and idea can be shared throughout both parties and also generate a new and novel idea that will fit the requirement of the industry and also the universities can develop their student to better fit the standards and requirements of the industry which

currently moving toward IR 4.0. All of these initiatives can increase the multifactor productivity of Malaysia which nowadays has become more contributing to the economic growth of Malaysia.

In summary, this study aims to fill in the knowledge of the influence of human capital in terms of education and labour skill together with technology in terms of R&D expenditure to the MFP in Malaysia by using ARDL models.

1.8 Thesis Structure

This thesis will consist of a different chapter. Chapter 1 is an introduction of all the variables, problem statement, objectives of this research and also the scope of this study. The next chapter, Chapter 2 will be introducing the past literature which conducts similar research on the topic of this research question. Chapter 3 will be showing the methodology that used in this research to prove there are or aren't a long-run and short-run relationship between independent variables and dependent variable. Chapter 4 then will show the result of the research and also some discussion of the result found from the study. Last but not least, chapter 5 will give a conclusion and remark on the result of the study.

1.9 Summary of Chapter

To sum up all from chapter 1, this chapter laid down the background of the study and the knowledge gap that this study means to fill in. Then the chapter continues with the objective of this study and also the question that want to be tackled at the course of this study. Next, the scope of the study is highlighted to show the basic flow and structure

of the research that will be conducted. Finally, the writing structure of the thesis is summarized at the end of this chapter.

CHAPTER 2 : LITERATURE REVIEW

2.1 Introduction

In this chapter, this study will be discussing the empirical studies of the theory and the variables available in this research. Lastly, this study will be introduced a theoretical framework at the end of this chapter.

2.2 Empirical Theory

Based on past literature, there are many types of approaches to estimated multifactor productivity (MFP) such as Cobb-Douglas production function, trans log production function through least square approach, Kendrick Index, Divisia, Fisher Index, stochastic frontier approach and data envelopment analysis. However, the theory that will be used in this study is the Solow growth model and further developed to endogenous growth model.

The Solow growth model is introduced by Robert M. Solow in 1957. Solow approach to measuring the MFP is through calculating growth accounting equation. The result will get the technological change which had been called 'Solow Residual'. According to Ahmed and Bhatti (2020), economic growth related to the growth of factor of production is in control by the unexplained part of the calculation of technological change. They also describe that the neoclassical growth model exogenously decided the technological progress just like manna dropped from the sky.

This model can easily explain the resources that have been used in the growth of economics. The purpose of the calculation of this model is to calculate the economic growth from the product of the various variables such as labour, capital and productivity. The neoclassic production function can be written as:

$$Y(t) = A(t)F[K(t), L(t)] \tag{2.1}$$

where Y is output, A is the technological progress, K is capital, L is labour and t is time. By assuming a Cobb-Douglas production function, then the function can be written as

$$Y_t = A_t K_t^{\alpha} L_t^{(1-\alpha)} \tag{2.2}$$

where α and $(1-\alpha)$ are the elasticities of output, Y on capital, K and labour, L respectively, t represents time and A is the Solow Residual that is equal to

$$A_t = Y_t / K_t^{\alpha} L_t^{(1-\alpha)} \tag{2.3}$$

However, the estimation through this model is very limited. This is because the estimation is depends on some assumptions such as the constant return of scale, perfect competition and autonomous Hicks-neutral technological progress to be a function (Kale & Rath, 2018).

Therefore, an endogenous growth model by Romer in 1986 and 1990 was developed. Romer in his theories argues that MFP is endogenous and depends on human capital and research and development expenditure which are generally generated from internally result from the processes inside the system rather than external unaccountable

forces. Furthermore, the endogenous model shows that in a knowledge-based economy that nowadays most of the countries are undergoing, due to the positive spillover effects from investment in technology and human capital, there are no diminishing returns to capital growth.

According to Romer (1986), the key of growth is based on the increasing productivity of intangible capital good knowledge. Besides that, Romer (1986) also identified Arrow's model that said that 'learning by doing' is important and based on increasing of return, it is the starting point of the dynamic growth model. He also in 1990 further explain endogenous technological change by using new ideas that an idea is non-rival. Due to the non-rivalry aspect of the idea, it results in increased returns and eventually will generate growth internally from the organization (Romer, 1990). Furthermore, he also use a market structure of monopolistic competition and its pricing system to his framework which argues that the firms marked up their newly produce goods for a price that is higher than the cost of production (Schilirò, 2019).

In a nutshell, with the existence of both Solow's model and Romer's models of explaining productivity growth with Solow's findings on the 'Solow Residual' and Romer's further research on the determinants of the 'Solow Residual', modern researchers can truly understand the use of the MFP in the calculation and assumption of the growth in general.

2.3 Empirical Studies

2.3.1 Multifactor Productivity (MFP)

Multifactor productivity is an important index to determine the growth of the economy which can lead to a better standard of living and quality of life. Definition of MFP varies from literature to literature but is mostly similar to each other. Organization for Economic Co-operation and Development (OECD) (2019) defines MFP as the overall efficiency of labour and capital inputs used in the production process which same as the definition provided in the Malaysia Productivity Report were describe MFP as a measure of efficiency in the usage of input (MPC, 2019). Besides that, Comin (2006) also defines MFP as the part of output that unexplained by the number of inputs used in production which result in where MFP level is determined by how productively and vehemently the inputs are used in production. This also has been agreed by Ahmed and Bhatti (2020) that MFP is used as a measurement of the economic growth of a country and commonly described as the part of the change in combination output which is not explained by the common factors of production. The unnoticed change that influences the output performance besides from the traditional factors of production such as labour and capital has been called the 'Solow Residual' as according to the economic model developed by Solow in 1957. In his research article, MFP is indicated as the 'technical change' which represent any kind of shift in the Cobb-Douglas production function from other 'physical 'units which are capital and labour inputs (Solow, 1957).

The discussion of MFP started with the introduction of the Solow Model in 1957 which Solow argues that MFP is an exogenic and time based phenomenon but later of the period with the introduction of Romer's Endogenous Growth Model, economists started

to argue that MFP is endogenic and depends on the existing knowledge and human capital Ahmed and Bhatti, (2020).

Various research has been done to determine and tabulate the determinants of MFP based on past literature or other economic models. Jajri (2007) using the Malmquist productivity index, decomposed MFP into technological change and technical efficiency change which eventually determine that there are 5 major determinants of MFP which are education and training, economic restructuring, capital structure, technical progress, and demand intensity. Another study of determinants of MFP by Isaksson (2007) groups determinants of the MFP into 4 major groups which are: First, creation, transmission and absorption of knowledge which consist of innovation and creation of knowledge like research and development activities, technology transfer for example foreign direct investment and trades, and technology adoption and absorptive capacity which can be described as human capital skills. Second, factor supply and efficient allocation which consists of education and training, health, infrastructures such as public capital, structural change and resource allocation like investment and financial system. Third, institutions, integration and invariants which consists of trade openness, import and export, politics and geography such as natural resources. Forth and the last is competition, social dimension and environment which consists of privatization, social diversity, income inequality, high youth dependency, communication cost, pollution, depletion of natural resource and etc.

Ahmed and Bhatti (2020) in their study found out that there are seven unique drivers of MFP in macroeconomy which are, human capital or stock of knowledge, R&D expenditure and informational and communication technology (ICT), domestic and