THE TECHNICAL EFFICIENCY OF GOVERNMENT LINKED COMPANIES (GLCS): INTERNAL AND MACROECONOMIC PERSPECTIVES

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THE TECHNICAL EFFICIENCY OF GOVERNMENT LINKED COMPANIES (GLCS): INTERNAL AND MACROECONOMIC PERSPECTIVES

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ABSTRACT

The ever challenging environment in the globalization era, has led Government Linked Companies (GLCs) to adapt various business strategies in their effort to become more efficient. The involvement of Malaysian government as the key player in economic activities does not help the GLCs to be more competent especially when the agenda is being politicised. Furthermore, GLCs are currently facing problems in terms of profit and management that affect their overall level of efficiency. Research on GLCs' competency to overcome the challenges in the business world is still insufficient. Thus, this study aims to investigate the effects of internal and macroeconomic factors that could positively improve the technical efficiency of GLCs. Hence, the objective of this study is to examine the impact of macroeconomic and internal factors on the efficiency of 17 top listed GLCs under G20. In addition, this study also analyses the role of the government as an interaction terms in affecting the technical efficiency of GLCs. Stochastic Frontier Analysis (SFA) is used to identify the technical efficiency score of GLCs followed by the Fixed and Random Effects and Fully Modified Ordinary Least Squares (FMOLS). The results from this study reveal that the internal factors such as the revenue, financial capital, government ownership, firm size and return on assets and macroeconomic factors such as GDP, infrastructure, unemployment, trade openness, inflation rate and real interest rate, show a significant impact on the GLS's technical efficiency. The study recommends government involvement as an interaction terms to improve GLC's efficiency. In terms of policy, the government should play a greater role in providing a stable macroeconomic environment, making rational decisions and establishing more international economic linkages through GLCs. It also indicates that policy-makers should act in accordance with good governance based on GLCs' performance and development.

Keywords: Government Linked Companies, technical efficiency, internal factors, macroeconomic factors, government role

ABSTRAK

Persekitaran yang mencabar dalam era globalisasi menyebabkan Syarikat Berkaitan Kerajaan (SBK) menyesuaikan diri dengan pelbagai strategi perniagaan dalam usaha untuk menjadi lebih cekap. Penglibatan oleh pihak kerajaan sebagai pemain peranan utama dalam aktiviti-aktiviti ekonomi tidak banyak membantu syarikat-syarikat SBK ini untuk menjadi lebih kompeten, terutamanya apabila agenda ini dipolitikkan. Tambahan pula, SBK kini menghadapi masalah dari segi keuntungan dan pengurusan yang menjejaskan tahap kecekapan secara keseluruhannya. Kajian mengenai kecekapan SBK bagi mengatasi cabaran dalam dunia perniagaan masih tidak mencukupi. Oleh itu, kajian ini bertujuan untuk menilai kesan faktor-faktor dalaman dan makroekonomi yang berkemungkinan boleh meningkatkan kecekapan teknikal SBK. Oleh itu, objektif kajian ini adalah untuk mengkaji kesan faktor makroekonomi dan faktor dalaman terhadap kecekapan di 17 buah SBK yang tersenarai di bawah G20. Selain itu, kajian ini juga menganalisis peranan kerajaan sebagai suatu bentuk interaksi (interaction terms) dalam mempengaruhi kecekapan teknikal SBK. Analisis Persempadanan Stokastik atau *Stochastic Frontier Analysis* (SFA) telah digunakan untuk mengenal pasti skor kecekapan teknikal SBK, diikuti oleh Kesan-kesan Tetap dan Rawak (*Fixed dan Random Effects)* dan Kuasa Dua Terkecil Lazim Ubah Suai Sepenuhnya (*Fully Modify Ordinary Least Square* atau FMOLS). Hasil kajian ini mendapati faktor dalaman seperti jumlah pendapatan, modal kewangan, pemilikan kerajaan, saiz firma dan pulangan ke atas aset serta faktor makroekonomi seperti KDNK, infrastruktur, pengangguran, keterbukaan perdagangan, kadar inflasi dan kadar faedah sebenar menunjukkan kesan yang signifikan terhadap kecekapan teknikal SBK. Kajian ini mencadangkan penglibatan kerajaan sebagai suatu bentuk interaksi (interaction terms) bagi meningkatkan keberkesanan SBK. Dari segi dasar pula, pihak kerajaan perlu memainkan peranan penting dalam menyediakan persekitaran makroekonomi yang stabil, membuat keputusan yang rasional dan mewujudkan hubungan ekonomi antarabangsa melalui SBK. Ini menunjukkan bahawa pembuat dasar juga perlu bertindak selaras dengan urus tadbir yang baik berdasarkan prestasi serta pembangunan SBK.

Kata kunci: Syarikat Berkaitan Kerajaan, kecekapan teknikal, faktor dalaman, faktor makroekonomi, interaksi, peranan kerajaan

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LIST OF ABREVIATIONS

GDP	Gross Domestic Product
CPI	Consumer Price Index
SFA	Stochastic Frontier Analysis
GLCs	Government Linked Companies
TE	Technical Efficiency
PTE	Pure Technical Efficiency
SE	Scale Efficiency
DMU	Decision Making Unit
ROA	Return on Asset
FC	Financial Capital
GOV	Government Ownership
BD	Board Structure
ER	Exchange Rate
ETP	Economic Transformation Programme
PCG	Putrajaya Committee on GLC High Performance

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Growth slowdown draws the attention of policy-makers and brings about anxiety to middle income countries (Aiyar, Duval, Puy,Wu & Zhang, 2013). It is widely believed that global business is the core of the economic structure of any country, and represents the engine of any developmental activities. In addition, it plays a vital role in the growth and development of an economy, as has been identified academically or practically by previous studies (Yacob, Aziz, Makmor & Zin, 2013). Government agencies have to play a more effective role, especially in economic development, to help boost efficient production of products and services. In order to carry out this role, Government Linked Companies (GLCs) need to be efficient in order to maintain their business success, given the increasing competition and to contribute to the economy.

In economics, 'efficiency' is a term that describes how well a system performs in producing the maximum output for a given quantity of inputs. If more outputs are produced without altering inputs; or if less input is used for the same quantity of outputs produced, efficiency is said to be improved. Efficiency is measured by using best production frontier to enable us to distinguish GLCs that will survive from those that will not.

Currently, there are two main techniques used to evaluate efficiency, namely parametric methods, such as the Stochastic Frontier Analysis (SFA) and non-parametric methods, such as Data Envelopment Analysis. The debate on which approach is more appropriate for analysing the efficiency is still open and has been the subject of many applied works (Luciano & Regis, 2007). This study follows the two-stage approach as suggested by Coelli, Roa & Battese (1998). In the first stage, a parametric SFA is used to estimate efficiency score, followed by the Panel Data Analysis.

The efficiency levels differ across companies and the differences in the efficiency level from one GLC to another GLC, as well as among GLCs, provide a benchmark index for policy-makers and shareholders. In this context, policy-makers and shareholders can utilise the results obtained from the efficiency analysis as a reference to optimise the efficiency in their respective GLCs. On the other hand, if the obtained results seem to be similar for all GLCs, then a general model can be developed in order to analyse the efficiency level across international GLCs in order to boost the overall efficiency of their respective national GLCs.

1.2 Background of Study

GLCs are companies that carry out a primary commercial objective and in which the Malaysian government owns a direct controlling stake. Controlling stake refers to the government's ability (not just percentage ownership) to appoint board members and senior management and to make major decisions (e.g., contract awards, strategy, restructuring and financing, acquisitions and divestments, etc.) for the GLCs, either directly or through government linked investment companies (GLICs). GLCs achieved high performance in diverse economic fields (PCG, 2012).

In February 2010, Malaysia introduced the New Economic Model (NEM) under the 10th Malaysia Plan. The government believes that the NEM can create a knowledge-based economy and transform Malaysia into a developed country by 2020. To improve the performances of GLCs and the competitiveness among firms, the government introduced the GLC Transformation Programme in May 2004. Since the competitiveness of firms or enterprises depends on their efficiency, efficiency evaluation is one of the methods that can improve the performance and increase the productivity of firms (Mohamad & Said, 2012).

GLCs under the G20 form a crucial part of the nation's legislative and financial policies. Currently, G20 consists of 17 GLCs in the entity as a result of mergers, demergers and other corporate rebuilding activity. There are many reasons for the divestment: (1) to enhance market capital; (2) to be more competitive; (3) to have more liquidity in the

market; and (4) to increase the number of investors. Most of the GLCs are sold or merged, in order to maintain growth, and at the same time, to avoid the 'crowding out' of private investments. The divestment programme allows the government to decrease their stake or sell their overall stake in the companies.

The main aim of GLCs must be to increase profit and enhance Malaysia's economic scenario (Musa, 2007). Therefore, they need to be more efficient, develop knowledgeable resources, hire more educated workers, create effective leadership, venture into new markets and establish professional management (Tan, 2008). GLCs also have the responsibility to create more job opportunities and new investments to address the economic crisis. Although GLCs have benefited from preferential treatment, they have been proven underperformed and inefficient.

Prime Minister of Malaysia said that GLCs play a pivotal role and are catalysts to spur the economic growth of Malaysia (Borneo Post, 2012). He also mentioned that in order to transform Malaysia to a high income economy and achieve Vision 2020, the role of the government and GLCs is important. Furthermore, GLCs must be able to create a platform to generate and enrich knowledge in key sectors and implement government policies. Therefore, to meet global challenges and to achieve Vision 2020, GLCs need to be competitive.

GLCs are the backbone of the Malaysian economy (Ahmad Kaseri & Wan Fauziah, 2012). In Malaysia, the government participates significantly in the economy, exercised

by holding equity in the private sector firms, which are also known as GLCs. Though the number of government-controlled companies is relatively small, representing less than 10 per cent of the companies listed on Bursa Malaysia, these companies account for approximately RM 260 billion in market capitalisation, or approximately 36 per cent of Bursa Malaysia's market capitalisation (Ismail *et al*. 2012).

GLCs play an important role in enhancing and augmenting economic growth in Malaysia. By the year 2020, Malaysia aims to be a progressive high-income nation, with unparalleled appeal to external investors, and survive at the regional and global levels. Hence, in order to achieve Vision 2020, the cooperation and contribution from both the private and public sectors are very important (Said & Jaafar, 2014).

The government provides investment funds to the GLCs to ensure that the GLCs perform well. The quality of GLCs has undeniably improved over the years, especially in the post GLC Transformation Programme implementation. GLCs contribute via tax payments, unemployment reduction (employing approximately 5% of the national workforce), implementation of government policies and by nurturing a knowledge-based economy (PCG, 2012).

Figure 1.1 below shows the extent of government involvement in GLCs. It shows the government shareholdings and degree of control. The government holds equity interest in companies that are listed on Bursa Malaysia. There are different types of control, for example, GLCs that are fully controlled (super control and exercise control), such as

Petronas, Malaysia Airlines (MAS), Malayan Banking Berhad (Maybank) and Telekom Malaysia (TM). Five Government Linked Investment Companies (GLICs) (as mentioned in Appendix B) are the largest shareholders for the fully-controlled GLCs. This is followed by quasi-control, whereby GLCs are the single largest shareholder and finally, non-GLCs that are not controlled by the government. Currently, there are 17 listed GLCs constituting the G20, which are under the federal government's administration.

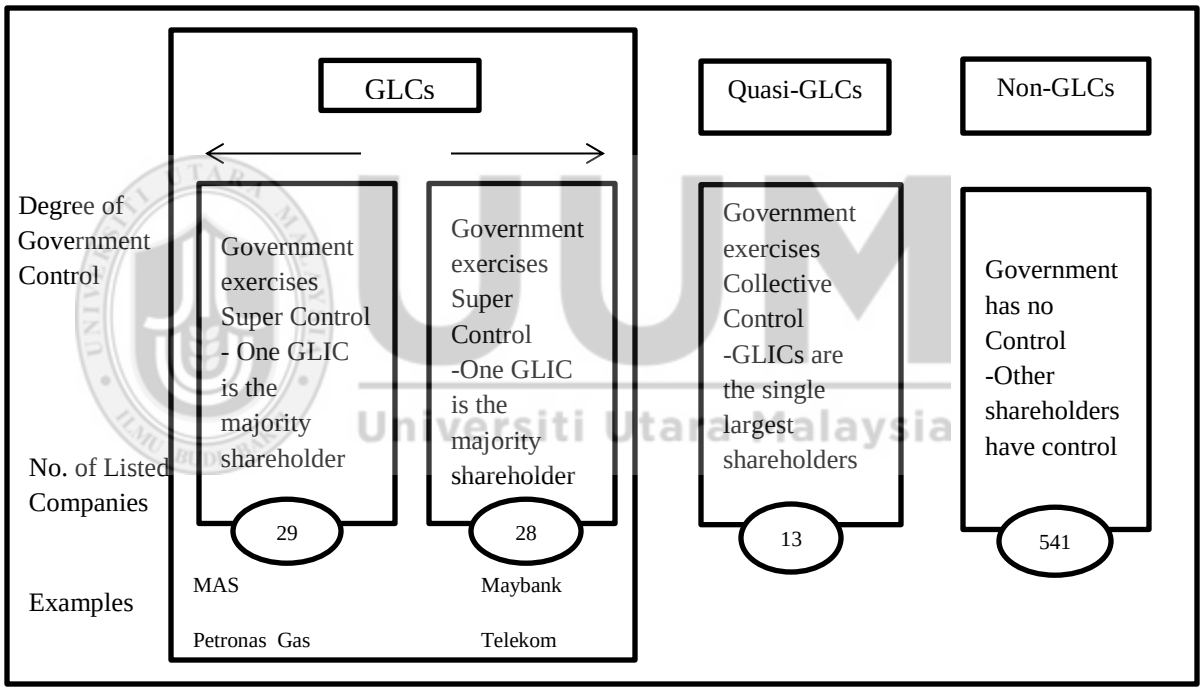

Figure 1.1
The Involvement of the Government in GLCs
Source: PCG, 2006

1.3 Issues

GLCs' historical underperformance was low until November 2007, during which the financial and operational sectors were at risk of not achieving Vision 2020 (PCG Report, 2008). According to the World Economic Forum (2013), Malaysia was placed 25th in the Global Competitiveness Index, in the context of efficiency, competitiveness and the stability of the financial sector. Several internal elements, such as revenue, financial capital, government ownership, firm size, return on assets, firm age and number of directors of GLCs, contributed overall as risk factors for GLCs themselves and for the economy as a whole.

On the global front, based on Forbes Global 2000, only six Malaysian GLCs made the list. They were Maybank, CIMB Group Holdings, Tenaga Nasional, Sime Darby, Axiata Group and Telekom Malaysia. In terms of global ranking, Maybank was ranked 332 followed by CIMB Group Holdings (467), Tenaga Nasional (516), Sime Darby (542), Axiata Group (807) and Telekom Malaysia (1961). This implies that Malaysia did not rank highly in terms of business performance compared to other high income countries, such as South Korea that houses corporations, such as Samsung Electronics and Hyundai Motors, which ranked as the top 100 companies in the world. This list is vital as it is deemed as a benchmark and a motivating factor for nations competing to achieve high income economy.

In addition, the contributions of other GLCs has been inconsistent in various sectors; there are ups and downs, especially in the services and plantation sectors. The

restructuring of GLCs, announced by the Malaysian Prime Minister in May 2004, was focused more on the corporate governance practices and performance. This triggered questions whether the existing mechanisms in play in GLCs are effective or inappropriate to drive the Malaysian economy towards positive growth.

The public's poor perception of the GLCs in Malaysia has worsened over the years due to the poor performance of key GLCs, such as Malaysia Airlines (MAS) and Proton Holdings Berhad (Lau & Tong, 2008). MAS plunged into losses over consecutive financial years, beginning 2004 with RM326 million, increasing in 2005 to RM 1.251 billion. This is due to the excessive cost over its revenue generated during the year. The losses continued in 2010 and 2011 by RM237 million and RM2.5 billion, respectively, even though MAS was in the process of implementing a business turnaround process (MAS, 2012; Said & Jaafar, 2014).

Citing another example, Proton Holdings Berhad also revealed poor performance when the share price of Proton Holdings in 2006 fell sharply after Volkswagen dropped its plans to invest in the organisation. As a result, Proton Holdings suffered a pre-tax loss of RM240.5 million in 2006. Proton also further suffered pre-tax losses prior to government tax grants for three consecutive years from 2007, 2008 and 2009 as well as 2011. This jeopardised public perception of its creditability as a leading car manufacturer in Malaysia (Proton, 2011; Said & Jaafar, 2014). Many other GLCs also underperformed financially. As indicated by the total returns to shareholders, public listed GLCs trailed

behind the overall market performance by 21 % over five years beginning 1997 to 2002 (Bursa Malaysia, 2003). This was a significant loss for the shareholders.

Besides that, the size of GLCs is also an important benchmark in measuring the efficiency of GLCs. Previous studies have concluded that GLCs underperformed in the broader Malaysian market on all key financial indicators, except for size (Ismail *et al*., 2012; Feng, Sun & Tong, 2004; PCG, 2015). Recently, Sime Darby Berhad, Malaysia's second largest company based on market value, lost around RM 964 million on four projects due to poor management decisions and control. This was also partly contributed by underperforming directors (Ismail *et al*., 2012). On the other hand, although GLCs are well primed in terms of size and age, yet they are still not able to yield consistent net profit throughout the year.

The trend of 17 GLCs under G20 (refer to Appendix A) shows that their net profits are inconsistent throughout the period from 2004 to 2013. GLCs, such as Boustead Holdings Berhad, TH Plantations, Malaysia Building Society Berhad (MBSB), Malayan Banking Berhad (Maybank) and United Engineers Malaysia (UEM), were able to increase their profits throughout this period, while other GLCs, for example, Telekom Malaysia (TM), CIMB, MAS, Malaysia Resources Corporation Berhad (MRCB) and UMW Holdings Berhad, showed negative trend. Some other GLCs were able to increase their net profit from 2004 to 2013 but in decreasing trend. Hence, this is a sign of poor performance and may indicate upcoming losses (Thomson Datastream, 2014).

Besides the internal factors mentioned above, macroeconomic factors, such as Gross Domestic Product (GDP), infrastructure, inflation rate, real interest rate, exchange rate, unemployment and trade openness, are also important factors that affect a GLC's efficiency. Even though Malaysia navigated successfully from the Asian financial crisis in 1997/1998, a foremost reason for the crisis on the local front was poor corporate governance (Khatri, Leruth & Piesse, 2002) across industries and enterprises (Jomo, Ching & Fay, 2005).

The Malaysian ringgit's value plunged \until April 1998. The crisis brought considerable losses for companies, including GLCs. These effects constrained these companies from securing essential loans and credits. In addition, it also contributed to unemployment rate which rose to 6% with negative GDP growth rate (NEAC, 1990). From 2000 to 2006, Malaysia's growth rate increased to 6%, but the crisis in 2008 again affected the growth rate (Selvanathan, 2008). The negative growth rate reduced the net export and the unemployment rate increased, especially in Small Medium Enterprises(SMEs), which are suppliers to most GLCs. At the same time, the stock market also declined by 40% from 2008 to 2009 (Selvanathan, 2009). Moreover, Khazanah (2009) indicated that the GLCs market value decreased from RM 276 billion in 2007 to RM 159 billion in 2008 because of the global financial turmoil.

GDP is utilised as a benchmark to gauge the efficiency of GLCs. According to the NEM, although it is assumed that GLCs are better placed to enhance economic growth, yet their revenue contributions towards Malaysia's GDP depicts otherwise. Although GLCs have

undoubtedly been a major element in the socio-economic development of Malaysia, their performance has lagged compared to the more established non- GLCs (Lemmon and Lins, 2003). Hence, the role of the government is very much needed to bail out the GLCs that are facing huge financial losses.

The government plays a vital role in GLCs, especially in terms of appointing board members and in decision-making. GLCs are traditionally governed by a board of directors whose members have affiliations with various political parties. For example, in Sime Darby Berhad, a government-controlled firm, six out of the 12 directors either have political connections or have served as senior government officers. Since the directors lack relevant business acumen, the board is ineffective and is unable to monitor managers, especially when the businesses are diversified.

Malaysia's GLCs are also bound by government policies, such as wealth distribution and restructuring of society under the New Economic Policy (NEP) (Beh, 2007). In addition the appointment of executives and board of directors are under the scrutiny and approval of the Ministry of Finance. However, government involvement in these GLCs cannot be disregarded as it provides numerous incentives to strengthen the economic and financial position of GLCs (Beh, 2007; Vietor, 2007).

Though the number of GLCs has reduced under the divestment programme, the role of the government, especially in large companies, remains crucial, especially in times of financial meltdown. For instance, government control is needed for investment in

projects linked to gross national income, such as regional corridor development. Moreover, major industries, such as defence, food production, national transportation, national infrastructure and nano-technology depend on the government for funds or facilities.

It can therefore be summarised that inefficiency in GLCs is caused by issues within the GLCs and from the macroeconomic environment. Hence, this study is dedicated to conduct an in-depth analysis with the aim to help improve GLCs' efficiency.

1.4 Problem Statement

The role and efficiency of GLCs in the modern market economy have important policy implications for many Asian countries, as GLCs are a vital part of a country's economic drive. However, numerous studies that have assessed the efficiency of the GLCs have only been undertaken in terms of financial performance, profitability performance, board effectiveness, corporate identity development and management (Mohamad & Said, 2012).

Literature in the field of efficiency asserts that internal factors, such as revenue, financial capital, government ownership, firm size, return on assets, number of directors on the board and firm age are essential elements of GLCs' efficiency, which are also factors which may lead to low performance. In terms of size, for a given set of prices, larger

firms should be efficient owing to their potential to realise optimal output achievement which cannot be realised by small firms in the short-term. In addition, firms which are more efficient are also more effective in competition in increasing their assets (Ajlouni & Hmedat, 2011; Andries, 2011; Ismail *et al*., 2013).

The effect of financial capital on efficiency is an empirical issue. Based on previous studies conducted, given the size of a GLC, its financial performance is comparatively unremarkable compared to non- GLCs. For instance, in 2007, most GLCs underperformed the composition index by 8.7% due to market crisis (PCG Report, 2008) In the context of market capitalisation and its relationship with efficiency, some studies have found that capitalisation affects efficiency positively (Isik & Hassan, 2003; Pasiouras, 2008). In contrast, Sufian (2009) and Maghyereh (2004) found that financial capital affects efficiency negatively.

The number of directors and the age of a GLC also invariably influence the policy and efficiency of a GLC, in adddition to the set of skills, knowledge and experience. Past literature has also addresssed these empirical issues in terms of the efficiency of a GLC (Alves, 2011; Al-Matar *et al*., 2014; Bhuyan & Appuhami, 2015; Yang *et al*., 2013). A well known example is MAS (an experienced internationally reknowned airline which succumbed to some unforeseen internal issues), which is now restructuring its business operations through an overhaul of the board of directors and massive cost reduction in order to re-achieve efficient operations.

Apart from internal factors, macroeconomic factors can also have an impact on GLCs. For instance, negative output rate and high unemployment rate of SMEs as suppliers as mentioned previously, can have a negative effect on GLCs. Based on previous studies, macroeconomics factors tend to affect the efficiency of firms and banks (Reda & Isik, 2006; Sufian, 2009). Thus, the effect of macroeconomic factors, such as GDP, infrastructure and the interest rate are vital as these create conducive environment to perform efficiently (Maghyereh, 2004; Moussawi & Obeid, 2011; Sufian, 2009; Reda & Isik, 2006).

Infrastructure has a great impact on productivity and efficiency (Aterido *et al*., 2011; Bah & Fang, 2015; Straub, 2011). Even though the ratio of infrastructure expenditure to GDP increased throughout the years of study (2004-2013), the efficiency of the G20 industry is still questionable. Trade openness also tends to affect GLCs' efficiency through a positive and negative relationship (Isik & Hassan, 2002; Pasiouras, 2008; Shao & Lin, 2002).

Based on the contradictory results of the previous empirical studies, it is vital to scrutinise the influence of both the internal and macroeconomic factors in determining GLCs' efficiency in Malaysia, especially when GLCs are laden with huge losses compared to non-GLCs, especially in terms of financial performance that ultimately requires government intervention.

The government's role in GLCs is associated with policies for social and wealth distribution. The number of GLCs has decreased through the years due tothe divestment programme by the government. Although government involvement appears to contribute negative effects, yet its contributions to GLCs are inevitable, especially for navigating through the financial crisis faced by the GLCs. In addition to the aforementioned factors, this analysis also finds the effect of government ownership on the efficiency of GLCs through macroeconomic factors. This is vital as GLCs tend to have complex ownership structures which results in comparatively more severe agency problems compared to non-GLCs (Ismail *et al*., 2012; Shleifer & Vishny, 1994).

In conclusion, one significant attributable shortcoming of previous similar research is that it has concentrated only on a specific issue. This study tries to address the demanding gap in the literature from a more holistic and strategic perspective by considering the importance of internal and macroeconomic factors in determining the GLCs' efficiency.

1.5 Research Question

In the context of the research background, issues and problem statement above, the foremost interest of this research is on the impact of internal and macroeconomic factors on Malaysian GLCs' technical efficiency and whether government ownership interacts with macroeconomic factors to affect the GLCs' overall technical efficiency.

Based on this, the following four research questions are put forth to guide this study:

i. What is the technical efficiency score of GLCs in Malaysia?

ii. Do internal factors influence the technical efficiency of GLCs?

iii. Do macroeconomic factors have an impact on GLCs' technical efficiency?

iv. Does GLCs' government ownership interact with macroeconomic factors and technical efficiency of GLCs?

In this study, the researcher is interested in statistically testing the relationship among the variables (i.e., internal factors, macroeconomic factors and interaction term). It is hoped that through this, the study can answer all the preceding research questions. These four general research questions have been particularised to guide the researcher in venturing deeper into the phenomena under investigation.

1.6 Research Objectives

The intent of this research is to understand the impact of macroeconomic and internal factors on the technical efficiency of 17 top listed GLCs in Malaysia, followed by the aim to examine the interaction of government ownership on macroeconomic factors.

The specific objectives of this study are expressed as follows:

1.6.1 To examine the technical efficiency score of GLCs in Malaysia.

1.6.2. To examine the impact of internal factors on technical efficiency of GLCs.

1.6.3 To examine the impact of macroeconomic variables on GLCs' technical efficiency.

1.6.4 To determine whether government ownership requires macroeconomic factors to influence technical efficiency of GLCs.

1.7 Significance of the Study

Most of the previous research on GLCs have focused on performance in terms of profit, firm value and board efficiency factors (Ahmad & Rahman, 2012; Ang & Ding, 2006; Ismail *et al*., 2013; Mohamad & Said, 2012). However, there has been a lack of emphasis on factors that affect efficiency and interaction term of government ownership on macroeconomic factors. Based on extensive literature review, the researcher is satisfied

that these variables have yet to be tested in the same research framework in the context of Malaysia.

Moreover, studies on GLCs' efficiency are important to assist the government and shareholders to understand and identify the factors that affect GLCs` efficiency. Therefore, this study adds to the existing body of knowledge and theories of efficiency and growth in respect of how efficiency is linked to macroeconomic factors as well as internal factors to enhance GLCs'performance.

GLCs constitute a significant part of the economic structure of Malaysia. Therefore, it is important that GLCs improve their performance to support the economic development in the long-run. Thus, this study focuses on the efficiency of GLCs, which is the engine of development, as opposed to GLCs in other countries. Since GLCs are the main players in the economy, the efficiency and improvement of GLCs are very crucial to provide a supportive financial infrastructure for economic development. Improvements in GLCs' efficiency may also minimise costs and increase the profit, also help to improve the economy.

Another significance of this study is the period it covers from 2004 to 2013, which is after the Transformation Programme to improve the performance of GLCs. Furthermore, in future other firms will also be able to benefit from the study of GLCs' efficiency because the finding will be able to assist managers in making appropriate adjustments to their managerial policies and decision-making.

Various scholars, for example, Sufian (2009), have also examined the impact of macroeconomic factors, especially in the banking sector. However, this study studies GLCs' efficiency by including both internal and macroeconomic factors, therefore providing information for the GLCs to remain successful in a competitive market environment.

More importantly, this research contributes significantly to the theory and body of knowledge by investigating the impact of macroeconomic and internal factors on GLCs' efficiency through the growth theory framework. In terms of the body of knowledge, this research analyses the concept of interaction term in a single model. Such an empirical approach has received major scrutiny and attention from communication researchers, (Abdullah, Habibullah & Baharumshah, 2009; Sufian, Kamarudin & Noor, 2012). However, the concept is relatively new in other fields, especially that which focuses on efficiency.

From the practical and managerial perspective, this study provides several alternatives in the field of operational management, especially in terms of efficiency. The utilisation of the efficiency and growth theories in this framework should provide GLCs with another perspective and option that could strengthen their resistance and operational stance against threats from the macroeconomic environment.

Therefore, it is hoped that this study will be able to provide benefits to the policy-makers, GLCs' management and the government to increase the technical efficiency of the GLCs.

This study believes that the policy-makers will be able to implement appropriate public policies with the valuable information and justification provided. The GLCs' efficiency analysis is also valuable to academicians, analysts and practitioners, as it provides insights into the survival of GLCs in the future. In future, it is hoped that the Malaysian economy will be completely globalised and liberalised and the overall competitiveness of GLCs is enhanced.

1.8 Scope of the Study

This study focuses on Malaysia and its due to GLCs huge impact on the nation's economy. The selection of the companies are based on G20 that been introduced in GLC Transformation Programme. There are 17 GLCs (listed in Appendix B) that been listed and controlled by GLICs constituents of Putrajaya Committee on GLC High Performance (PCG) due to various mergers, demergers and other corporate restructuring exercises of Proton, Pos Malaysia and Petronas. Data covers the period from 2004 to 2013, i.e., after the GLC Transformation Programme. Data for efficiency analysis is obtained from Thomson Financial DataStream and annual report of each company. The data for macroeconomic variables are taken from World Bank, Economic Planning Unit and World Development Indicators (WDIs).

1.9 Organisation of the study

The thesis is divided into several chapters. The first chapter introduces the research, while the second chapter comprises the review of the literature pertaining to GLCs' performance, macroeconomic factors, internal factors and interaction term. Based on the extensive literature review, the theoretical framework and related theories used in the research are presented in Chapter 2. In Chapter 3, a thorough explanation of the research methodology used in this research is mapped out as well as the postulated models that are tested. This is followed by Chapter 4 and Chapter 5, which comprise the analytical steps taken in this study and the outcomes. The results include efficiency score of GLCs as well as the statistical results derived from the analysis. Finally, the thesis ends with Chapter 6, which discusses and concludes the outcome of this research together with policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on theoretical and empirical review on efficiency, which provides different frameworks for analysing the impact on the efficiency of Government Linked Companies (GLCs). Extensive researches had been conducted by previous researchers as contained in most literature on efficiency. In this context, reviews of the efficiency definition and classification are indicated in Section 2.2 explains the methods of measuring efficiency. Section 2.3 reviews the underlying theories of this study. Section 2.4 will review the previous literatures on GLCs performance and Section 2.5 reviews the impact of internal factors macroeconomic factors and interaction term. Finally, this chapter ends in Section 2.6 by identifying the research gap and Section 2.7 that summarise the whole chapter.

2.2 Efficiency Definition and Classification

The product and service in an efficiency analysis can be calculated by comparison between the outputs an inputs utilised in the process of the product's or the service's production. Efficiency can be used as a measurement to determine a firm's performance. There are three type of efficiency such as economic efficiency, allocative efficiency and technical efficiency.

2.2.1 Economic Efficiency

Economic efficiency is a concept that handle the optimal option of input and output on the basis of responses to market prices (Bauer, Berger, Ferrier & Humphrey, 1998). An organisation should concentrate on economic efficiency as an important tool in order to sustain their existence and production. Economic efficiency can be calculated based on price data. An organisation will be efficient economically if the selection of combination of input and output levels are optimal to achieve its economic goal.

Their economic purpose is to minimise the cost and maximise the profit, whereas this can be done through the combination of technical efficiency and economic efficiency, which is known as 'value engineering analyses'. Economic efficiency requires both technical and allocative efficiency in order to create an effective production, with reduction in cost, increase in profit margin and retain the quantity and quality of output.

2.2.2 Allocative Efficiency

Allocative efficiency is whereby firms having the proportional costs minimization after they reached its optimal combination of inputs (Hassan, 2005). Hence allocative efficiency focuses more on the cost of production faced by firms because of the intervention policies by government and various market factors that leads to uncontrollable situation. Business organisation nowadays concentrate more on doubtfulness of market terms changes and government policies rather than the cost of input and output to achieve allocative efficiency.

2.2.3 Technical Efficiency

Technical efficiency is a type of efficiency that focuses on the physical relationship between levels of input in relation to level of output. Thus, in order to calculate technical efficiency, the data relating to input and output are needed (Bauer *et al*., 1998). A firm is known as technically efficient when their inputs are either minimised at a specified level of outputs or outputs are maximised at a specified level of inputs. The purpose to measure the technical efficiency is to determine whether firms employ best technology in the operation of product. Technical efficiency can be decomposed into pure technical efficiency and scale efficiency (Banker, Charnes & Cooper, 1984).

2.2.3.1 Pure Technical Efficiency

Pure technical efficiency is defined as the excess usage of input level at a given output level due to direction of the operations of the firms (Chan, 2008). Therefore, the focus will be more on the ability of the management to maximise the production of outputs at a given level of inputs or minimise the inputs at a given level of outputs to avoid thriftlessness.

2.2.3.2 Scale Efficiency

Scale efficiency is a way to calculate the productivity of firms at a particular point depending on the amount achieved at the optimum scale size, with the maximum level of average productivity, which means that scale efficiency is considered as the firm's ability to work at its optimum scale (Kounetas & Tsekouras, 2007).

Hence, the components can be illustrated by the diagram below which is developed by Farrell (1957) for the firms under the assumption of constant returns to scale (CRS), produce a single output Q, by employing 2 inputs, X_1 and X_2. In Figure 2.1, the curve SS' represents the unit isoquant of the efficient firm which permits the measurement of technical efficiency.

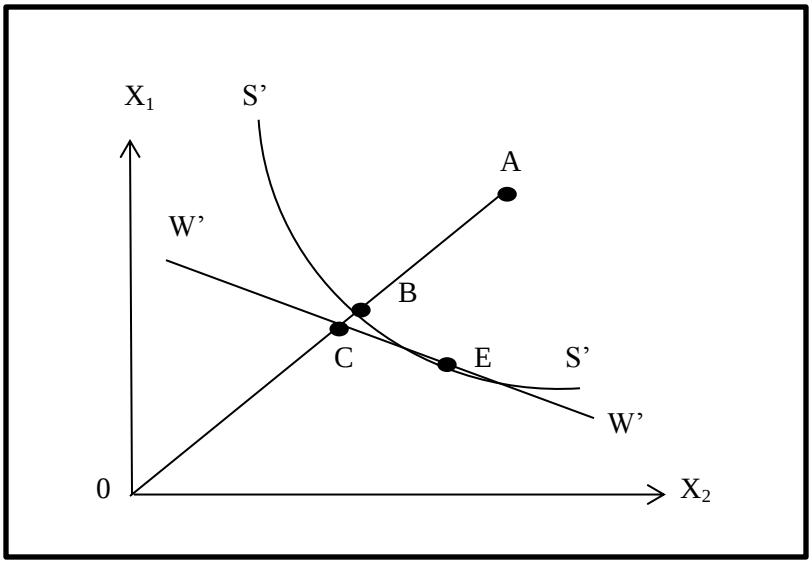

Figure 2.1
Technical Efficieny of Two Inputs and One Output

2.3 Theoretical Review

Due to the nature of the variables used, different underlying theories could be appropriate to theoretically underlie the framework of the study. The following sections discuss these underpinning theories with supporting arguments.

2.3.1 Economic Theory

Neoclassical economics assume that producers in an economy always operate efficiently, however in real terms; producers are not always fully efficient. This difference may be explained both in terms of efficiency, as well as unforeseen exogenous shocks outside the producers' control. The main core of the modern economic theory is based on the assumption of optimising behaviour, either from a producer or a consumer approach.

Economic theory assumes that producers optimise both from a technical and economic perspective. First, the technical perspective assumes that producers optimise by not wasting productive resources. While the economic perspective assumes that producers optimise by solving allocation problem involving prices.

However, not all producers succeed in solving both types of optimisation problems in all circumstances. Performance at a firm or industry level, defined as the ratio of outputs of production unit produces to inputs that the production unit uses, yielding a relative measure of performance applied to factors of production (Fried *et al*., 1993). This condition may depend on differences in production technology, production process or differences in the environment where production occurs. However, at a given moment of time, even when technology and production environment are essentially same, firms or industries may exhibit different productivity levels due to differences in their production efficiency (Korres, 2007).

Thus, it is important to have a way of analysing the degree to which producers fail to optimise, the departures from full technical and economic efficiency. Based on this general notion, one of the main analytical approaches to efficiency measurement is the analysis of production frontiers, a tool which has expanded greatly in the last decades. However, even though the concept of production efficiency is central in production performance, its estimation has been proved to be rather complex, with relevant literature providing a range of different methodologies and approaches (Lovell, 1993), with one of the major approaches to be the Stochastic Frontier Analysis (SFA). The stochastic

frontier model was originally developed by Aigner, Lovell & Schmidt (1977). Typically, the production or cost model is based on a Cobb Douglas function.

2.3.2 Arbitrage Pricing Theory

The Arbitrage Pricing Theory (APT) was developed primarily by Ross (1976). It is a one-period model in which every investor believes that the stochastic properties of returns of capital assets are consistent with a factor structure. Ross (1976) argues that if equilibrium prices offer no arbitrage opportunities over static portfolios of the assets, then the expected returns on the assets are approximately linearly related to the factor loadings.

The role of bank manager is to continuously evaluate investment options with limited resources and the paramount need to maximise shareholders returns. This can be defined as the process of arbitraging between the opportunities available. Arbitrage is known as a practice of receiving the expected positive return from overvalued or undervalued securities in the inefficient market without any small risk and zero additional investments.

APT states that the expected return of an investment or a financial asset can be modeled as a linear relationship of various macroeconomic variables or a situation that shows the degree of correlation changes in each variable that derived by a beta coefficient. The model represent rate of return that used to obtain the price or value of the asset precisely.

Moreover, the asset value should equal to the expected of final asset value or future cash flow discounted at the rate implied by the model. If the asset value changes, arbitrage should bring it back to the line (Dybvig & Ross, 2003).

In the APT context, arbitrage is known as formed of trading in at least two assets, with at least one being is not represent the market value. The arbitrageur sells the asset which is relatively too expensive and utilise it to buy the other one which is relatively too cheap. Beenstock and Chan (2007) presented a study proposing an alternative methodology for testing APT in the context of the market for British securities. Using the macro variable model, they identified four macroeconomic variables for the United Kingdom (UK) market namely interest rates, Fuel and material costs, Money supply and Inflation. The inflation rate was found to be consistently priced.

The significance of other factors was based on their choice of sample period and estimation model. They found that the rate of inflation, short-term interest rate and the money growth rate are priced factors. Furthermore, they found less support for output, employment, exchange rates and balance of payments. Under the APT, an asset is considered to be undervalued or overvalued if its current price deviates from the price predicted by the model. APT implies that the performance of aorganisation is heavily determined by the changes in each of the macroeconomic variables.

2.3.3 Resource Based View Theory

Resource based view of the firm (RBV) has been considered as one of the most growing research area in the last few decades (Galbreath, 2005). The theory of RBV was first introduced by Wernerfelt (1984), where he argued that the internal resources can determine the organisational success. These resources can be either intangible or tangible assets (Collis, 1994), or capabilities such as accumulated skills and knowledge (Teece, Pisano & Shuen, 1997).

The RBV conceptualises the firm as a set of resources, where many resources differ in their importance in creating an added value for a firm (Barney, 1991). In addition, he argued that the firm's resources are the firms reputable employees', knowledge and skills, brand names, and the capital equipment. Moreover, he pointed out that the firm's resources are the most important factors for achieving sustainable competitive advantage. Therefore, the main competitive advantage's sources to accomplish superior performance are rare, valuable, and incomparable resources of the firm. These types of resources are considered as the intangible strategic resources of the firm (Barney, 1991, 2002).

Additionally, the RBV theory underlines the match between the organizational capabilities and the available opportunities. Therefore, the mechanism of RBV is to take into account the full use of available resources in the firm to build the core competencies for obtaining and sustaining competitive advantage (Makadok, 2001). As a result of that, competitors will face difficulties to achieve the same level of competitive advantage if

the firm considers different factors such as the internal organisational strategies, access to useful information resources, and human capabilities. (Barney, 1986; Russo & Fouts, 1997). Therefore, organisations should establish the link between internal capabilities and external environment to achieve the desired competitive strategic situation.

The impact of RBV on the competitive advantage of the firm can be noticed from the angle that the RBV focuses on the importance of resources in sustaining and originating competitive advantage of the organisation, thus, it should improve the mechanism of selecting the resources with great potential value (Makadok, 2001). Additionally, the internal and external environment should be aware by the organisation to have the capability of planning and designing the most effective and suitable action plans (Barney, 1986). Moreover, the capabilities of the organization can increase the importance of the available resources and help in the effective use of these resources (Prahalad & Hamel, 1990).

In particular, the objective of this study is to examine the effect and the relation between internal factors on efficiency of GLCs. While reviewing comprehensively the literature, the variables applied in this study have been underpinned theoretically by the RBV. As an example, size in term of total asset has been considered as one of the main resources of efficiency (Ajlouni *et al*. 2011; Almumani, 2013; Bokpin, 2013; Ismail *et al*., 2013; Mesa *et al*., 2014; Mrad & Hallara, 2012; Voulgaris & Lemonakis, 2013; Sharma & Dalip, 2014; Sufian, 2007; Sufian & Kamarudin, 2015; Yang *et al*., 2013). The other variable such as age, is considered as a unique intangible another resource of efficiency

(Ahmad & Rahman, 2012; Cho *et al*., 2015; Floros *et al*., 2014; Gandhi & Shankar, 2014; Sharma *et al*., 2013; Voulgaris & Lemonakis, 2013; Yang *et al*., 2013). Many previous studies mentioned that broad structure is the key source for the firm effiicency in term of making decision (Alves, 2011; Bokpin, 2013; Demirbas & Yukhanaev, 2011; Oba *et al*., 2014; Taktak & Mbarki, 2014; Yang *et al*., 2013).

Furthermore, financial capital is the vital source for the firms. Average capital ratio provides an indicator about the efficient operation of the institution and the management's compliance with capital requirements and regulations of competitive advantage (Ajlouni & Hmedat, 2011; Almumani, 2013; Chan, 2008; Pasiouras, 2008; Sufian, 2009). Moreover, revenue has been regarded as determinants for efficiency (Afza & Asghar, 2014; Joo & Fowler, 2014; Nguyen & Nghiam, 2015; Sufian & Kamarudin, 2015; Sunil Kumar, 2011; Uyar *et al*., 2013).

Return on Asset (ROA) is also known as profitability ratio that lead to efficiency (Ahmad & Rahman, 2012; Ismail *et al*., 2013; Mostafa, 2011; Mrad & Hallara , 2012; Sharma & Dalip, 2014; Sufian, 2007; Sufian, Kamarudin & Noor, 2012; Pellegrina, 2012) and finally ownership structure that can affect the efficiency (Abdul rahman *et al*., 2011; Ang & Ding, 2006; Firth *et al*., 2012; Iannotta *et al*., 2013; Lin & Wong, 2013; Mrad & Hallara, 2012; Yang *et al*., 2013).

In summary, the above mentioned arguments revealed that the variables used in this study could be considered as sources of the efficiency, therefore, justifies the use of RBV as one of the underpinning theories in this study.

2.3.4 Agency Theory

One of the key components of agency theory that was focused by Williamson is the interaction between the (agent) and the (principal). Whereby the (agent) has privileged attentiveness which is exercised by practicing it to boost their own particular utility for the advantage of another (the principal). This hypothesis implies the thought of government effort to optimise social welfare. Under the agency hypothesis, governments design public financial institutions to cure market failures. The costs resulting from this agency problem includes both the loss of potential benefits and the costs of measures designed to reduce the loss of potential benefits.

Agency theory depends on the fragmentation of agreement and the partition of proprietorship (shareholders) and control (management), which is the principle normal for companies these days. A fact mentioned by Adam Smith as early as the eighteenth century, they were noticeably popularised by Adolf Berle and Gardiner Means only in the 1930s. They argued that a company does not behave in accordance with the classical model, which assumes that, despite the management of companies by agents, these agents

act in the best interest of the owners of the firm. And as a consequence the owners ensures that the agents'best interest are cared for.

Then again, the second postulate of Berle and Means ought not be overlooked either. Because of the shareholders' apparent "restricted obligation" and the shareholders' failure to control the administration, the office confrontation is intensified. Restricted obligation implies that that an organization is in liable of its own obligations and liabilities. Shareholders are just obligated to the organization to pay up their offer capital. At the end of the day, they are sharing the organization's benefits; and are not in receipt of its misfortunes entirely.

Restricted obligation, as the strife goes, shifts the danger of business disappointment from the organization's shareholders to its lenders. Both, the companies' owners and managers therefore have too much of an incentive to take risks, as the creditors would be the party which would suffer most, in case of a bankruptcy. This could result in an inefficient use of resources. The differing qualities and expansive number of shareholders in corporation of public interest can't/won't apply powerful control over the administration for different reasons,in an instance the presence of a coordination issue. This incorporates issues of diverse hobbies of shareholders as well as corporating shareholders with the same convictions together.

With the unavoidable issue of free riding, i.e. every shareholder needs to maintain a railway track strategic distance between the expenses of control and trusting the alternate

shareholders who are practicing the vital control. This prompts an aggregate activity issue with each of the shareholders acting rationally, when not exercising control. But this may lead to a situation where nobody controls the management at all.

2.4 Government Link Companies (GLCs) Performance

Lee (1994) examined the market share price performance of 10 initial public offerings (IPO) of GLCs listed on KLSE over the period of 1984 to 1992 in relation to 71 IPO of non- GLCs listed on KLSE over the period of 1974 to 1989. He found that, IPO of GLCs performed better than IPO of non- GLCs in the long run.

Ramirez and Tan (2003) examined the study of 17 GLCs and 92 non- GLCs in Singapore from the period of 1994 to 1998. They found that both GLCs and non- GLCs were competing equally in term of financing. However they also found that, GLCs are rewarded with premium about 20 per cent in financial market that reflects market perception of benefits because of the government link. Their observation resulted that GLCs is performing well and the reason behind it is due to the advantages in procuring business opportunities via government projects. Moreover, GLCs received projects easily without tenders and usually received favourable terms in finding. On the other hand, if GLCs are not performing well, it is because of the managers or other internal factors.

Ang and Ding (2006) examined the financial and market performance of Singapore Government Linked Companies (GLC) with non-GLCs, whereby different sets of governance structures and government ownership. They found that, GLCs indicate higher valuations than non- GLCs, even used factors such as profit, leverage, firm size, industry and ownership as control variables. They also compared financial and market performance of Singapore GLCs and non-GLCs and found that Singapore GLCs provide average superior returns on assets and equity and indicates higher valuations and better corporate governance compared to non-GLCs.

Hisyam, Rubi and Huson (2008) examined the study on 27 GLCs and non- GLCs by comparing the financial (proxy by return on assets) and market performance (Tobin Q) over the period of 1995 to 2005. They found that non- GLCs perform better than GLCs on market performance. However in terms of financial performance, GLCs are better than non- GLCs. Finally, they concluded that GLCs implement better government mechanism and strong management expenses compared to non-GLCs.

Ezat and El- Masry (2008) examined the relationship between timeliness of Corporate Internet Reporting and firm's characteristics. They found that there is no significant relationship between timeliness and firm's size, type of industry, liquidity, ownership structure, board composition and board size. However there is also no formal test on timeliness to report good or bad news in GLCs because of greater government influence mechanisms which would create different incentives and timeliness of income. Moreover, when the government covers the financial and non-financial position of the companies,

the managers tend to have lower incentive to manage earnings and move them to use social contributions that the companies made to justify the position of companies.

Nor Idzma and Hetty (2006) examined the debt capital structure of 44 GLCs including GLICs and 230 non- GLCs listed in KLSE that operate in ten different industries during the period of 2001 to 2005. They found that, there is no significant difference in capital gearing ratio between GLCs and non-GLCs. Furthermore, there is also no relationship between firm's gearing ratio and its market value. They concluded that, there are other factors that determine the firm's market value, such as earning per share, cash flow and business prospects.

Issham (2006) examined the differences in performance of 37 GLCs and 208 non- GLCs over the period of 1999 to 2002. He found that GLCs in Malaysia tend to have lower value added (EVA) than non- GLCs. However his findings are contradicting because of lack of competition in the view that government companies have better corporate governance and well monitored. In terms of size and value added (EVA), he found that, increase in the size of GLCs will destroy the company values. It is because large sized of GLCs will indicate high cost of capital than the return.

Wong and Govindaraju (2012) examined the relationship between technology progress and economic growth in Malaysia by using selected Government Linked Companies (GLCs). They employed technology stock and logistic growth function in their study and found that Proton and Golden Hope are the firms that have better technology process.

Moreover, the analyses indicate that, technology process shows positive effects on the area that has comparative advantage compared to energy sector. Therefore, they concluded that TNB's technology process is lagging compared to Proton. Similar to

Razak, Ahmad and Joher (2008) examined the relationship between Goverment ownership in GLCs and the impact firm characteristics of corporate governance, agency cost, growth, risk and profitability on the performance of the company and compared with non- GLCs. They found that, GLCs performed better than non- GLCs in accounting measure that are ROA, sales and profit margin. However, in term of market based performance (Tobin Q, asset to equity), non- GLCs performed better. Moreover, the study concluded that GLCs shows continuous improvements based on their performance. Furthermore, they found that there is no significant results when ROE and P/E. Finally, they concluded that, government ownership makes GLCs perform better.

Ahmad (2006) examined three measures of profitability, productivity and output and compared these with the performance of non- GLCs in order to find the significant difference between the two groups over the period of 1996 to 2006. The study found that, in terms of profitability and productivity, non- GLCs perform better than GLCs. However, in terms of output or sales, GLCs perform better than non- GLCs. This is explained in terms of the size of GLCs, which indicates that, larger size produce higher output.

Hence, most of the previous studies concentrated more on the performance, technology and efficiency of GLCs, whereby a more a detailed explanation have been herewith provided in (Appendix F). Even though there are GLCs that perform better than non-GLCs but their efficiency in terms of internal and macroeconomic perspectives are still arguable.

2.5 Empirical Review

2.5.1 Technical Efficiency

In the literature on efficiency, there are plenty of research work that has been conducted on efficiency. Therefore, a great deal of empirical research explores the studies on efficiency, but it still lacking especially in terms of Government Linked Companies (GLCs). Mohamad and Said (2012) investigated the performance of selected biggest listed companies in Malaysia. 114 companies were selected and in order to reveal the ranking of the companies super- efficient Data Envelopment Analysis (DEA) model that is equivalent to the Anderson- Petersen's DEA model has been utilised. There was one input and six outputs were selected for this study. The input is total operating expenditure (revenue less net profit) and the outputs are change of revenue, change of net profit, change of assets, ROR, ROE and ROA. The first three outputs measure the performance and the next three outputs measure the profitability ratio. The result show that only small numbers of companies are operating efficiently under the CRS and VRS.

Tunga, Suhaimi and Salamudin (2011) examined the technical efficiency of government linked companies (GLCs) and benchmarked its results with top foreign owned firms. They selected 31 GLCs from the period of 2000 to 2008. Stochastic frontier model was conducted and they found that technically efficiency of GLCs still low compared to foreign firms. The inputs selected were capital input which referred to total assets (RM) and labour input which based on the number of employees in the firm. The output was proxy from the firms net revenue per year (RM).

Juo, Fu, Yu and Lin (2015) used three inputs in the study includes financial funds, labour (defined as the number of employees) and physical capital (net amount of fixed assets). The output vector includes financial investments and loans. Their analysis consists of 31 banks operating in Taiwan. After eliminated the unbalanced data, the study choose the balanced panel data covering from 2006 to 2010. As conclusion, most of the sample banks on average still earn positive profits.

Moreover, study conducted by Jose, Retolaza and Prunonosa (2014) measured the social and overall efficiency from 2000 to 2011 of Spanish banking. Their study is based on McGuire *et al*. (1988) and with the aim to control available funds included in the hypothesis related to the performance of corporations, whereby three inputs were introduced such as Equity, Total Assets and Deposits. While the outputs used were Profit, Loss and Risk.

Mostafa (2007) examined the efficiency of sixty- two top listed companies in Egypt. He used production frontier approach to test the efficiency among the companies. He used assets and employees as inputs and net profit, market capitalisation and share price as outputs. Finally, based on the result he found that the performances of several companies are sub-optimal, whereby they need more improvements in term of profits and markets.

Chiang and Cheng (2014) explored the use of the data envelopment analysis (DEA), Cobb-Douglas and translog production function methods in estimating 23 contractors' efficiency in Hong Kong from 2003 to 2009. Four inputs (total cost of sales, operating expenses, total salary, total assets) and three outputs (liquidity, total contract volume, profit) were identified. The efficiency scores obtained from the DEA method were significantly different from those obtained from the translog and Cobb-Douglas methods, while the efficiency scores from the translog method were similar to those from the Cobb-Douglas method. The result shows that the organization had poor usage of its assets in the course of recent years. On the yield side, the present proportion was too little, inferring that the organization experienced abundance current liabilities with respect to its present resources.

Huh (2015) investigated the impact of acquisitions on the steelmaker's performances and technical efficiency in the world steel industry over the period 1992 to 2011. The output used was the volume of steel production for each steelmaker which is calculated by sales divided by average hot coil price. Whereas for the inputs, the number of employment and net fixed assets are used as proxies for each firm's labour and capital variables. In order

to examine efficiency of steelmakers, the study proposed as stochastic frontier model of Battese & Coelli (1995).

Cui and Li (2015) calculate the civil aviation safety efficiency of ten Chinese airline companies from 2008 to 2012. They used labour, capital, fund and technology as inputs and total passenger turnover volume and net profit rate as outputs. This is similar to study conducted by Chen, Du, Sherman and Zhu (2010) that conducted the study in two stages. In first stage of profitability, it is measured using labour and assets as inputs and the outputs are profits and revenue. In the second stage for marketability, the profits and revenue are then used as inputs, while market value, returns and earnings per share are used as outputs.

In another study, by Edvardsen (2004) that examined the efficiency of Norwegian construction firms in 2001 by using Data Envelopment Analysis (DEA) method and bootstrapping method to test estimated results. Revenue as output in the DEA model was classified based on the type of business such as residential construction, non-residential construction (such as offices and schools), and civil engineering construction (such as roads, harbors, and tunnels). Inputs were labour (number of people), real capital (measured by capital service based on the use of production equipment, machines) and external expenses (materials, subcontractors, energy).

Based on their result, he found that most of the firms having high efficiency and this is because the influence of the variables such as high wage per hour, low shares of

apprentices, low level of product variety, and high hours worked per employee. However, when applying bootstrapping method, he found that the constant returns to scale (CRS) hypothesis was rejected, and only variant returns to scale (VRS) was appropriate with construction firms. Moreover, he concluded that in term of location, firms in Oslo had no impact in increasing the efficiency.

Gulati (2011) examined the technical, pure technical and scale efficiencies of Indian domestic banking industry using the non-parametric technique of data envelopment analysis. Three inputs are physical capital, labour and loans, while two outputs are net-interest income and non-interest income. The empirical results show that only 9 out of 51 domestic banks operating in the financial year 2006 to 2007 are found to be efficient and, thus, define the efficient frontier of the Indian domestic banking industry, with the TE scores range from 0.505 to 1, with an average of 0.792. The result revealed that managerial inefficiency is the main source of overall technical inefficiency in Indian domestic banking industry. Moreover, they proved off-balance sheet activities and profitability are the most influential determinants of the technical efficiency.

2.5.2 Internal Factors and Technical Efficiency

2.5.2.1 Revenue and Technical Efficiency

Literature on efficiency advocates that revenue significantly linked to its efficiency. The improvement in profit efficiency is mainly attributable to the properly shifting portfolio to generate higher revenues by increasing revenues more than costs (Avkiran, 1999; Berger & Mester, 2003; Berger, Demsetz, & Strahan, 1999, Resti, 1998, Hughes, Lang, Mester, & Moon, 1999).

Most of the literatures support the hypothesis that revenue can improve the efficiency and quality of banks (Jiang *et al*., 2009; Sufian & Kamarudin, 2015; Uyar *et al*., 2013). In other words, revenue can be linked with firm's cost, capital and risk of the firm in order to achieve efficiency. The empirical review by Nguyen and Nghiam (2015), investigated the interrelationships between bank risk, capital and efficiency of the Indian banking system.

In their point of view, bad management is identified as the cause for the decrease in cost efficiency precedes an increase in the level of risk that leads to lower cost efficiency. Such banks also tend to have poor loan and investment portfolios, causing low revenue efficiency. The result showed that revenue diversification is found to have a negative

effect on cost efficiency of private banks. Private Banks tend to intensify revenue diversification more than public banks.

In addition, according to Afza & Asghar (2014), the efficiency of modaraba and leasing firms in Pakistan is of significant importance since both these industries although have small share in the financial sector of Pakistan but these sectors have the potential to grow. Therefore, they tried to examine the level of efficiency with the SFA technique over the period of 2005 to 2010. The results indicated that Modaraba companies are more cost efficient as than leasing companies whereas; in contrast leasing companies are found to be more technical efficient than the modaraba companies. It indicates that the Modaraba's are optimally utilising their resources to reduce the overall cost of doing business whereas; the leasing companies are producing higher outputs and revenue than the modaraba leasing companies and overall efficiency.

Comprehensive literature review conducted by Joo and Fowler (2014) to measure the relative efficiency of 90 airlines in Asia, Europe, and North America. In addition, the authors use Data Envelopment Analysis for efficiency score and Tobit Regression Analysis for finding determinants of the efficiency. Results indicate that the efficiency of the airlines in Europe is the lowest among the airlines in these three regions.

Efficiency differences between the airlines in Europe and the airlines in the two other regions (Asia and North America) are statistically significant in terms of technical efficiency and pure technical efficiency, but not significant between the airlines in Asia

and North America. For the determinants of efficiency, the authors identified that revenues and expenses were significant for explaining efficiency scores of airlines. It seemed that airlines' revenue management or pricing along with cost containment affected directly the airlines' overall efficiency (TE).

Moreover, most of the previous studies on airlines have shown the relationship between the low-cost strategy of new entrants and changes in airline revenue management systems (Gorin & Belobaba, 2004). These authors found that low-fare airline entrants can lead to substantial revenue losses for the incumbent carriers. However, both incumbents and low fare new entrants alike benefit substantially from the use of revenue management systems. A comprehensive review of revenue management and its development can be found in McGill & Van Ryzin (1999).

2.5.2.2 Financial Capital and Technical Efficiency

The impact of capital adequacy on firm efficiency has become important due to the focus of substantial debate on capital requirements at the onset of the global financial crisis. The average capital ratio is calculated using equity over total assets. It shows the level to which shareholders have their capital at risk in the financial. Hence, they may show their concern over the monitoring of management.

Average capital ratio provides an indicator about the efficient operation of the institution and the management compliance with capital requirements and regulations. A result with lower ratio is considered to facilitate a lower level of efficiency and the ratio of lower equity to total assets is related to the probability of taking higher risk and greater leverage, and therefore, the costs of borrowing is higher.

This rationale is also buttressed by Park and Weber (2006) who stressed on the fact that with the increase in capital ratio, the bank customers' confidence will also increase owing to the decrease in portfolio risk alongside the anticipated financial problems. The theoretical positive relationship between financial capital ratio and efficiency is supported by several studies, such as Pasiouras (2008); Rao (2005) Casu & Girardone (2004) Isik & Hassan (2003) and Berger (1995), who indicate that banks having higher equity with respect to their ratio of total assets are anticipated to perform better.

However, Chan (2008) argues that the positive effect of high financial capital ratio on efficiency is a contingent to the environment in which a bank is operating. Chan (2008) concludes that in any environment where the financial capital offers a relatively cheaper source of funding in comparison to some deposits as well as other liabilities, and without subjecting the equity portion to explicit reserve requirement or interest cost, the positive effect of high financial capital ratio on efficiency appears clearly. Andries (2012) examine the pre-crisis and the crisis situation in the CEE countries and discovered that the best-performing banks during the recent financial crisis had significantly more core equity capital and were more focused on traditional banking activities.

Capraru and Ihnatov (2014) determinants of banks' profitability in five selected CEE countries over the period from 2004 to 2011. The sample contains 143 commercial banks from Romania, Hungary, Poland, Czech Republic and Bulgaria. The capital adequacy ratio has a statistically significant positive impact on all profitability ratios, with weaker significance in the case of ROA. The effect is stronger in the case of ROE. This may be explained by the fact that banks with high capital adequacy have larger profits. Hence, management efficiency and capital adequacy growth influence the bank profitability for all performance proxies and concluded that banks with higher capital adequacy are more profitable.

On the other hand, bank efficiency and equity to total assets ratio could be related negatively. A higher value of the proportion of equity to total assets ratio shows that regulations on the capital requirement of banks are very stiff. Koehn and Santomero (1980) indicated the effect of capital requirement on the performance of banks to be uncertain and hinges on the aversion of risk distribution among banks.

In such cases, banks which are typified to be non-risk averse have the greater tendency of opting for a combination of more risky assets as a result of a higher requirement, which could result in maximization of the possibility of bankruptcy. This is due to the fact that capital requirement provides the banks with incentives to liquidate fast, thus reducing their ability to honor deposits contracts (Diamond & Rajan, 2000). These arguments are

supported by Almumani (2013), Ajlouni & Hmedat (2011), Sufian (2009), Chan (2008) and Maghyereh (2004).

Sufian (2009) empirically came out with the evidence that although the market discipline hypothesis suggests that banks whose shares are publicly traded should exhibit higher efficiency, the empirical findings seem to suggest that the Malaysian capital market exerts no discipline over bank management and the destruction of the banking system's capital had severely constrained their ability to lend to even solvent companies in the midst of the crisis, due to the need to comply with international capital adequacy rules. Nevertheless, Havrylchyk (2006) and Reda and Isik (2006) found no relationship between capitalisation and efficiency. These mixed and inconsistent findings have given rise to the need to test the variables again for further verification.

Furthermore, greater capital requirements lead to agency conflict among the shareholders of the bank, the bank managers and the creditors whose banks are performing and efficient. Besanko and Kanatas (1996) stressed that when banks issue new equity to conform to the capital requirements, it may impact the shareholders' surplus which reduces the banks market value, particularly when shareholders fail to monitor the firms' performance efficiently.

2.5.2.3 Ownership and Technical Efficiency

In the literature of ownership, there has been plenty of research work conducted on the relationship between ownership and organizational efficiency. The performance literature research area differentiates between ownership structure such as firm ownership, government ownership and foreign ownership between different levels (Ghazali, 2010; Richter & Weiss (2013).

Past studies on the ownership- efficiency relationship showed conflicting results in this relationship. Several of them found that ownership improved the overall organisational efficiency and economic development (Stiglitz, 1993), while others impact negatively organizational performance due to some critical reasons. Indeed, an extensive empirical literature documents the inefficiency of government-owned non-banking firms, the political motives behind the public provision of services, and the benefits of privatisation (Barberis *et al*., 1996; Frydman *et al*., 1999; Lopez-de-Silanes *et al*., 1997; La Porta & Lopez-de-Silanes, 1999; Megginson *et al*., 1994). For more clarification regarding the effect of government ownership on organisational efficiency, the next few lines will mention some of these studies from different angles.

Mrad and Hallara (2012) examined the relationship between the residual Government ownership, performance and value creation on the post privatization period. The results revealed that very high levels of government ownership are associated with an increase in

performance and value creation within the privatised company, while low levels of this ownership are associated with a decrease in performance and value creation. This debate has been reopened recently because of the need for government ownership in enterprises (Boubakri *et al*., 2009, Omran 2009; Ng *et al*., 2009; Boubakri *et al*., 2011; Wu, 2010). In fact, although the idea that the role of the state must be minimum for a better economic growth was dominant for a long time among many economists and policymakers, the recent economic and financial crisis came to shake this dogma.

Moreover in GLCs context, Ang and Ding (2006) investigated the governance structure of government-linked companies (GLCs) in Singapore under the ownership/control structure of Temasek Holdings, the government holding entity, which typically owns substantial cash flow rights but disproportional control rights and exercises no operational control. On average, GLCs provide superior returns (on both assets and equity), and are valued more highly, through their better management of expenses than non-GLCs. GLCs do better than non-GLCs in many performance measures and do not appear to be worse off in other measures. Therefore, ownership bring positive effects to GLCs performance through internal indicators. In addition, Ting and Lean (2011) found that NGLCs appear to have better financial performance than GLCs.

Same goes via Indian context, there are number of papers on technical and cost efficiency of banks in India (Das *et al*., 2005; Das, 2002; Jayaraman & Srinivasan, 2009; Kumar & Gulati, 2008; Ram Mohan & Ray, 2004; Shanmugam & Das, 2004). Literature on efficiency by Srinivasan and Jayaraman (2014) provided a holistic approach to measure

the profit efficiency of banks, factoring desirable/undesirable outputs, using Nerlovian profit indicator approach. They found that bank size, ownership, and stock exchange listing had a positive impact on profit efficiency and to some extent, revenue efficiency. This has been supported by previous author, Ghazali (2010) that provided relevant literature on government ownership and evidence that when the government was a substantial shareholder, they performed better than others especially when the organisation's core business is not for profit or financial performance.

Most of the past literatures have related the relationship between cost, risk and ownership. Previous literature stated that lower risk can lead to higher profitability and overall lead to high efficiency (Barry *et al.*, 2011). However, Barry *et al*. (2011) conducted a research on a panel of European banks through the 1999–2005. The result showed that different ownership structures imply different levels of risk and profitability, but such findings hold mainly for privately owned banks. Public banks with different ownership structures do not present different levels of risk and profitability, suggesting that market forces align the risk behaviour of such banks.

Lannotta *et al*. (2013) examined the ownership structure between government and private banks. They showed that lower GOB profitability and efficiency may be related to the fact that GOBs financed projects with high social returns that POBs are not willing to fund due to their low private returns (social view). Alternatively, GOBs may be less profitable and efficient than POBs because they are run by political bureaucrats and have goals in contrast with value creation (political view). To sum up, GOBs may pursue

political and social goals at the cost of lower efficiency and profitability. This is similar to previous study conducted by Sufian (2009) on Malaysian banks and Yang *et al.* (2013) that examined the effect of the separation of control and ownership on the efficiency performance of Taiwanese electronics firms for the period from 2004 to 2010. The paper runs OLS regressions to find the relationship between efficiency performance and the separation of control and ownership. In other words, concentrated ownership means lower quality of CG.

Brei and Schclarek (2015) investigated theoretically the lending responses of government-owned and private banks in the event of unexpected financial shocks. They predicted that public banks provide more loans to the real sector during times of crisis, compared to private banks which cut down on lending and increase liquidity holdings. In addition, the findings showed that the presence of public banks might decrease the probability of a systemic bank run as long as depositors perceive public banks as safer.

Similarly, Razak *et al*. (2011) investigated governance mechanism and firm performance of Malaysian GLCs and non-GLCs over 11 year period from 1995 to 2005. However, their results are contradicting with Ang and Ding, whereby they found that in Malaysia, non-GLCs perform better than GLCs after examining corporate governance and factors which influence company performance such as risk, growth and leverage. Similar previous findings obtained Lau and Tong (2008), who found a significant positive relationship between the degree of government ownership and firm value.

Different results were obtained by Firth *et al*. (2012). They stated that Government controlled listed firms have greater investment cash flow sensitivities than private controlled listed companies, especially on the left-hand side of the U-shaped curve where cash flow is negative (Firth *et al*., 2012). They stated that the difference in sensitivities appears only among firms that possess few profitable investment opportunities. The empirical results reported in the previous section indicate that ownership type influences corporate investment decisions. In particular, government controlled firms invest more than privately controlled firms, for a given level of internal funds. However, based on their findings, there is no evidence that access to finance and soft budget constraints explain the differences between the investment–cash flow sensitivities of government controlled and privately controlled listed firms.

2.5.2.4 Size and Technical Efficiency

Literature on efficiency advocates that firm size may be significantly linked to its efficiency. It is hypothesised that large firms (e.g: bank) may have professional and effective management teams or they may be comparatively cost conscious than management teams in small banks as their owners stress on bottom-line profits (Evanoff & Israilevich, 1991). The existing literature demonstrates differences in the relationship between size and efficiency. A related study by Berger, Hunter and Timme (1993) revealed that the positive relation between efficiency and size may not be visible as

factors signifying so are not yet conclusive. Larger firms may be generally efficient owing to their ability to produce maximum output.

In other words, larger firms may have greater profits for a particular price because they have gradually increased in size over a certain period. On the other hand, small firms are not able to achieve this caliber of success in the short run. There is also the possibility that firms with greater efficiency are more competitive, and as a result, they gradually become large. Size is deemed crucial as an important factor to affect GLCs efficiency because of their natural as 'big' companies with large capital. Due to its criticality, their efficiency has to be closely monitored, not only because it affects the operation of production, but because it is also tied to a large amount of investment. The literature review reveals the arguments that bank size should be linked to efficiency (Almumani, 2013; Andries, 2011; Mesa *et al*., 2014 and Reda & Isik, 2006).

Most studies that used asset size find inconsistent results for the relationship between size and efficiency (Ajlouni & Hmedat, 2011; Andries, 2011; Ismail *et al*., 2013 and Sharma and Dalip, 2014) find those larger banks are more efficient, i.e., as banks tend to increase their asset size, they become more efficient. In addition, Sufian and Habibullah (2012) found that both large and small banks showed better efficiency. First, if it relates to market power, large banks should pay less for their inputs. Second, there may be increasing returns to scale through the allocation of fixed costs (e.g., research or risk management) over a higher volume of services, or efficiency gains from a specialised workforce.

There are some authors who conducted a comprehensive literature review about the previous research. In his study about efficiency, Ismail *et al*. (2013) used size as major determinant for efficiency of commercial banks Malaysia. They found that conventional commercial banks like Maybank, followed by AmBank experienced the highest average PTE, TE and CE. Third, the results show how bank size for conventional commercial banks is positively and significantly associated with efficiency (CE, TE, PTE, SE, and AE). This indicates that larger banks tend to achieve higher efficiency. This might be due to the factors that larger and profitable banks have more capital that can be used to adopt new technology that can enhance their profits and minimise their management cost. In contrast, bank size for Islamic commercial banks is negatively and significantly associated with efficiency (CE, SE, and AE). This is in line with (Andries, 2011 and Mesa *et al*. 2014).

In another perspective, firm size can also affect the profit of the organization differently. Based on the previous study conducted by Sufian (2007) on Malaysian Islamic banks during the period of 2001-2004 found that, smaller banks are profit efficient than larger ones. The findings showed that proxies of bank size namely, size is negatively associated with the proxy measure for profitability, ROA, although not statistically significant. (DeYoung and Nolle, 1996; Kaparakis, Miller and Noulas, 1994 and Sufian & Kamarudin, 2015). The results suggest that, during the period of study, although the larger banks tend to make more loans and becoming more efficient, the smaller Malaysian Islamic banks tend to be more profitable. However, the study also proved that

profits are positively related to efficiency. In addition, Havrylchyk (2006) and Avkiran (1999) found bank size does not significantly affect efficiency.

2.5.2.5 Age and Technical Efficiency

The age of the firm is measured by the years since it was established, whereby indirectly shows the seniority and experience of the firm (Rubio and Ruiz, 2009). Firm's age has been used as one of the internal variables that affects the enteprises (Gaoxia, 2011; Liu xiaoxuan, 2000; Wadud, 2004; Yaoyang, 1998; Yaoyang & Zhangqi, 2001). The effect of experience on a firm's productivity is a question seldom addressed in the literature. In principle, a positive relationship between the seniority of a company and its sales and profits might be expected (Thomas *et al*., 1998). Experience has three components that are expected to have positive relationships with sales and profits. In the particular case of efficiency, and generally speaking, greater seniority affords the company greater know-how, which can lead to a greater capacity for developing its activities in a more efficient way (Thomas *et al*., 1998).

In the case of firm experience -typically measured by firm age- Berger and Mester (1997) consider that a firm's age might be related to technical efficiency. The relationship between firm age and efficiency has been studied by many researchers. According to relevant theories and literatures, efficiency plays a significant role in the growth of firms,

while it is obvious that the relationship between firm's age and efficiency is positive (Cho *et al*., 2015; Christos Floros *et al*., 2014).

Agiomirgianakis et al. (2006) examined financial factors affecting profitability of Greek manufacturing firms over the period 1995-1999, and showed that firm size, age, exports, sales growth, reliance on debt on fixed assets and investment growth, as well as efficient management of assets influence profitability.

Christos Floros *et al*., (2014) investigated the relationships between size-age-exports and technical efficiency for Greek manufacturing sectors over the period 2003-2011 by using Tobit regression analysis. The Tobit model that was used in the study is as follows:

$$\text{Efficiency} = \alpha + \beta\ \text{Exports} + \gamma\ \text{Size} + \delta\ \text{Age} \qquad (2.5)$$

Exports denote the average number of exports (per sector), Size denotes the average Number of Employees of firms (per sector), and Age denotes the average age of all firms (per Sector). Based on the findings, they found that age is positively (negatively) correlated with efficiency for East Macedonia, Central Greece and Central Macedonia (Peloponnese, and Crete).

In the same line of research Yang *et al*. (2013) examined the relationship between efficiency performance and the structure of ownership and control in the Taiwanese electronics firms. They introduced several variables to control the firm characteristics, namely firm size (FSIZE), firm age (FAGE), and leverage (LEV). They found that, three

variables are expected to have positive coefficients because as a firm grows larger and older, it accumulates more experience and achieves economies of scale.

Similarly, Ahmad and Rahman (2012) examined the relative efficiency of the Islamic commercial banks (ICBs) and conventional commercial banks (CCBs) in Malaysia. The result of PTE shows that PTE of the CCBs is slightly higher due to the age of the CCBs' existence in Malaysia that gives wider experience and knowledge on the domestic market as compared to the ICBs.

In addition, Cho *et al*. (2105) explored three characteristics of internal auditors, namely, compensation, activity and expertise, based on 1,340 firm observations from 2009 to 2010 for Korean listed firms. A firm with a longer life cycle (AGE) is expected to be positively associated with operating efficiency, as predicted by Demerjian *et al*. (2012). The results for these control variables are generally consistent with those in prior studies (Core *et al*., 1999; Demerjian *et al*., 2012; Mehran, 1995). Hence, they found that leverage (LEV) and CEO stock options (CEOSO) are significantly negative, and the coefficients for firm (AGE) and listed firms (LIST) are significantly positive.

In the same vein of research, Hassan *et al*. (2009), investigated the differences in mean cost, revenue and profit efficiency scores of conventional versus Islamic banks. It also aims to examine the effect of size and age on cost, revenue and profit efficiency of the sampled banks over the period 1990-2005. The DEA nonparametric efficiency approach originally developed by Farrell was applied to analyse the data. The average bank lost an

opportunity to receive 27.9 percent more revenue, given the same amount of resources. Similarly, the average bank lost the opportunity to make 20.9 percent more profits utilising the same level of inputs. They found that size and age factor did not significantly influence the efficiency scores in both banking streams.

Similar results were obtained by Voulgaris and Lemonakis (2013) in their research on 168 aquaculture firms. The period of analysis covers the period 2002-2011. The results suggest that productivity increases with the size of the firm; age is not a significant determinant while exports are critical for their productivity, as well as profitability. They indicate that the average age of the fishing firms is around 20 years with a high variance but the youngest being 5 years of age.

Christos Floros *et al*. (2014) examined the relationship between firm size and efficiency is positive. They provide a review of relevant studies and show mixed results. In other words, firms appear to have either a positive or a negative relationship with size and age factors. Size-efficiency relationship could be negative for large firms and positive for small firms (the same applies to the age-efficiency relationship). This is similar to research conducted by Hu *et al*. (2009).

2.5.2.6 Board Structure and Technical Efficiency

Literature on efficiency advocates that board structure may be significantly linked to its efficiency. Several studies have focused on studying the effect of the size of the earnings management. Proponents of agency theory suggest that a large board promotes conflicts of interest between manager and shareholders, mainly because of difficulties of coordination and communication that may hinder consensus decisions (Jensen, 1993; Bhuyan & Appuhami, 2015; Bushman *et al*., 2004; Kao & Chen, 2004 and Taktak & Mbarki, 2014). This allows the manager to dominate the directors and use its managerial discretion to maximise his wealth through the earnings management (Lipton & Lorsch, 1992; Abdul Rahman & Ali, 2006).

Most of the literatures support the hypothesis that a large board of directors reduces earnings management because such board usually allows getting profit from the various experiences of the different partners and board members (Peasnell *et al*., 2005). In other words, larger firms may have greater profits for a particular price because they have gradually increased in size over a certain period. The empirical review by Taktak and Mbarki (2014) shows that by controlling the nature of affiliation, the coefficient relative to the size of the board becomes significant in determining the earning of the banks. It seems that, it is difficult in a large board of directors to be influenced by the decisions of managers. Large boards can usually take advantage of the different experiences of the members which impacts negatively earnings management (Jian & Ken, 2004).

In addition, according to corporate governance principles drafted by Capital Market Board Turkey (CMB), boards of directors should comprise of both executive and non-executive directors, and non-executive directors should form the majority of the board. Based on these principles, there should be at least four non-executive directors for a board with six members. According to CMB principles, the independent members should consist of one-third of all board members, which means the average number of independent members should be at least two (Oba *et al*., 2014).

On the other hand, Abeysekara (2010) examined the effect of board size on firms, disclosing more, rather than less, strategic and tactical intellectual capital resources using the top 26 of the 52 firms ranked by the Nairobi Stock Exchange for market capitalization in 2002 and 2003. The findings provide insights into how a larger board size can help boards to overcome skill deficiencies in making more discretionary disclosure related to future earnings. He provided evidence that larger boards are difficult to control by the chairperson, and smaller boards are hence preferred for good-quality relevant disclosure (Hermalin & Weisbach, 2003; Kaymak & Bektas, 2008). This is similar to the study conducted by Bachilier (2009), whereby there is a positive relationship between the board change and efficiency of privatised company. Three of the companies of the sample have reduced the number of their directors in the years analysed.

Alves (2011) extended previous research by examining empirically how board structure affects the magnitude of earnings management for companies listed in Portugal. The

literature provides evidence that boards of directors are an important part of the firm's structure. It is considered that, mainly, the board composition, the board size and the structure and composition of the board's monitoring committees are important characteristics that affect the effectiveness (Fama, 1980; Fama & Jensen, 1983; Jensen, 1993; Klein, 1998). The findings of this study made the following contributions. First, the results indicate that, on average, both board size and board composition have an impact on the levels of earnings management in the Portuguese listed firms.

This is similar to previous study conducted by Iwasaki (2007), whereby board of directors as an important instrument of efficient and good corporate governance practice. However, some others authors support that larger board size could increase firm efficiency (Abeysekara, 2010; Belkhir, 2009; Demirbas and Yukhanaev, 2011 and Yang *et al*., 2013). Comprehensive literature review conducted by Yang *et al.* (2013) by using a panel dataset for the period from 2004 to 2010, for Taiwan electronic firms found the relationship between efficiency performance and the separation of control and ownership. As expected, the other three variables are all negatively related to efficiency such as CEO duality (DUAL), board size (BSIZE), and pledge ratio (PLR) important for effective board monitoring performance except for board independence (IDSR).

Demirbas and Yukhanaev (2011) used a survey questionnaire to provide an empirical example from a transition economy to the corporate governance literature by exploring the attitudes of the 55 board directors from 30 listed companies on the Russian Trading System (RTS) Stock Exchange. They provide evidence that is in favor of employee

representatives on the board of directors and agree that board size and composition should be enhanced by employee representatives on the independent board of directors which has become an urgent issue for many companies in order to survive and develop (Khiari, *et al*. 2007; Yakovlev, 2004; Puffer & McCarthy, 2003).

While most of the previous studies have shown the positive relationship between board size and organisational efficiency, there are other studies that found non-significant results (Blasi & Schleifer, 1996; Dolgopyatova, 2003). They focus on the average number of board members in the Russian enterprises and conclude that the number usually stands at seven. They found that this number had not fluctuated significantly throughout the transition, but the number of board members had varied according to the size of the company as there were many companies with more than seven directors.

2.5.2.7 ROA and Technical Efficiency

In the literature of efficiency, there has been a plenty of research work conducted to study the relationship between profitability ratio and efficiency. ROA has a relationship with efficiency since more efficient organizations such as bank that are likely to indicate higher profit earnings (Mathuva, 2009; Mesa *et al*., 2014; Mester, 1993; Tripe, 1998). A low ROA of banks may either be due to conservative lending and investment policies or excessive operating expenses. In contrast, a high ROA may be the result of efficient

operations, a low ratio of time and savings deposits to total deposits, or of high yields earned on the assets.

In attempt to measure the performance of Indian banks in terms of efficiency, Sharma and Dalip (2014) found that ROA is having a weaker association with the change in the productivity and therefore, appears significant at 15 per cent level of significance, thus providing an agreement that increase in the amount of total assets partially affect the net profit of the banks and thereby, making influence on the productivity growth of the banks in India. This is in line with previous research by Mrad and Hallara (2012).

Sufian and Noor (2009) conducted a comparative analysis on the performance of the Islamic banking sector in 16 MENA (Middle East and North Africa) and Asian countries. Their evaluation on proposed framework showed that, the proxy measure for profitability measured by ROA, exhibits positive relationship with bank efficiency levels, indicating that the more efficient banks tend to be more profitable.

Pellegerina (2012) investigated the impact of ROA on Islamic and conventional bank efficiency and found interesting evidence that a positive association between dimension and profitability (ROA) holds for Islamic intermediaries, a result which seems in line, for example, with what Bashir (1999) found on Sudanese Islamic banks. Larger conventional banks seem to reflect a different situation since they appear more efficient and highly profitable (lower shares of liquidity and reserve provision, less non-performing loans, higher return on assets).

In addition, Moussawi and Obeid (2011) stated that a bank that tends to enhance its profitability selects the efficient factors of production in order to reduce its costs, as well as enhance its efficient production. Moussawi and Obeid (2011) findings are consistent with previous studies, such as (Ahmad and Abdul Rahman, 2012; Alsarhan, 2009; Joo *et al*., 2011; Pasiouras, 2008a; Sufian, 2007; Sufian and Noor, 2009; and Yildirim, 2002), who found that profitability significantly influences efficiency. On the other hand, it has been argued that profitability may affect efficiency negatively.

According to Moussawi and Obeid (2011), banks having reserve profit or market power could likely have lesser incentives as compared to others to improve production efficiency. It was further stated that in a case where the degree of competition is very high, well-established banks with respect to efficiency, can select or be forced to select a marketing policy which can prevent them from realising a high profitability level.

In their contribution to the same vein of research, Ismail *et al.* (2013) examined the efficiency of Islamic and conventional commercial banks in Malaysia by using Tobit regression analysis. In terms of profitability (ROA), the results found a negative relationship between profitability of Islamic and conventional commercial banks with efficiency (CE, TE, and PTE). The negative relationship might be due to the pattern of efficiency levels in Malaysia where some banks with high efficiency levels experience diminishing returns of scale (Ataullah & Le, 2006; Casu & Girardone, 2004; Mohd Zamil, 2007). Consequently, the increase in cost will lead to the lower profitability for

efficient banks. This is in line with the previous literature that has been done in India by Ataullah and Lee (2006) found that high profitability, which is measured by ROA is negatively related to bank efficiency due to NPLs for the period 1992-1998.

While most of the previous studies have shown the positive relationship between ROA and organisational efficiency, there are other studies that found non-significant results (Sufian & Habibullah, 2012). Sufian and Habibullah (2012) investigated the impact of economic globalisation on bank efficiency in a developing economy. By employing the Data Envelopment Analysis (DEA) method, they found that return on asset (ROA) bring no effect to the efficiency of the Indonesian banking sector during the post-Asian financial crisis period of 1999–2007.

2.5.3 Macroeconomic Factors and Technical Efficiency

2.5.3.1 Gross Domestic Product (GDP) and Technical Efficiency

Literature on gross domestic product (GDP) may significantly link to its efficiency. Several studies have focused on studying the effects of GDP as an external factor to efficiency. Previous research stated that in order to control for a country's macroeconomic environment, the two variables that have considered are GDP growth rate and the inflation rate (Hryckiewicz, 2014; Kasman & Yildirim, 2006; Lozano-Vivas & Pasiouras, 2010; Maudos *et al*., 2002; Pasiouras & Gaganis, 2013 and Shen, Jiao & Li,

2015). The negative coefficient for GDP growth shows that countries with higher recovery rates are more exposed to increased risk in financial sector. Thus, in order to overcome the issue, government intervention and regulation are needed (Bikker & Hu, 2002; Demirguc-Kunt & Huizinga, 1999; Hryckiewicz, 2014; Neely & Wheelock, 1997). Most of the literatures support the hypothesis that GDP can control and enhance the technical efficiency of firms (Boyed *et al*., 2001; Huang & Eling, 2013; Oliver, *et al*. 2013; Stankeviciene & Nikonorova, 2014). In other words, they find that the negative impact of GDP per capita on efficiency indicates that firm expanding activity may pressure less to control their inputs and therefore become less efficient.

Sufian and Habibullah (2012) use the log of gross domestic product (GDP) to control the cyclical output effects. The results regarding the impact of macroeconomic conditions on the efficiency of the Indonesian banking sector shows a positive sign (statistically significant at the 5% level or better), thus supporting the argument of the association between economic growth and the performance of the banking sector. Thus, the result about the impact of the GDP growth provides support for the argument of positive association between economic growth and financial sector performance.

Stankeviciene and Nikonorova (2014) extended the previous research by proposing a model of sustainable value measurement in commercial banks during financial crisis. To reach this goal, the sustainable value approach and the importance of corporate social responsibility in the commercial banking and the role of shareholder value in sustainable value were analysed to calculate the opportunity cost, it is needed to look at the resource

efficiency of the benchmark. These efficiencies show how much return the benchmark creates per unit of resource. The benchmark is served as Lithuanian economy, when the Gross Domestic Product acts as the return figure. In this case, the efficiency of the benchmark shows how much GDP of Lithuania creates per resource unit.

In addition, Hryckiewicz (2014) investigated the bank risk and macroeconomic factors in the banking sector. The negative coefficient for GDP growth shows that countries with higher recovery rates are more exposed to increased risk in the banking sector. Indirectly, the banks are not able to increase their activities to avoid the risk and overall reduce the efficiency.

Huang and Eling (2013) analysed the efficiency of non-life insurance companies in four of the fastest-growing markets in the world (BRIC) namely, Brazil, Russia, India and China. They found that the environment affects the efficiency of non-life insurers operating in the BRIC countries. The macroeconomic variables DGDP, CPI, and DIR all have a positive influence on the input slacks and thus can thus classify as adverse environmental factors with respect to efficiency.

Chen (2012) denoted the situation of the external overall economic prosperity and fluctuation. It suggests that, other things being equal, the coefficient of income growth shows that an economic boom would be conducive to banks' outputs. However, this estimatation is significant for the private banking group, but not for the public banking group. It should reflect relatively stable business operation for the public banks and the

inefficiency score is not as sensitive to the variation in the external environment as that of the private banks.

On the other hand, GDP tends to bring negative impact on efficiency (Pastor, 2002). Kouki and Nasser (2014) examined how bank efficiency and stability are affected by the market power in Africa. Results show that higher degree of market power is associated with higher level of efficiency and profitability. The banks with more market power operating are able to be in command of the price and hence improve their profit. The findings are opposite from the theory, whereby there is negative impact of GDP per capita on banks efficiency. This is similar to previous literature conducted by of Maudos *et al*. (2002).

While most of the previous studies have shown the positive relationship between GDP and organisational efficiency, there are other studies that found non-significant results (Oliver, 2013). The empirical review by Oliver *et al.* (2013) examined the productivity growth in Spanish banks in the pre-crisis period by separating out the contributions to productivity growth from business practices and from industry wide technological progress shows the GDP growth rate has no direct effect on the productivity of banks, when the rest of variables are controlled.

2.5.3.2 Infrastructure and Technical Efficiency

There is a great deal of empirical research that explored the relationship between infrastructure and efficiency. The importance of infrastructure in the context of growth has been felt intensely by the researchers and policy makers. Empirical findings on these issues are, however, inconsistent and often contrary to each other.

Over the last two decades, a large number of studies have focused on this subject. Infrastructure has direct implications on on productivity and efficiency in manufacturing sector (Barro, 1997; Lucas, 1988; Romer, 1986). High quality infrastructure is a must for rapid economic development and requires sustained investment. It includes highways, railways, ports, bridges, hospitals, power plants, tunnels, and municipal facilities like sanitation, waste management, water supply, and other facilities serving public needs. Developing countries face shortage of government or public funds and are generally inadequate in addressing the infrastructural needs of the country (Sambrani, 2014).

In case of India, infrastructure inadequacies have been recognised as a major constraining factor for the productivity of firms (Mitra *et al*., 2014 and Pinto *et al*., 2006). Furthermore, previous work by (Hulten *et al*., 2006; Mitra *et al*., 2011, 2002; Sehgal & Sharma, 2010) estimated moderate to large impact of physical infrastructure on manufacturing firms' performance. Previously, Mitra *et al*. (2014) examined the effect of several factors--imports (total, intermediate, and capital inputs) and exports as an

outcome of trade liberalisation, in-house R&D, technology transfer, and physical infrastructure on the productivity and efficiency of Indian industry.

In term of infrastructure, the analysis considered physical infrastructure for the period of 1994-2008. It covers transportation (road, rail, and air). The result show that infrastructure and ICT have positive impact on industry's productivity and efficiency. In the end of their study, their findings suggest that infrastructure is an important factor of productivity, with an elasticity of 0.109 at the conventional significance level. Thus, infrastructure enhances productive performance by helping firms to be more efficient rather than by attaining technical progress.

Infrastructure is often modeled as public capital, distinct from other types of physical included in the production function. Infrastructure plays a role as an input in the production function. Hence, investment in infrastructure will increase growth in the transition and lead to higher steady state income per worker (Aterido *et al*., 2011; Bah & Fang, 2015; Straub, 2011).

Consistent with previous study, Bah and Fang (2015) developed a general equilibrium model to assess the quantitative effects of the business environment, including regulations, crime, corruption, infrastructure and access to finance, on output and total factor productivity (TFP) in Sub-Saharan Africa. Infrastructure services defined as transport, energy, water and sanitation that are consumed by households and used by firms in their production processes and delivery of goods and services. They found that,

poor infrastructure increases transaction costs and makes African firms less competitive than their international counterparts.

Moreover, the percentage of sales lost due to power outages and the percentage of shipments lost during transit are used to measure the deficiency of infrastructure. Poor infrastructure is also very costly for business operations. Businesses lose large shares of their sales due to government regulations, poor infrastructure, corruption and crime. The implications of these losses are lower aggregate output and lower TFP. This is similar to previous study by (Eifert *et al*., 2005).

On the other hand, Cull, Sun and Xu (2014) study provided evidence that, at first, the level of infrastructure in the region where a firm operates may determine its investment intensity, access to finance and cash flows, for instance, good infrastructure boosts the extent of the market and can lower input costs, which therefore encourages investment. They stated that higher returns associated with better infrastructure, banks and suppliers could be more willing to supply credit to firms operating in regions with better infrastructure. However, the result obtained is unlikely to be attributable to regional variations in the underlying quality of infrastructure.

Sun, Harimaya and Yamori (2013) investigated the effect of strategic investors on bank efficiency in the context of regional economic development. The data on Chinese city commercial banks operating regionally are well-suited for the study. City commercial banks are mandated to continuously extend loans to city infrastructure investments,

regional firms, regional infrastructures, and regional real estates to successfully spur regional economic growth and development without strictly assessing credit risk.

The findings suggested that strategic investors significantly increase efficiency in Chinese city commercial banks, while the effect of strategic investors on the efficiency of Chinese city commercial banks is negatively correlated to the level of regional economic development. They proved that negative correlation of the effect of strategic investors on Chinese city commercial banks' efficiency with regional economic development may be explained by the mix of local official promotion system and city commercial banks' governance structure.

2.5.3.3 Inflation and Technical Efficiency

In the literature on efficiency, there are plenty of research work that has been conducted between the macroeconomic factors and efficiency. Therefore, a great deal of empirical research explores the relationship between inflation and efficiency (Hryckiewicz , 2014). Pasiouras and Gaganis (2013) pointed out that regarding the relation between inflation and efficiency, the majority of research confirms that the control of macroeconomic factors will eventually affect all organization efficiency. In addition, Studies showed that inflation is positively associated with firm efficiency (Kasman and Yildirim, 2006; Lozano-Vivas and Pasiouras, 2010; Maudos *et al*., 2002).

Abid, Ouertani & Ghorbel (2014) investigated the households' NPLs in the Tunisian banking system by using macroeconomic variables (GDP, inflation, interest rates). The result provided supplementary information about the impact of macroeconomic conditions on household such as unemployment and interest rates. They found that GDP growth, the inflation rate and the real lending rate as the crucial macroeconomic determinants of households' NPL in Tunisian banking system. This is similar to previous studies conducted by Baumeister & Benati (2010) and Girardin & Moussa (2011).

There are some authors who conducted a comprehensive literature review about the previous research. In their study about bank performance, Sufian and Habibullah (2012) account for macroeconomic risks by controlling the rate of inflation (INFL). The extent to which inflation affects bank performance depends on whether future movements in inflation are fully anticipated, which in turn depends on the ability of banks to accurately forecast its future movements.

An inflation rate that is fully anticipated raises profits as banks can appropriately adjust interest rates in order to increase revenues, while an unanticipated change could raise costs due to imperfect interest rate adjustment (Perry, 1992). Likewise, the impact of inflation rate is also positive, but only when there is control of actual flows, personal contacts, and political globalization. This is similar to previous study by Demirguc Kunt and Huizinga (1999) that found a positive relationship between inflation and bank performance.

2.5.3.4 Real Interest Rate and Technical Efficiency

There is a great deal of empirical research explores the relationship between interest rate and efficiency. Market risk is the risk that the value of an investment will decrease due to moves in market factors including equity risk, interest rate risk, and currency risk. Thus, the non-performing ratio is no longer the only index to evaluate the risks of banks. Interest rate risk is the hazard of banks refinancing their long-term loans at interest rates above the rates they receive (Sun and Chang, 2011).

This is because most of the outputs of the commercial banks such as loans and deposits are closely related to the level of interest rate in the economy. Therefore, any changes in monetary policy are believed to bring direct and indirect impacts on the output of commercial banks and thus, affect the efficiency of banks. As highlighted by Guevara and Maudos (2002), Vander Vennet (2002), Bos and Kool (2006), a country's characteristics are important in influencing bank efficiency level. Same goes to other firms, increased cost, traced largely to poor performing infrastructural facilities,high interest and exchange rates, has resulted into increased unit price of manufactures, low effective demand for goods, liquidity squeeze and fallen capacity utilization rates.

Inflation can be described as persistent increase in the general price level constitutes to saving for future use and thereby retards investments and growth (Okeye & Eze, 2013). High interest rates and the reluctance on the part of financial institutions to comply with

laid down lending guidelines tend to frustrate corporate investment and fail to ensure protection and growth of local industries.

Moreover, Chiu and Chen (2009) consider not only credit risk, but also market and operational risk factors such as the foreign exchange rate, the interest rate, and the economic growth rate to analyse Taiwanese bank efficiency. Moreover, they showed the variability of the inefficiency effect grows if the interest rate volatility becomes more violent. The word extended by Sun and Chang (2011), found that interest rate volatility does not show a significant effect on the inefficiency effect. Higher interest rate volatility for banks in China, South Korea, the Philippines, and Taiwan will benefit their cost efficiency, whereas there is an opposite conclusion if the banks operate in India. Thus, there were only two variables that show the impact of stock return volatility and interest rate volatility on bank efficiency.

Abid *et al*. (2014) used the real lending rate as the crucial macroeconomic determinants of households' NPL. Consequently, the result shows that households' NPLs are sensitive to changes in RLR. It is worth signaling that most household credit types are loans with floating rates. Similarly, previously empirical evidence indicates that NIMs decline (rise) as operational costs decrease (increase) (Entrop *et al*., 2012; Maudos & Solis, 2009; Clayes; Vander Vennet, 2008; Carbo & Fernandez, 2007).

In addition, Siddiqui (2012) found that administrative costs, non-performing loans ratio and return on assets significantly influence interest spreads in Pakistan. Interest rate

spreads are hypothesized to be a function of bank-specific and industry-specific variables, as well macroeconomic factors, in line with similar studies in the literature (see Chirwa & Mlachila, 2004; Entrop *et al*., 2012; Bennaceur & Goaied, 2008; Siddiqui, 2012; Demirguc-Kunt & Huizinga, 1998).

The results are consistent with those found by other studies such as Ngugi (2001) and Beck *et al*. (2010) based on Kenya. Chirwa and Mlachila (2004) and Siddiqui (2012) also found a positive impact of non-performing loans ratio on interest spreads of commercial banks for Malawi and Pakistan, respectively.

Moreover, Sufian and Habibullah (2012), who conducted a study on bank performance stated that macroeconomic variable such as interest rate is very important to determine the profitability of banks. An interest rate adjustment in order to increase revenues could raise costs. At the same time, they found that banks with extensive branch networks may attract more loan transactions and in the process command larger interest rate spreads and subsequently higher profitability levels.

Were and Wambua (2014) empirically investigated the determinants of interest rate spread in Kenya's banking sector based on panel data analysis. The findings show that higher bank liquidity ratio has a negative effect on the spreads. In general, the research findings show the relatively high correlation between bank size and interest rate spread are linked to the structure of the banking sector, in which the market is dominated with a few big banks.

On the other hand, study by Entrop *et al*. (2012) examines the interest income and expense margins separately. However, the degree to which new business interest rates, the loan rates that are charged to certain customer and product groups, or even individual loan products are affected by operational efficiency which remains unclear in the NIM studies.

2.5.3.5 Exchange Rate and Technical Efficiency

Literature on macroeconomic factors may significantly link to its efficiency. Several studies have focused on studying the effects of exchange rate as external factors to efficiency. Exchange rate in economy shows dependence of sector productivity on the strength of terms of trade effects (Sheng & Xu, 2011).

A paper by Helpman and Itskhoki (2010) extends Melitz's (2003) modelled by introducing search unemployment in one sector to examine the interaction of labour market efficiency and trade impediments in shaping the relationship between productivity and price levels across countries show that the country with more flexible labour markets has both higher productivity and a lower price level, which operates against the standard Balassa–Samuelson effect. However, Sheng and Xu (2011) found that is not clear how these differences in labor market efficiency affect the relationship between the real exchange rate and productivity.

Li *et al*. (2015) analysed the impact of exchange rate movements on cross-border trade is of particular interests to both researchers and policymakers, especially in the era of global imbalance. Most studies use aggregate data, which cannot separate the response of export price from that of volume. Moreover, there is substantial heterogeneity across firms (Melitz, 2003). Thus, the result shows that exporters with higher productivity have smaller pass through.

Cheung and Sengupta (2013) explored the real effective exchange rate (REER) effects on the share of exports of Indian non-financial sector firms for the period 2000–2010. The empirical analysis reveals that, on average, there has been a strong and significant negative impact from currency appreciation and currency volatility on Indian firms' export shares. This is similar to previous studies by Virmani (1991), Joshi and Little (1994), Srinivasan (1998), Srinivasan and Wallack (2003) and Veeramani (2007, 2008) that used aggregate data to demonstrate the negative REER appreciation effect on India's aggregate merchandise exports.

On the other hand Hallak (2013) empirically examined the effect of this phenomenon on bank loan prices. He found that the private sector share of external debt negatively and significantly impacts the price of bank loans. This result supports the hypothesis that private sector debt contributes to international financial stability to a greater degree than sovereign debt. Nevertheless, this impact cannot be identified in the presence of fixed exchange regimes that are unsuitable with respect to fundamentals.

2.5.3.6 Unemployment and Technical Efficiency

Over the past decades, unemployment in Malaysia shows fluctuations from early 1980's to 2010. Recent economic development in 2010, Malaysia had set a target to achieve a high income nation through inclusivity and sustainability by year 2020. This programme was translated from Economic Transformation Programme (ETP) in which a high income nation can be achieved via three vital principles. The principles are high income nation, inclusiveness and sustainability.

Unfortunately, unemployment is a crucial scenario faced by developing country especially with saturation of population due to lack of vacancies offered, huge influx of foreign worker, mismatch skills and the job selection, spatial job location offered, higher demand on semi-skilled workers and others. Thus, it will result in wastages of human labour towards nation especially in local labour. Unemployment is a stress condition that gives crucial impact to the society and national development.

Previous study by Durjadin and Goffette-Nagot (2007) stated unemployment may reduce one's self-esteem by affecting the individual performance in terms of social, physical and economical. The effects of unemployment rely on certain factors which are social problems and supported by Firmansyah *et al*. (2012). Therefore, labour force increased

government tax and higher spending on welfare of unemployed people are impacts of unemployment (Osman *et al*., 2015).

There are some authors who conducted a comprehensive literature review about the previous research. The analysis of the relation between technical change, employment and labour process is not always clear in the conventional economic theory. In the neoclassical economic analysis, technology is exogenously given and, in the long run, the labour market reaches its equilibrium, whereas in the Keynesian tradition, unemployment due to technical change can only be temporary.

Most of the recent literature show relationship between unemployment and bank risk (Bofondi & Ropele, 2011; Castro, 2013 and Louzis *et al*., 2012). Study conducted by Bofondi and Ropele (2011), for example, state that increasing unemployment had a significantly adverse effect on loan portfolio quality over a sample of Italian banks during the period 1990-2010. Similarly, Louzis *et al*. (2012) found that unemployment has a direct and significant impact on all NPL categories (business loans, consumer loans and mortgages), mortgages being the least sensitive NPL type. This is similar to past studies conducted by Demirguc-Kunt & Huizinga (2000) and Bikker & Hu (2002) that identified possible cyclical movements in bank profitability. Their findings suggest that such correlation exists, although the variables used were not direct measures of the business cycle.

In addition, Pavlidou *et al*. (2011) examined the unemployment effects in G-7 countries and found that unemployment is present and deepening in the last two decades, whereas any employment growth observed is mainly associated with part-time, temporary, low-paid and vulnerable jobs. Moreover, any rise in unemployment rates refers rather exclusively to unskilful labour.

On the other hand, previous studies also have found that business cycle can directly affect unemployment (Keuschnigg & Ribi, 2013). Feldmann (2015) studied the effect of banking system concentration on unemployment in developing countries over the period 1987 to 2007. He found that many developing countries are characterised by high levels of both banking system concentration and unemployment. However, he also mentioned that generous unemployment benefits raise unemployment by reducing the job-search intensity of the unemployed and their willingness to accept job offers.

By lowering the economic cost of unemployment, they may also put upward pressure on workers' wage claims, further raising unemployment. The effect of stricter employment protection legislation is ambiguous from a theoretical point of view because it leads firms to reduce both hiring and dismissal rates (Bertola, 1990). Hence, this showed that unemployment can affect the business cycle.

2.5.3.7 Trade Openness and Technical Efficiency

Literature on trade openness may significantly link to its efficiency. Several studies have focused on studying the effects of trade openness as an external factor to efficiency. Previous research adopting the stochastic frontier framework primarily focuses on the role of trade or FDI itself as a determinant of technical efficiency (Kneller & Stevens, 2006; Mastromarco, 2008; Nourzad, 2008; Wang & Wong, 2012; Wijeweera, Villano, & Dollery, 2010).

Few have focused on the role of trade and FDI as conduits for international R&D transfer with exceptions of Henry, Kneller & Milner (2009) and Mastromarco & Ghosh (2009). Henry *et al.* (2009) examined the imports as a channel of transferring international R&D into 57 less developed countries (LDCs) over the time period of 1970-1998. The authors found that trade is an important channel for international technology diffusion, which increases the individual country's ability to move toward its production frontier.

Most of the literatures support the hypothesis that trade can control and enhance the technical efficiency of firms (Halpern & Murakozy, 2012; Kasahara & Lapham, 2013; Mitra *et al*., 2014; Sharma & Mishra, 2015; Sufian & Habibullah, 2012 and Wang & Wong, 2012). Hagemejer and Kolasa (2011) study the efficiency between international and non- international firms. Their findings are perfectly consistent with most recent theoretical advances in the international trade theory, whereby firms internationalised

was not only more productive as compared to their non-internationalised counterparts, but also the overall pace of growth of productivity among the former was faster than elsewhere.

Sufian and Habibullah (2012) examined the efficiency of Indonesian banking sector. They identify that trade can be linked within the context of the ASEAN economies; the examples could be free trade zones areas such as the ASEAN Free Trade Area (AFTA), ASEAN-Japan Comprehensive Economic Partnership (AJCEP), ASEAN-Australia-New Zealand Free Trade Area (AANZFTA), ASEAN-China Free Trade Area (ACFTA), ASEAN-India Free Trade Area (AIFTA), ASEAN-Korea Free Trade Area (AKFTA), etc. Their findings conclude that greater trade and capital account restrictions inhibit the efficiency of banks operating in the Indonesian banking sector (Dreher, 2006; Sufian, 2009).

This is similar to study by Wang and Wong (2012) that suggests to promote trade and capital flows and increase the access to foreign R&D can be extremely important to the improvement in efficiency for LDCs. Moreover, they conclude that efficiency also depends on other factors such as infrastructure and political stability. Improvements in infrastructure and political stability as well as increases in urbanization all help improve technical efficiency in a country.

Previously, Kung and Wong (2009) studied moving average and trading breakout rules for Taiwanese stock market and suggest that these two rules have substantial predictive

power for 1983-1990 period, lesser for the 1991-1997 period, and no power for the 1998-2005 period. Hence, they concluded that Taiwan stock market is more efficient in recent years. Their result is based on study conducted by Lai *et al.* (2010) that analyse technical analysis with psychological biases for Taiwan stock market and proved the influence of trade signals.

On the other hand, Sharma and Mishra (2015) explored the linkage between trade participation and productivity performance for a sample of Indian manufacturing firms over the period 1994–2006. Overall their results are somewhat mixed and indicate for a weak inter-link between trade and productivity, but the result appear to be more favorable for the export channel of trade as it clearly indicates that exporting leads to productivity improvement over time.

There are also some statistical evidences to conclude that more productive firms self-select themselves in the exporting as well as importing market. The learning effects of importing on productivity growth turn out to be more favourable for labour productivity than TFP. Finally, the results clearly highlight the positive effect of Research and Development (R & D) efforts of firms on labour productivity in Indian manufacturing.
Similar to study conducted by Aristei, Castellani, and Franco (2013) in Eastern European and Central Asian countries for the period of 2002–2008. They examined trade linkages and firm heterogeneity and found that firms exporting did not increase the probability of importing, while the latter had a positive effect on foreign sales. The effect is mainly channeled through an increase in firm productivity and product innovation.

In addition, Mitra *et al*. (2014) conducted a study in India from the period of 1994–2008 and provided evidence on the needs of trade, R&D, technology transfer, and infrastructure endowment on productivity and efficiency. The results are echoed in Mastromarco and Ghosh (2009) study on 57 LDCs whereby, FDI, imports, and foreign R&D transferred through imports have positive effect on a domestic country's technical efficiency.

On the other hand, Sachs and Warner (1999) pointed out that trade liberalisation have long terms negative impact on a country's development if it leads to specialization in extractive sectors (Rodriguez & Rodrik, 1999). This is supported by Wang and Wong (2012), where they stated that improvements in infrastructure and political stability can affect technical efficiency in a country.

2.5.4 Interaction Terms and Efficiency

Sufian, F., Kamarudin, F. and Noor, N. (2012) examined the revenue efficiency and impact of internal and external factors on Malaysian domestic Islamic banking sector efficiency from the period 2006 to 2010. Their sample consists of 17, domestic and foreign banks. They employed Data Envelopment Analysis (DEA) method to calculate the revenue efficiency score. They found that the domestic Islamic banks have lower revenue efficiency values compared to foreign banks. Moreover, they proved that

capitalisation, market power and liquidity have positive and significant relationships with revenue efficiency. As the interesting part, to further investigate the impact of bank specific and macroeconomic factors on revenue efficiency of Islamic banks, they included some interaction variables, such as LNTA* DOM_IB, LLRGL* DOM_IB, ETA* DOM_IB, BDTD* DOM_IB, LOANSTA* DOM_IB, NIETA* DOM_IB, LNGDP* DOM_IB and INFL* DOM_IB. They concluded that ETA* DOM_IB variable have positive sign and statistically significant which shows that better capitalized domestic Islamic banks able to increase the level of revenue efficiency. On the other hand, (BDTD* DOM_IB) and (LOANSTA* DOM_IB) have negative impact on the revenue efficiency of the domestic Islamic banks.

Deraniyagala, S. (2001) analysed the impacts of technology accumulation on firm-level technical efficiency in the Sri Lankan clothing and agricultural machinery industries, using cross-section survey data and Stochastic Frontier Model. Econometric analysis of the economy impacts of technology development in developing countries is limited and this paper looks to fulfil this gap. The result shows simple adaptive technical change has a significant and positive effect on efficiency in both industries. Furthermore, variables relating to technological skills and training also emerge as significant determinants of firm-level efficiency. Another interesting part is that, this paper has investigated whether size of industries influenced technical efficiency jointly with the other independent variables by carrying out the interaction terms estimation. However, they come out with the conclusion that none of the interaction variables were significant, which indicating that such joint effects were not important in these industries.

Scotti *et al*. (2012) investigated the intensity of competition on airports' efficiency in Italy during the period of 2005 to 2008 by employing stochastic distance function model. They found that the intensity of competition has a negative impact on airports' efficiency. They concluded that, public airports are more efficient than private and mixed ones. This due to the public airports initiative to accept the positive externalities created by air transportation in the local economy and tends to subsidise airlines especially in local systems where the competition is high. Furthermore, they found that many interaction effects are statistically significant because of confirmation of the multi–output features of airport activity.

Findik, D. and Tansel, A. (2015) examined the intangible investment effects on firm efficiency in manufacturing firms in Turkey for the period 2003-2007 using stochastic production frontier approach. The results indicated that the effects of software investment on firm efficiency is larger in high technology firms which refer to chemicals, electricity, and machinery as compared to that of the low technology firms which consist of textiles, food, paper, and unclassified manufacturing. In terms of interaction terms, the result shows that the interaction with labour is negative and insignificant whereas interaction with raw material is negative and significant. Therefore, they concluded that increase in raw material will decrease the capital stock on output. On the other hand, the interaction effect with electricity and fuel is positive which brings complementary effects for both high and low technology firms.

Mok, V. and Yeung, G. (2005) investigated the determinants of technical efficiency in foreign-financed manufacturing firms in southern China by using a stochastic frontier model. They found a strong relationship between efficiency and employee motivation. Moreover, they provided empirical evidence that firms with a relatively high expatriate ratio performed less efficiently compared to others. Furthermore, in investigating the industry-specific variable, they used industry interaction terms. These terms were obtained by multiplying industry dummy variables respectively with the logarithm of capital, labour and raw material variables. Finally, the study indicates that the joint effects of the industry interaction terms are not significant.

2.6 Research Gap

GLCs' performance remains pivotal in spearheading the Malaysian economy. However, research conducted is limited and more research is needed to further understand the structure and critical elements that are contingent on the changes in the global business environment. Despite the devastating impact of the financial crises, rising prices of raw materials, open market liberation, etc., not many scholars have tackled the issue exhaustively from various economic and management perspectives.

Most of the previous studies have emphasised the performance and efficiency in general and none has been concerned with the internal and external factors simultaneously. Extant literature has focused more on the impact of government-controlled companies on

firm performance (Ang & Ding, 2006); value (Lau & Tong, 2008); earnings management (Yen, Chun, Abidin & Noordin, 2007); and level of earnings conservatism in these companies (Ismail, Kamarudina & Othman, 2012), but none has analysed the vital impact of macroeconomic and internal factors on GLCs' efficiency exclusively. Therefore, a vacuum exists in the specific impact of different factors on the GLCs, its performance and its relationship to the nation's economic well-being.

This study utilises seven major factors as internal and macroeconomic indicators, which in turn, play a major role in a firm's performance and economic growth. The internal factors are: rate of revenue, financial capital, government ownership, return on assets, firm size, firm age and board structure. The macroeconomic factors are: GDP, infrastructure, inflation, real interest rate, real exchange rate, unemployment and trade openness.

The impact of GLCs' performance is more critical in a country like Malaysia, which has a smaller internal market to support goods and services, and hence tends to rely heavily on external trade. In such a situation, the country is vulnerable to any global and/or external threats. Similarly, Malaysia's dependency on industrialised economy means that any decline in the performance of the GLCs will most certainly hamper the GDP of the country.

This study thus, fulfills the research gap in GLCs by examining the relationship between internal and macroeconomic factors on efficiency. The major contribution of this study is

to analyse the impact of internal and macroeconomic factors on GLCs' efficiency. Another major contribution of this research is the use of interaction terms in controlling the macroeconomic variables and the overall efficiency of GLCs. Most of the past studies have used few internal or macroeconomic factors to analyse the technical efficiency. But in literature, there is more than one indicator that is available to analyse the overall efficiency of any firm.

In terms of methodological contribution, this study employs the FMOLS to look into the impact of the internal and macroeconomic factors on GLCs' efficiency. Previous studies have focused more on Tobit's analysis and simple OLS regression to find the relationship. The purpose of using this method is to get the effects of each independent variable individually in a panel set to obtain a better and credible result. This study provides policy recommendations to policy-makers and shareholders.

2.7 Conclusion

This chapter reviewed the literature to study the variables. Gaps within the literature and variables have also been identified. The underlying theories that explained the variables in this study have properly discussed. It highlights the previous studies that investigated the performance of GLCs and relationships between maroeconomic factors, internal factors and interaction variable on efficiency of GLCs.

Based on the comprehensive literature review, many conclusions can be summarised as follows:

First, this chapter discusses the development of the theoretical framework. In other words, the relationships between the variables under investigation have been gathered and combined to emerge the new and unique framework of this study. The underpinning theories, that have been used to explain the theoretical framework, explained and discussed. Three underpinning theories have been used to explain the theoretical framework of this study are Economic Theory, Resource Based View (RBV) and Arbitrage Pricing Theory (APT) and Agency Theory.

Second, there is a bulk research that has been conducted by many researchers regarding the effect of macroeconomic factors on efficiency. However, many studies reported a positive and significant relationship between macroeconomic factors and efficiency; other studies reported adverse results that there is no significant effect and sometimes macroeconomic factors can affect the efficiency negatively. Due to this inconclusive findings in the previous literature, this study is an attempt to investigate why and how their relationship happens and what other factors may be explained in a better way in different context.

Third, there are also many studies which examined the effect of organisation specific factors or known as internal variables on organisational efficiency. Some of these studies found a positive and significant impact of internal factors on GLCs efficiency, however,

others found adverse results that internal factors can affect the performance negatively and sometimes it is the main reason for collapsing due to some critical factors.

Finally, as the situation of macroeconomic factors and internal factors, ownership were found to have inconclusive results when examined with organisational efficiency. Some researchers argued that there is a need for interaction variable that can play a mechanism role between ownership of government in those GLCs and efficiency through macroeconomic factors. In addition, these researchers argued that investigating the direct effect of ownership on GLCs under internal variables on efficiency is not enough, therefore examining the indirect effect can bring more concluding results.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter contains the research methodology used in this study. It provides details of the research approach and methods used for data collection as well as the data analysis. The section that follows is devoted to explaining the research approach, efficiency measurement and procedure using Stochastic Frontier Analysis (SFA) and panel data analyses to test the objectives.

3.2 Theoritical Framework

3.2.1 Cobb Douglas Production Function

Cobb Douglas Production Function is a functional form of production function and is used to represent the physical relationship between inputs and outputs, particularly the amount that can be produced by those inputs. The Cobb Douglas form was developed by Charles Cobb and Paul Douglas in 1927. The function as follows:

$$P\ (L, K) = bL^{\alpha}K^{\beta} \qquad (3.1)$$

Where:

P= total production (value of goods produced in a year)

L= labour input (total number of persons worked in a year)

K= capital input (monetary worth of all machinery, equipment and buldings)

b= total factor productivity

α and β are the output elasticities of labour and capital, respectively.

Further, if:

$$\alpha + \beta = 1$$

The production shows constant returns to scale (CRS). Returns to scale shows the changes in output subsequent to a proportional change in all inputs. If output increases by the same proportional change, then there are (CRS and if there is more or decreasing change, it shows increasing returns to scale (IRS) and decreasing returns to scale (DRS).

The Cobb Douglas production function assumes that if labour or capital vanishes, then so will production; the marginal produvctivity of labour is proportional to the amount of production per unit labour and marginal produvctivity of capital is proportional to the amount of production per unit capital.

3.2.2 Approaches to Efficiency Measurement

Efficiency consists of two components: technical efficiency (TE) and allocative efficiency (Misra & Kant, 2004; Murillo-Zamorano & Vega-Cervera, 2001). Two main approaches are used to measure efficiency, namely input-oriented and output-oriented, which is based on whether the measure adopts an input conserving or output expanding strategy (Coelli, 1995; Coelli *et al*., 2005; Murillo-Zamorano, 2004).

3.2.3 Input-Output Oriented Approach

The input-oriented technical efficiency (TE) approach is concerned with how much contraction in inputs is possible in order to produce a given level of output. Mathematically, TE is the ratio of the minimum feasible inputs to actual inputs required to produce the actual level of outputs (Battese, 1992). Allocative efficiency (AE) measures the ability of a firm to use inputs in optimal proportions, given their respective price and production technology. It is concerned with choosing between different technically efficient combinations of inputs that are used to produce maximum feasible outputs (Siry & Newman, 2001).

TE and AE combined is economic efficiency (Coelli *et al*., 2005), and is defined as the ability of a producer to produce a given quantity of output at minimum cost for a given level of technology (Worthington & Dollery, 2000). Economic efficiency is also known

as cost efficiency in the input-oriented case. Thus, when a producer efficiently uses its resources allocatively and technically, then the producer is said to be economically efficient or cost efficient.

The output-oriented approach to efficiency measurement is concerned with expanding the outputs, for a given level of inputs and production technology. Economic efficiency (also called revenue efficiency) is measured in terms of deviation from the isorevenue line which is obtained by multiplying technical and allocative efficiency. Hence, economic efficiency = TE x allocative efficiency.

3.2.4 Selecting Efficiency Approaches

There is no clear theoretical distinction between the two efficiency measures. However, selection of a particular efficiency estimation approach depends on the nature of inputs and outputs. Output-oriented measures of efficiency are appropriate if the producer has limited control over inputs. On the other hand, input-oriented measure of efficiency is appropriate when the producer has limited control over output usage (Coelli *et al*., 2005). Coelli & Perelman (1999) and Puig-Junoy (2000) argued that the input-oriented approach of efficiency is not suitable if input prices are not mentioned.

They also argued that the output-oriented approach may not be appropriate if the aggregating weights are either unavailable or inappropriate. Aggregating weights are

used to change multiple outputs into a single output. For example, price can be used as a weight to aggregate outputs. Although the existing nature of inputs and outputs determines the choice between the two efficiency measures, an empirical study of European railways carried out by Coelli and Perelman (2000) has reported that there are no effects on the efficiency due to the different approaches.

The correlation coefficient between efficiency estimated using the two approaches is positive and significant. Tzouvelekas *et al*. (2001), in their study of TE of organic and non-organic olive farming in Greek agriculture, found clear differences between the efficiencies estimated, where the producers were operating under variable returns to scale. However, similar efficiencies were observed where the producers were operating under CRS. Thus, returns to scale of a producer makes the difference in the efficiency result.

3.2.5 Specification of Inputs and Outputs

In order to analyse the efficiency score of GLCs, the determination of inputs and outputs is needed. While there have been increasing attempts to study the efficiency of the GLCs, researchers have not reached a consensus as to what are the best inputs and outputs. Several pioneering studies have attempted to define the concepts (Cui & Li, 2015; Hung *et al*., 2014; Mohamad & Said, 2012; Sufian, 2009). Two main approaches are notable for providing the definition of both inputs and outputs. They are the production and the

intermediation approach and both make use of the traditional microeconomic theory of the firm with each providing distinct characteristics of firm activities. This study is based on the production approach.

The production approach defines a firm as a producer of goods and services. Based on this approach, the best way of measuring output is by the production of goods and services and by the transaction type over a particular given period of time. However, such explicit production and transaction flow data, although distinctively appropriate, are generally unavailable. Therefore, sometimes, other data are employed instead, such as net profit, sales or loan accounts. The inputs used are the physical inputs, like labour and capital, for which their costs must be added because the only requirement for the performance of production and transactions are the physical inputs. More detailed explanation on inputs and outputs used by previous researchers are provided in (Appendix C).

3.3 Nonparametric and Parametric Method

3.3.1 Nonparametric Method

The nonparametric approach uses the set of observations of outputs and inputs to construct an isoquant line to determine the efficiency of firms. Farrell (1957) made two assumptions: the first assumption is to ensure that if two points are attainable, then any point representing a weighted average of them is also attainable in isoquant diagram; and the second assumption is no observed point lies between the isoquant frontier and the

origin. Charnes, Cooper and Rhodes (1978) generalised the concept of two inputs and one output into the multiple outputs and inputs case and developed the Data Envelopment Analysia (DEA) based on Farrell's (1957) input-output oriented model. DEA involves the use of linear programming to calculate the production frontier (Thiam, Ureta & Rivas, 2001).

3.3.2 Parametric Method

The concept of the parametric method of efficiency estimation was developed by Aigner & Chu (1968). Parametric models can be divided into deterministic and stochastic models. This study is based on the stochastic frontier model.

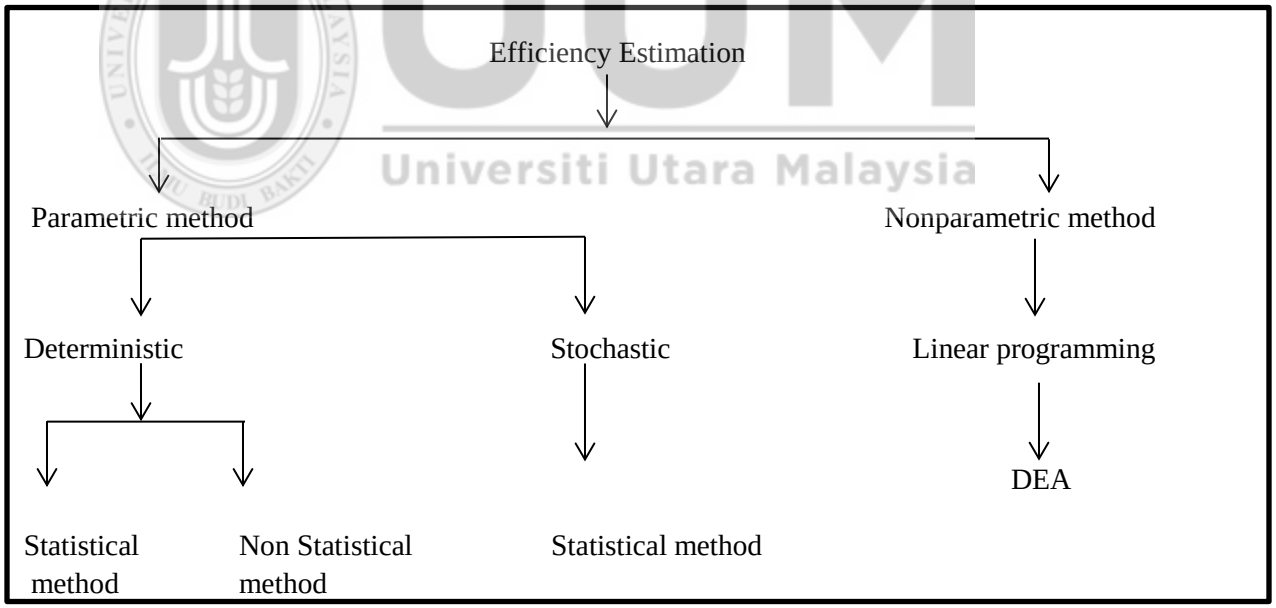

Figure 3.1
Estimation methods for production frontier and TE

3.3.2.1 Stochastic Frontier Model

Aigner *et al*. (1977) and Meeusen & Broeck (1977) developed the stochastic frontier model (SFM) that assumes that the output of a firm is a function of a set of inputs, inefficiency and random error. In the SFM, inefficiency is identified with a disturbance terms in the functional equation (Greene, 1993a). A general stochastic production function with a single output is given by:

$$Y_i = f(x_i;\beta).\exp\ (\varepsilon_i), \qquad (3.2)$$

$$\varepsilon_i = \ v_i - \mu_i$$

Where *Yi* denotes output, x_i denotes a set of inputs, β is a set of parameters to be estimated and *i* denotes producers. ε_i is a composed error term consisting of two elements, v_i and μ_i , where v_i represents random error (also called statistical noise) and μ_i is a non-negative random variable, which accounts for technical inefficiency.

The Stochastic Frontier Model (SFM) is illustrated in Figure 3.2 below. Two producers (*i* and *j*) are considered for illustration. Producer *i* uses inputs x_i and produces output Y_i. If production had been under favourable conditions for which the random error v_i is positive, and had been utilizing the inputs in an efficient way (μ_i = 0), production would have been $Y_i = f(x_i;\beta).\exp\ (v_i)$ which lies above the deterministic frontier $f(x_i;\beta)$. However, producer *i* is not utilizing inputs efficiently; hence, production is Y_i which is below the deterministic frontier. On the other hand, producer *j* is producing output Y_j

using inputs x_j, which are less than the value on the deterministic frontier $f(x_i;\beta)$ because its productive activities are associated with unfavourable conditions, for which the random error is negative (v_j<0). In addition, producer j is not utilizing its inputs efficiently ($\mu_j \geq 0$).

Observed production is Y_j which is given by $f\,(x_j\,;\beta_j)\,.\,exp\,(v_j - \mu_j)$, and reflects both random error and inefficiency. In both cases, the observed production values are less than the corresponding frontier output values, and the frontier production values lie below or above the deterministic production function. Thus, the frontier itself is stochastic because of the presence of the 'exp (v)' stochastic component in the function [$f\,(x_j\,;\beta_j)$. exp (v)] (Aigner *et al*., 1977; Schmidt & Knox Lovell, 1979). Observed outputs lie below the deterministic frontier in both cases presented here, and there is the possibility that the observed output lies above the deterministic frontier [$f\,(x\,;\beta)$)] if $v_i > \mu_i$ (Battese, 1992).

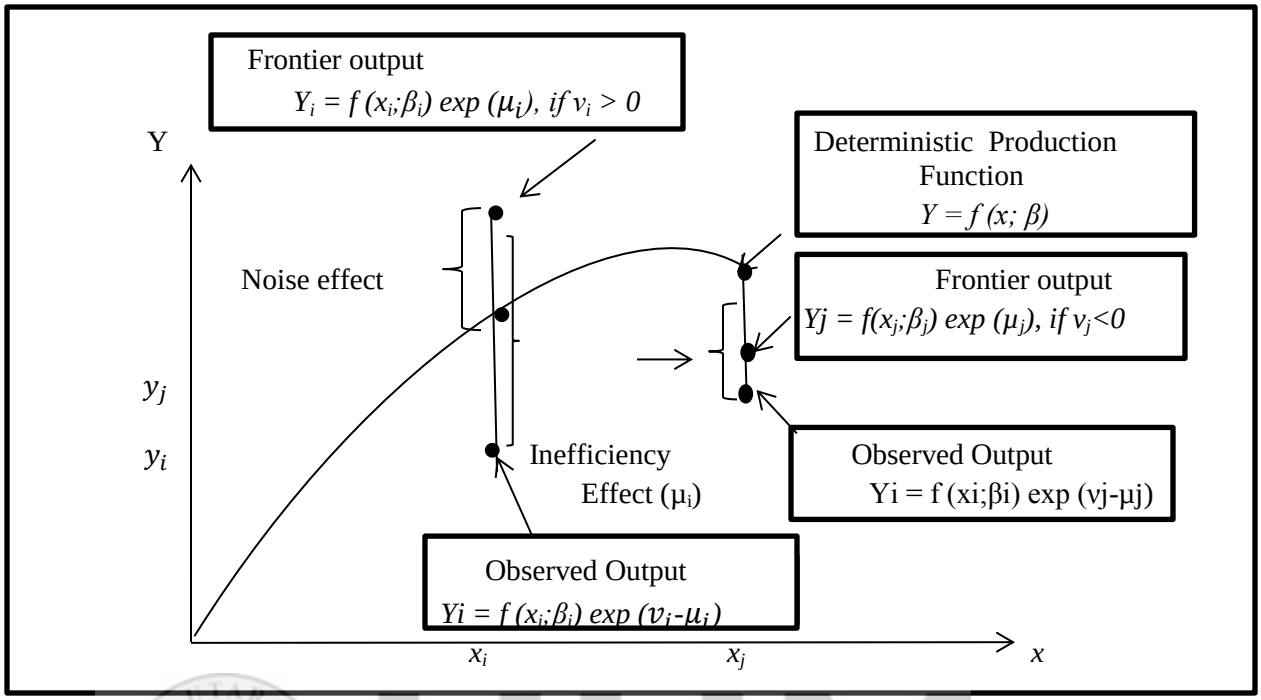

Figure 3.2
Stochastic frontier model

3.4 Advantages of Stochastic Frontier Analysis (SFA)

Stochastic production frontier is one of the methods developed for estimating TE rather than capacity utilisation. Besides that, the technique also can be applied for estimation by using the modification of inputs and outputs in the production function.

The most prospective advantage of using the stochastic production frontier approach compared to nonparametric method, such as DEA, is that random variations in can be accommodated so that the measure is more consistent with the potential under normal working conditions. This technique is able to estimate the efficiency produced as a direct

output from the package. Moreover, it has ability to account data errors and omitted variables. In addition, it is also more suitable for modeling the effects of other variables, such as environment variables.

3.5 Functional Forms in Production Analysis

Specification of functional form has a significant role in the estimation and interpretation of the efficiency and structure of production technology (Murillo-Zamorano, 2004). The two most popular forms are the Cobb-Douglas (CD) and Translog (TL) functional forms (Alauddin *et al*., 1993; Lindara *et al*., 2006).

3.5.1 Cobb-Douglas Functional Form

Logarithmic transformation of the CD functional form makes the model linear in inputs, making econometric application easy (Coelli, 1995; Lindara *et al*., 2006). However, this attractive feature imposes a number of restrictions. The most notable is that the CD functional form imposes constant elasticity of substitution that is equal to one. That is, inputs are assumed to be perfect substitutes, which is not always true (Coelli & Perelman, 2000; Newman & Wear, 1993). In addition, the CD functional form assumes the same value of returns to scale for all firms in a sample (Coelli, 1995; Coelli *et al*., 2005). In the CD model, individual input related parameters (β) are partial elasticities, which measure

the responsiveness of output for 1% change in the *i*th input (Nicholson, 2002). The sum of the parameters exhibits the production structure of technology.

3.5.2 Translog Functional Form

The TL functional form is a direct generalisation of the CD functional form (Nicholson, 2002). The TL functional form is more flexible (Bigsby, 1994; Lien *et al.*, 2007; Parikh *et al.*, 1995). Flexibility arises due to inclusion of second order terms, including interaction and cross-multiple terms. Interaction and cross-multiple terms provide an opportunity to explain the structure of production explicitly (Samoilenko & Osei-Bryson, 2008). For example, a positive coefficient on an interaction term indicates a complementary relationship between the two factors. The TL functional form has other desirable properties, for example, no prior restrictions are imposed, such as for elasticities of substitution, or the assumption of identical returns to scale (Bigsby, 1994; Coelli, 1995).

Hence, this functional form is more appropriate than CD when the structure of the production technology (such as elasticity of substitution and returns to scale) are the prime concern of analysis. The TL functional form is not free from limitations. There is a risk of multicollinearity when many parameters need to be estimated and numbers of observations are few (Siry & Newman, 2001). Therefore, this functional form is most likely to be of use if the number of inputs is few. In addition, some authors (such as

Sharma & Leung, 1998) argue that parameters associated with interaction and cross-multiple terms do not have straightforward interpretation. Following Coelli (2005), a general TL production function is given by Equation (3.2);

$$Y_i = \beta_0 + \beta_i \ln X_i + \frac{1}{2}\sum\sum \beta_{ij} \ln X_i \ln X_j \quad (3.3)$$

where i and j = 1, 2,……..,n.

Y_i, β_0, and β_i are the same as the CD model, and β_{ij} are parameters to be estimated associated with interaction terms. The TL function can exhibit any degree of returns to scale depending on the values of the parameters (Nicholson, 2002). If $\sum \beta_i$ = 1 and $\sum \beta_{ij}$= 0, then the TL function exhibits CRS; otherwise, it exhibits variable returns to scale. The CD form is nested in the TL form and when all β_{ij} are zero, the CD form results.

3.5.3 Choice of Functional Form

Since both functional forms have advantages and disadvantages, careful selection of a functional form is essential. The functional form is selected largely on practical consideration and specific objectives of the research (Binam *et al*., 2004). If description of the structure of production technology along with efficiency estimation are the main concerns, then the TL functional form is appropriate (Paul *et al*., 2000). The CD

functional form is also appropriate for analysing the production structure and estimating efficiency of a firm (Siry & Newman, 2001; Ogundari *et al*., 2010).

However, it is restrictive because the CD functional form imposes constant elasticity of substitution equal to one (Barrell & Te Velde, 2000; Sidhu & Baanante, 1981). A study carried out by Kopp & Smith (1980) has concluded that functional specification has a noticeable but small impact on estimated efficiency. Coelli *et al*. (2005) suggested following the principle of parsimony and selecting the simplest functional form which accomplishes the objective of the study, and this favours the CD form.

3.6 Process of Identifying Inputs and Outputs

The selection of variables of inputs and outputs must be relevant in this study. There is a lack of literature regarding the inputs and outputs of GLCs. The selection of inputs and outputs depends on the sectors of selected companies, such as services, manufacturing, agriculture and construction, and the relevant information that is available. Similar to many studies on banking efficiency (Sufian, 2009; Moffat, 2008), the inputs for this study include labour (number of employees) and fixed capital (represented by the value of fixed assets). The relevant output is net profit. The inputs and output used in the SFA model are illustrated in Figure 3.3 below.

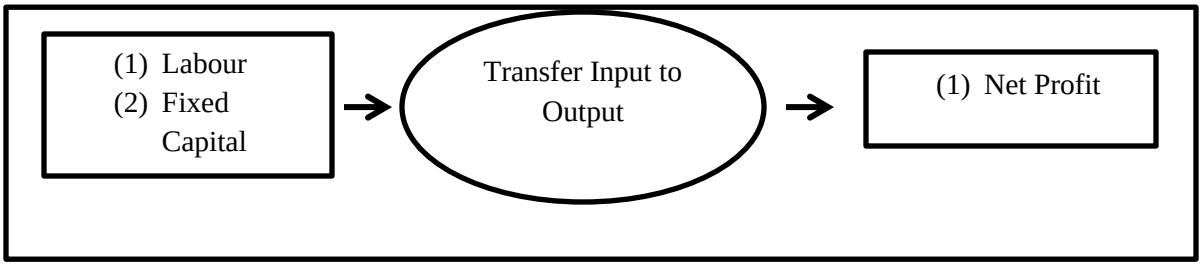

Figure 3.3
The Two Inputs and One Output Used in the SFA Model.

3.7 Application of SFA Model

This study uses the SFA model which was originally proposed by Aigner, Lovell and Schmidt (1977). The production or cost model is based on CD function as follows:

$$\log y = \beta' x + v \qquad (3.4)$$

where y is the observed outcome, $\beta' x + v$ is the optimal production frontier (e.g., maximum production output or minimum cost), $\beta' x$ is the deterministic part of the frontier and $v \sim N(0, \sigma_v^2)$ is the stochastic part. The components of x are generally logs of inputs for a production model. These two parts constitute the stochastic frontier.

The amount by which the observed individual fails to reach the optimum (the frontier) is u, namely inefficiency, where $u = |U|$ and $U \sim N[0, \sigma_u^2]$. The stochastic frontier model becomes:

$$y = \beta' x + v - u, u = \ |\mathrm{U}| \tag{3.5}$$

In the stochastic frontier model, the error term ε is made up of two independent components, $v - u$, where u measures technical inefficiency, namely the shortfall of output y from its maximal possible value given $[g(x_0, \beta) + v]$ by the stochastic frontier. When a model of this form is estimated, the obtained residuals, $\hat{\varepsilon} = y - g\left(x - \hat{\beta}\right)$ may be regarded as estimates of the error term ε (Jondrow *et al*., 1982). The conditional distribution of u given ε, E[u|ε] is the mean productive efficiency. Under each of the assumed possible distributional forms for the inefficiency terms in a model, this distribution contains whatever information ε yields about u. The predicted value is $\beta' x$.

The residual is computed by Jondrow *et al*.'s (1982) formula:

$$E[|u|v - u] \text{ or } E[|u|v + u] \tag{3.6}$$

$$\hat{E}[|u|\varepsilon] = \frac{\sigma\lambda}{1+\sigma^2} \ \left[\frac{\phi(z)}{1-\Phi(z)} - z\right], \varepsilon = v \pm u, z = \frac{\varepsilon\lambda}{\sigma} \tag{3.7}$$

The marginal effect in the model is the coefficient β. Estimation of the model parameters is usually of secondary interest, whereas, estimation and analysis of the inefficiency of individuals in the sample and of the aggregated sample are of greater concern. The results obtained are critically dependent on the model form and the assumptions set. Regarding this, special focus is given to panel data estimation technique.

3.8 Estimation Models

3.8.1 Input-Output Variables

The specification of model is needed to represent the data for this study. In order to examine the first objective, the SFM is used to calculate the TE score. The SFM provides both CB and TL production functions. Moreover, test regarding the competence of CD relative to the less restrictive TL is conducted to find the function form of stochastic frontier. Thus, the models estimated are defined as in the equations below:

$$lnY_{it} = \beta_0 + \sum_{j=1}^{2} \beta_j \, lnx_{j,it} + v_{it} - u_{it} \quad (3.8)$$

$$lnY_{it} = \beta_0 + \sum_{j=1}^{2} \beta_j \, lnx_{j,it} + \sum_{j=1}^{2} \sum_{h=1}^{2} \beta_{jh} \, lnx_{j,it} ln_{h,it} + v_{it} - u_{it} \quad (3.9)$$

From the above equations, lnY_{it} is the logarithm of net profit and lnx_j refers to fixed assets and labour in year of observation. The results of testing the functional form of the model are shown in the next chapter. The second test is performed in order to determine whether the inefficiency effects need to be included in the model. The key parameter is as follows:

$\gamma = \sigma_u^2/\sigma_v^2$ which lies between zero and unity.

Moreover, if $\gamma=0$, the technical inefficiency is not present. Thus, it shows that the null hypothesis is $\gamma=0$, indicating that a SFM does not need to be estimated and the mean response function (OLS) is an adequate representation of the data. However, the closer the value of γ to unity, the more likely it is that the frontier model is appropriate.

3.8.2 Internal Variables

In order to examine the second, third and fourth objectives, panel data analysis are employed. For the second objective, the value of TE is regressed on the internal indicators. Model 1 below is developed and modified from previous researchers (Almumani, 2013; Havrylchyk, 2006; Isik and Hassan, 2003; Mrad and Hallara, 2012; Sufian, 2007; Yang *et al*., 2014).

Model 1:

$$TE_{it} = \beta_1 + \beta_2 lnREV_{it} + \beta_3 lnSIZE_{it} + \beta_4 lnGOV_{it} + \beta_5 lnFC_{it} + \beta_6 ROA_{it} + \beta_7 BD_{it} + \beta_8 lnAGE_{it} + \varepsilon_{it} \quad (3.10)$$

Whereby, TE_{it} refers to the overall TE of GLCs, $lnREV_{it}$ is the log rate of revenue obtained by GLCs, $lnSIZE_{it}$ is the log rate of total assets in GLCs, $lnGOV_{it}$ refers to log rate of government ownership in GLCs, FC_{it} is the log rate of financial capital, ROA_{it} refers to return on assets, BD_{it} is number of directors on the board, $lnAGE_{it}$ refers to log rate of GLCs' experience, ε is a standard error, *i* refers to GLCs and *t* is time-series.

3.8.3 Macroeconomic Variables

In order to examine the third objective, the value of TE is regressed on the macroeconomic indicators. The macroeconomic indicators show the development of countries through per capita income (Mankiew, 2000). Model 2 below is developed and modified from previous researchers (Abid *et al*., 2014; Hryckiewicz, 2014; Oliver, 2013; Osman *et al*., 2015; Pasiouras & Gaganis, 2013; Sun & Chang, 2011) and is used in this study as follows:

Model 2:

$$TE_t = \beta_1 + \beta_2 lnGDP_t + \beta_3 lnINFRA_t + \beta_4 INF_{it} + \beta_5 RIR_t + \beta_6 lnER_t + \beta_7 UNEMP_t + \beta_8 lnOPENNESS_t + \varepsilon_t \quad (3.11)$$

Whereby, TE_t refers to overall TE of GLCs, $lnGDP_t$ is the log of the GDP, $lnINFRA_t$ is the log of the rate of infrastructure, INF_t refers to inflation rate (percentage), RIR_t is a real interest rate (percentage), $lnER_{it}$ is log rate of real exchange rate, $UNEMP_t$ is log rate of unemployment, $lnOPENNESS_t$ refers to log rate of trade openness, ε is a standard error, *t* is time-series.

Before conducting tests of cointegration between these variables, it is necessary to perform panel unit root tests. Cross-section dimension brings an improvement to the

power of unit root and cointegration tests by acting as repeated draws from the same distribution.

3.8.4 Interaction Terms

In order to examine the fourth objective, the value of TE is regressed on the macroeconomic indicator together with the interaction terms, which is government ownership in each GLC. Based on Equation (3.21), Model 3 is developed and modified based on previous researchers (Sufian *et al*., 2012; Deraniyagala, 2001; Mock & Yeung, 2005) that supports the interaction terms between firms' specific factors and TE.

Model 3:

$$TE_{it} = \beta_1 + (\beta_2 lnGDP_t * GOV_{it}) + (\beta_3 lnINFRA_t * GOV_{it}) + (\beta_4 INF_t * GOV_{it}) + (\beta_5 RIR_t * GOV_{it}) + (\beta_6 lnER_t * GOV_{it}) + (\beta_7 UNEMP_t * GOV_{it}) + (\beta_8 lnOPENNESS_t * GOV_{it}) + \varepsilon_{it} \quad (3.12)$$

Where, TE_{it} refers to overall TE of GLCs, $lnGDP_t$ is the log of the GDP, $lnINFRA_t$ is the log of the rate of infrastructure, INF_t refers to inflation rate (percentage), RIR_t is a real interest rate (percentage), $lnER_t$ is log rate of real exchange rate, $UNEMP_t$ is rate of unemployment,$lnOPENNESS_t$ refers to log rate of trade openness (percentage), GOV_{it} refers to government ownership in each GLC , ε is a standard error, *i* refers to GLCs and *t* is time-series.

3.9 Estimation Methods

3.9.1 Technical Efficiency

The TE of firms shows the ratio of observed output and maximum output by using certain level of input in an appropriate environment. The TE of firm *i* at time *t* can expressed in terms of errors as below:

$$TE_i = \frac{y_{it}}{exp\, f(x_{j,it};\beta_{it}) * exp(v_{it})} \quad (3.13)$$

$$TE_i = \frac{exp\, f(x_{j,it};\beta_{it}) * exp(v_{it}) * (u_{it})}{exp\, f(x_{j,it};\beta_{it}) * exp(v_{it})} \quad (3.14)$$

$$TE_{it} = E[\exp(-u_{it}) \mid (v_{it} - u_{it})] \quad (3.15)$$

Thus, u_{it} refers to non-negative random variable that shows the TE value between 0 and unity. Unity value means that a firm is fully efficient and the value $TE_{it} < 1$ shows that there is a shortfall in observed output from the maximum level in a environment characterised by $\exp(v_{it})$. Moreover, maximum likelihood of stochastic production functions developed by Battese and Coelli (1992) used to estimate the TE of firms. SFA is a parametric approach that assumes a specific function form (Coelli *et al*., 2005).

The maximum-likelihood estimates of the parameters in the CD and the TL stochastic frontier production function models are obtained using the Frontier 4.1 software. Hypothesis tests based on the likelihood ratio (LR) are conducted to select the functional form and to determine the presence of inefficiencies. The likelihood ratio tests used to find the appropriateness of model.

The likelihood-ratio test statistic as follows:

$$\lambda = -2\{log\lfloor likelihood\ H_0\rfloor - log\lfloor likelihood\ H_1\rfloor\} \quad (3.16)$$

Thus, the approximate value of χ_q^2 distribution equal to the number of parameters is assumed to be zero in the null hypothesis, where likelihood (H_0) and likelihood (H_1) are the values of the likelihood function under the specification of the null hypothesis and the alternative hypothesis.

3.9.2 Internal and Macroeconomic factors

This section provides the important procedures in examining both series and panel data. The suitable estimation methods are discussed to achieve the objectives stated. Most of the macroeconomic data, such as inflation, unemployment and GDP are non-stationary and contain a unit root or stochastic trend (Greene, 2000). For the internal factors, the data are more on the company's profile and from the annual report.

3.9.2.1 Fixed Effect and Random Effect

In fixed effect, data is gathered from all factors that are of interest. The models allow for different constants for each group. The intercept changes because of the differences that occur between them. The standard F-test can be used to check fixed effect against the simple common constant OLS method.

In random effect, all factors have possible levels but only random sample of data are included. Random effect occurs when the level of input is choosen from the population at random. Usually, the statistical conclusion is assumed to be obtained from the factors of the origin data. There are differences that can be seen in the model similar to individual characteristics and time error accounted in the model. Both individual and time errors are combined in the model. Breusch-Pagan tests is the counterpart to the F- test. In making a choice between the fixed and random effect approaches, the Hausman test is used. The null hypothesis is not accepted when larger Hausman statistics, which shows that the random effect is inconsistent but the fixed effect is consistent.

3.9.2.2 Panel Unit Root Test

Unit root test is used to determine whether the trend data in a research should be regressed for data stationary. Most economic theories suggest the long-run relationship between the variables and the cointegration techniques can be used to detect the long-run relationship between those variables. Economic theory requires all variables to be stationary if the regressions are to be realistic.

There are several unit root tests specifically for panel data which have been introduced in past decades. Among them are Quah (1992, 1994); Levin & Lin (1992, 1993); Maddala & Wu (1999); Hadri (2000); Levin, Lin & Chu (2002); and Im, Pesaran & Shin (2003, 1997).

The panel unit root test has the specification to identify problems, such as heterokedasticity and different correlations. Each panel unit root test data has its own benefits and limitations and for this study, the researcher has chosen the Levin, Lin and Chu (LLC); and Im, Pesaran and Shin (IPS) (1997) versions, which are based on the well-known Dickey-Fuller procedure. This LLC test is not only considered simple when estimation is carried out, but has also been widely used in empirical studies and the strength of this test has been tested in various Monte Carlo tests.

3.9.2.2.1 Levin, Lin and Chu (LLC) 2002

In LLC, it is found that the main hypothesis of panel unit root is as follows:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + X'_{it}\delta + \varepsilon_{it} \qquad (3.17)$$

Where lag order for different terms allowed, to vary across cross-sections. The null hypothesis is a unit root, while under the alternative, there is no unit root.

3.9.2.2.2 Im, Pesaran and Shin (IPS) 1997

Im, Pesaran and Shin (1997) or IPS proposed a test for the presence of unit roots in panels that combine information from the time-series dimension with that from the cross-section dimension, such that fewer time observations are required for the test to have power. The advantage of the IPS method over previous panel unit root tests is that it allows the data generating processes to vary across countries with respect to Augmented Dickey Fuller (ADF) coefficients and error structures. This can be particularly important with respect to the number of lagged difference terms in the ADF equation.

IPS begins by specifying a separate ADF regression for each cross-section:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + X'_{it}\delta + \varepsilon_{it} \qquad (3.18)$$

The IPS test statistic requires specification of the number of lags and the specification of the deterministic component for each cross-section of the ADF equation.

3.9.2.2.3 Maddala and Wu (1999) Test

This is known as Fisher test. This test can use different lag lengths in the individual ADF regressions and it can also be carried out for any unit root test derived. The Fisher test, based on the sum of the p-values is widely recommended. The advantage of this test is that it does not require a balanced panel as in the case of the IPS test. Also, one can use different lag lengths in the individual ADF regression.

The Fisher test and the IPS test are directly comparable. The aim of both tests are to find the combination of the significance of different independent tests. The Fisher test is non-parametric; the IPS test, on the other hand, is parametric.

3.10 Panel Cointegration Test

Pedroni (1999, 2004) extended the Engle and Granger (1987) two-step strategies to panels and relied on ADF and Philips and Perron (PP) principles. First, the cointegration equation is estimated separately for each panel member. Second, the residuals are examined with respect to the unit root feature. If the null hypothesis is rejected, the long-

run equilibrium exists, but the cointegration vector may be different for each cross-section. In addition, deterministic components are allowed to be individual-specific. The residuals are pooled either within or between the dimensions of the panel, giving rise to the panel and group mean statistics (Pedroni, 1999).

In the case of the panel statistics, the first order autoregressive parameter is restricted to be the same for all cross-sections. If the null is rejected, the parameter is smaller than 1 in absolute value, and the variables in question are cointegrated for all panel members. In the group statistics, the autoregressive parameter is allowed to vary over the cross-section, as the statistics amount to the average of individual statistics. If the null is rejected, cointegration holds at least for one individual. Hence, group tests offer an additional source of heterogeneity among the panel members (Dreger & Reimers, 2005).

The procedures proposed by Pedroni make use of estimated residuals from the hypothesised long-run regression of the following form (Pedroni, 1999):

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \ldots + \beta_{Mi} x_{Mi,t} + e_{i,t} \qquad (3.19)$$

for t = 1,…..,T; i = 1,….,N; m = 1, …., M,

where T is the number of observations over time, N is the number of cross-sectional units in the panel and M is the number of regressors. In this set up, α_i is the member specific

intercept or fixed effects parameter which varies across individual cross-sectional units. The same is true of the slope coefficients and member specific time effects, $\delta_i t$.

The tests for the null of no cointegration are based on testing whether the error process e_{it} is stationary. This is achieved by testing whether $\rho_i = 1$ in:

$$\hat{e}_{it} = \rho_i \hat{e}_{it-1} + v_{it} \qquad (3.20)$$

Pedroni (1999) proposed seven tests which can be divided into two groups of panel cointegration statistics designed to test the null hypothesis of cointegration between the variables in Equation (3.28) against the alternative hypothesis of cointegration.

Gutierrez (2003) stated that the first category of four statistics is what Pedroni labeled as within-dimension statistic or Panel t-statistic, which includes a variance ratio statistic, a non-parametric Philips and Perron type ρ-statistic, a non-parametric Phillips and Perron type t-statistic and ADF type t-statistic.

The second category of three panel cointegration statistics is defined as a between-dimension statistic or Group t-statistic, including a Philips and Perron type ρ-statistic, a non-parametric Philips and Perron type t-statistic and finally an ADF type t-statistic.

3.11 Fully Modified Ordinary Least Squares (FMOLS) Estimation

The FMOLS procedure is from Christopoulos and Tsionas (2003, 2004). In order to obtain asymptotically efficient consistent estimates in panel series, non-exogeneity and serial correlation problems are tackled by employing FMOLS introduced by Pedroni (1996). Since the explanatory variables are cointegrated with a time trend, and thus, a long-run equilibrium relationship exists among these variables through the panel unit root test and panel cointegration test and followed by FMOLS for heterogenous cointegrated panels (Pedroni, 1996, 2000).

This methodology allows consistent and efficient estimation of cointegration vector and also addresses the problem of non-stationary regressors, as well as the problem of simultaneity biases. It is well known that OLS estimation yields biased results because the regressors are endogenously determined in the *I*(1) case. The starting point of OLS is as in the following cointegrated system for panel data:

$$y_{it} = \alpha_i + x'_{it}\beta + e_{it} \tag{3.21}$$

$$x_{it} = x_{i,t-1} + \varepsilon_{it} \tag{3.22}$$

where $\xi_{it} = [e_{it}, \varepsilon'_{it}]$ is the stationary with covariance matrix Ω_i. The estimator β will be consistent when the error process $\omega_{it} + [e_{it}, \varepsilon'_{it}]'$ satisfies the assumption of cointegration

between y_{it} and x_{it}. The limiting distribution of OLS estimator depends on nuisance parameters. Following Philips and Hansen (1990), a semi-parametric correction can be made to the OLS estimator that eliminates the second order bias caused by the fact that the regressors are endogenous. Pedroni (1996, 2000) followed the same principle in the panel data context, and allowed for the heterogeneity in the short-run dynamics and the fixed effects. Pedroni's FMOLS estimator is constructed as follows:

$$\hat{\beta}_{FM} - \beta = \left(\sum_{i=1}^{N} \hat{\Omega}_{22i}^{-2} \sum_{t=1}^{T} (x_{it} - \hat{x}_t)^2 \right)^{-1} \sum_{i=1}^{N} \hat{\Omega}_{11i}^{-1} \hat{\Omega}_{22i}^{-1} \left(\sum_{t=1}^{T} (x_{it} - \bar{x}_t) e_{it}^* - T\hat{\gamma}_i \right) \qquad (3.23)$$

$$\hat{e}_{it}^* = e_{it} - \hat{\Omega}_{22i}^{-1} \hat{\Omega}_{21i}, \qquad \hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^0 - \hat{\Omega}_{22i}^{-1} \hat{\Omega}_{21i} \left(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^0 \right)$$

where the covariance matrix can be decomposed as $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i$ where Ω_i^0 is the contemporaneous covariance matrix, and Γ_i is a weighted sum of autocovariances. Also, $\hat{\Omega}_i^0$ denotes an appropriate estimator of Ω_i^0.

Both the within-dimension and between-dimension panel FMOLS test were employed from Pedroni (1996, 2000). An important advantage of the between-dimension estimators is that the form in which the data is pooled allows for greater flexibility in the presence of heterogeneity of the cointegrating vectors. Specifically, whereas test statistics constructed from the within-dimension estimators are designed to test the null hypothesis $H_0 : \beta_i = \beta_0$ for all *I* against the alternative hypothesis, where the value β_A is the same for all *i*, test statistics constructed from the between-dimension estimators are designed to

test the null hypothesis $H_0 : \beta_i = \beta_0$ for all i against the alternative hypothesis $H_A : \beta_i \neq \beta_0$, so that the values for β_i are not constrained to be the same under the alternative hypothesis.

Clearly, this is an important advantage for applications, such as the present one, because there is no reason to believe that if the cointegrating slopes are not equal to one, they necessarily take on some other arbitrary common value. Another advantage of the between-dimension estimators is that the point estimates have a more useful interpretation in the event that the true cointegrating vectors are heterogeneous.

Specifically, point estimates for the between-dimension estimator can be interpreted as the mean value for the cointegrating vectors. This is not true for the within-dimension estimators (Pedroni, 2001).

3.12 Data and Choice of Variables

The study uses secondary data for GLCs obtained for the period from 2004 to 2013. The sample consists of top listed 17 GLCs under G20 industry. Based on Suhaimi (2008), panel data is an appropriate way because of the ability to observe each sample, such as banks, for more than once over the time duration. The data for GLCs are extracted from Thomson DataStream and annual report of each GLC.

The selection of inputs (fixed asset and labour) and output (net profit) are based on production approach because of the suitability for all companies (Peter and Drucker, 1974). The samples of 17 GLCs have significant assets and complete data from 2004 to 2013. Furthermore, in this study, the macroeconomic data gathered from World Bank, Economic Planning Unit and WDIs. Data is transformed to index considering small amount and negative sign and also differing measures.

Table list (refer Appendix D) provides the explaination concerning the internal and macroeconomic indicators used along with their proxies. This research uses one dependent variable, namely, TE and seven internal and macroeconomic independent variables which reflect the GLCs financial indicators and structure and also the environment in which the companies are located.

3.13 Summary

Generally, this chapter focuses on the method used in the analysis, specifically, the SFA, fixed and random effects and FMOLS. The input and output used in SFA are discussed together with the variables used in the FMOLS. The SFA is used to find the efficiency score for the purpose of identifying the key source of GLCs' inefficiency. Variables are discussed next and finally, the model employed is highlighted based on literature review. The results of the analysis and findings are presented in the following chapters.

CHAPTER FOUR

EMPIRICAL ANALYSIS AND FINDINGS: GOVERNMENT LINKED COMPANIES' (GLCs) EFFICIENCY

4.1 Introduction

Chapter four describes the efficiency of GLCs by using SFA. This chapter consists of growth of GLCs in Malaysia and technical efficiency scores of GLCs.

4.2 GLCs Indicator: The Growth

Overall the 17 GLCs under G20's market capitalisation had grown from RM133.8 billion to RM431.1 billion from May 14, 2004 to April 7, 2015. As of April 1 2011, its G20 conveyed profit for value of 10.5% in 2010 (ETP, 2012). Growth of GLCs in Malaysia is described by indicators, such as net profit, total revenue, total assets and market capital. The trend of these indicators are displayed in Figure 4.1 until Figure 4.4 below.

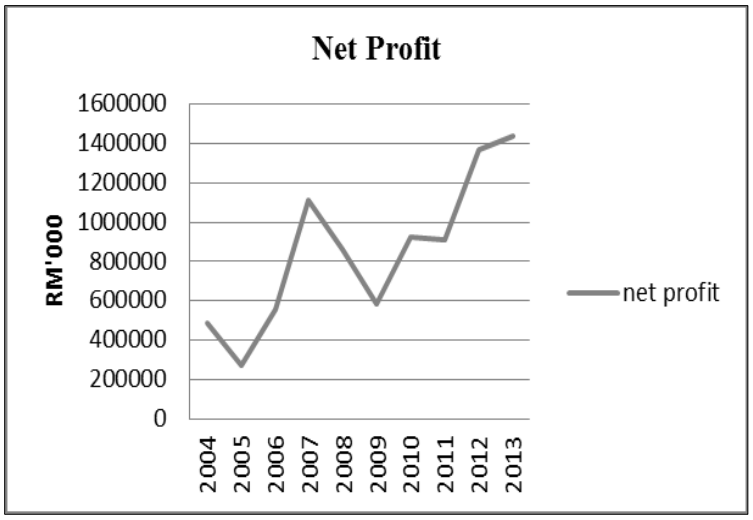

Figure 4.1
Net Profit of GLCs (RM'000)

Figure 4.1 above shows the net profit of GLCs in Malaysia. Overall, throughout the period from 2004 to 2013, the net profit of GLCs has increased, especially after 2009; except for a sharp decline from 2008 to 2009, it has been upwards ever since.

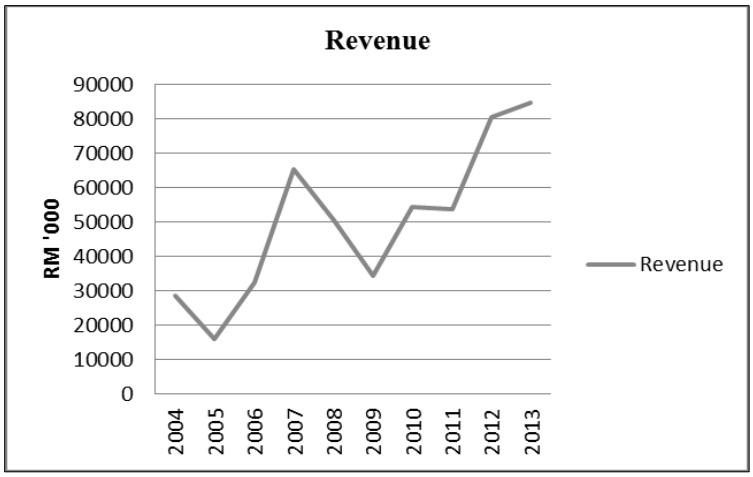

Figure 4.2
Total Revenue of GLCs (RM '000)

Figure 4.2 above shows the total revenue of GLCs from 2004 to 2013. Overall, it shows fluctuating pattern, whereby revenue tends to increase from 2005 to 2007 till a slight downward pattern in 2009 and recovering positively thereafter.

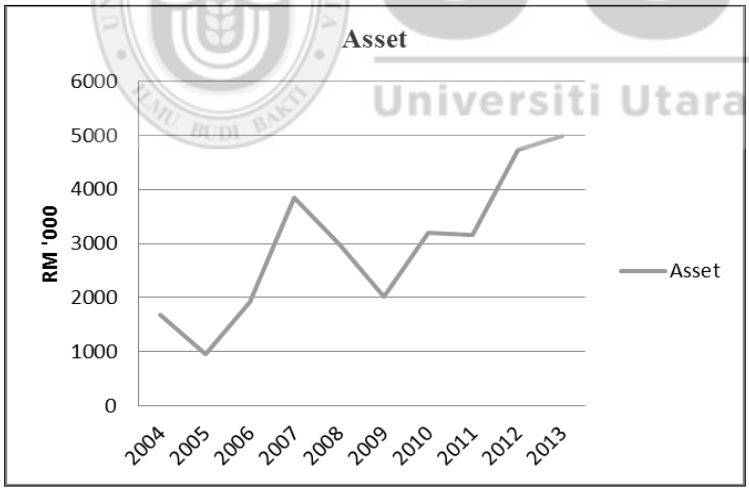

Figure 4.3
Total Assets of GLCs (RM '000)

Figure 4.3 above shows the total assets of GLCs from the period of 2004 to 2013. The patterns are similar with that of net profit and total revenue above, whereby it remained bullish till 2007 with a marginal slump in 2009, and remaining positive thereafter.

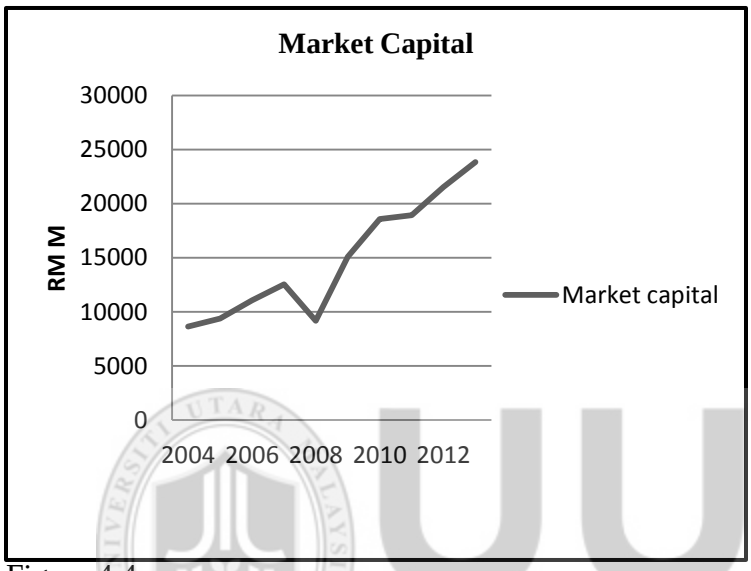

Figure 4.4
Market Capital of GLCs (RM 000)

Figure 4.4 above clearly depicts the market capital of GLCs from 2004 to 2013. From the graph, the market capital was on the increase except a brief period in 2008. However from 2009, the market capital remained upwards till 2015. Overall, key indicators of GLCs remained fluctuating throught the period of study. Table 4.1 below represents the descriptive statistics of GLC indicators from 2004 until 2013.

Table 4.1
Government Linked Companies' (GLCs) Indicators in 2004 until 2013

Description	Net Profit (RM'000)	Revenue (RM'000)	Assets (RM'000)	Market Capital (RM'000)
Mean	851306.50	50076.85	2945.70	1487735.23
Median	860227.70	50601.63	2976.57	1302748.21
Maximum	1472952.00	86644.24	5096.72	2463785.34
Minimum	253914.10	14936.12	878.60	856236.36
Standard Deviation	374842.70	22049.57	1297.03	535902.21
Skewness	0.11	0.11	0.11	0.33
Kurtosis	1.98	1.98	1.98	1.66
Jacqua-Bera	1.81	1.811.81	3.71	
Probabliity	0.40	0.40	0.40	0.16
Observations	170	170	170	170

Source: Author's estimate from GLCs report published by Economic Transformation Programme Review, 2014

4.3 Input- Output Analysis

The choice of input (labour and fixed asset) and output (net profit) to calculate technical efficiency score in this study were approached by most researchers (Cui & Li, 2015). In this study, the selection of input-output variables is based on the availability of data set by each company. Yearly data is utilised from 2004 to 2013 because of two considerations. First, GLCs have been able to develop and improve their efficiency after the GLC Transformation Programme which was implemented in 2004; and second, because of the complete data availability by each company.

This input and output variables have been used by several researchers (Cui & Li, 2015; Hung *et al.*, 2014 and Mohamad & Said, 2012) in their analysis of profitability performance and TE. Moreover, this input and output can be used to measure the performance and efficiency estimation (Sufian, 2009).

Table 4.2
Descriptive Variable of input and output in the period of 2004 - 2013

Indicator	Mean	S.D	Median	Max	Min
Output					
Net Profit	14.97	0.42	14.89	16.03	11.27
Inputs					
Labour	4.38	0.34	4.49	4.90	3.51
Fixed Assets	16.02	2.90	15.91	23.41	11.32

Source: Author's calculation (percentage)

The average net profit of GLCs from 2004 to 2013 is 14.97 with standard deviation of 0.42 that indicates low profit among GLCs. Table 4.2 shows that labour is 4.38 with low standard deviation of 0.34.

4.3.1 Descriptive Statistics Analysis

Table 4.3 below shows the descriptive analysis of each GLC under G20 industry by mean, median, maximum and minimum values.

Table 4.3

Descriptive Statistics Output (Net Profit) of GLCs in the period of 2004 to 2013

GLCs	Mean	Median	Max	Min
1.AFFIN	14.900	14.891	14.970	14.802
2.TM	14.875	14.884	14.915	14.817
3.AXIATA	14.840	14.772	15.454	14.771
4.BIMB	14.766	14.853	15.037	14.130
5.BOUSTEAD	14.897	14.907	14.982	14.771
6.CCM	14.792	14.789	14.817	14.771
7.CIMB	15.389	15.445	15.781	14.916
8.AIRPORT	14.864	14.829	15.055	14.771
9.MAS	14.403	14.834	14.945	11.273
10.MBSB	14.853	14.809	14.978	14.783
11.MRC	14.789	14.790	14.806	14.749
12.SIME DARBY	15.312	15.265	15.725	14.803
13.TH PLANTATIONS	14.878	14.807	15.501	14.7816
14.TNB	15.134	15.124	15.469	14.878
15.UMW	15.369	15.360	15.792	15.043
16.MAYBANK	15.502	15.476	16.029	14.882
17.UEM	14.951	14.949	15.095	14.833

Table 4.4

Descriptive Statistics Input (Labour) of GLCs in the period of 2004 to 2013

GLCs	Mean	Median	Max	Min
1.AFFIN	4.138	4.205	4.240	3.506
2.TM	4.379	4.375	4.422	4.320
3.AXIATA	4.607	4.630	4.683	4.442
4.BIMB	4.259	4.260	4.299	4.219
5.BOUSTEAD	4.487	4.476	4.542	4.428
6.CCM	4.023	4.041	4.062	3.909
7.CIMB	4.675	4.697	4.731	4.546
8.AIRPORT	4.587	4.582	4.615	4.576
9.MAS	4.669	4.686	4.751	4.557
10.MBSB	3.805	3.800	3.888	3.713
11.MRC	3.895	3.906	3.928	3.851
12.SIME DARBY	4.819	4.891	4.904	4.623
13.TH PLANTATIONS	4.532	4.528	4.579	4.497
14.TNB	4.617	4.643	4.720	4.442
15.UMW	4.668	4.662	4.698	4.648
16.MAYBANK	3.781	3.706	4.214	3.551
17.UEM	4.479	4.484	4.498	4.430

Table 4.5
Descriptive Statistics Input (Fixed Assets) of GLCs in the period of 2004 to 2013

GLCs	Mean	Median	Max	Min
1.AFFIN	20.135	21.489	21.992	14.247
2.TM	14.050	13.922	15.130	13.391
3.AXIATA	16.711	16.507	18.909	16.118
4.BIMB	21.165	21.239	21.756	19.932
5.BOUSTEAD	15.380	15.512	16.181	13.954
6.CCM	14.039	14.141	14.548	13.404
7.CIMB	21.437	22.913	23.409	18.370
8.AIRPORT	16.360	16.419	16.600	15.934
9.MAS	15.263	15.072	17.100	14.142
10.MBSB	13.090	12.970	14.477	12.024
11.MRC	13.413	13.660	14.017	11.949
12.SIME DARBY	16.789	17.129	17.587	13.257
13.TH PLANTATIONS	12.037	12.115	13.043	11.323
14.TNB	16.116	16.031	16.543	15.842
15.UMW	16.986	17.037	17.297	16.643
16.MAYBANK	13.223	12.907	14.429	12.202
17.UEM	16.121	16.218	16.515	15.426

Table 4.3 shows that net profit rate shows that most GLCs have average mean values between 14.000 and slightly above 15.000. The highest mean is by Maybank with the value of 15.502. Then, the lowest mean is by MAS with the value of 14.403.

Table 4.4 and Table 4.5 indicate inputs for all GLCs from 2004 to 2013. For the input labour, the mean value is between 3.000 and 4.500. The highest mean for labour owned by Sime Darby with the value of 4.819 and lowest mean owned by MBSB with value of 3.805. The mean of highest fixed assets is owned by CIMB with the value of 21.437. The lowest mean is owned by TH Plantation with the value of 12.037. On average, the mean value for G20 is between 5.500 and 6.200. The next section analyses the siginficant inputs and output for G20 to obtain the accurate efficiency value.

4.4 Ordinary Least Squares (OLS) Estimation

OLS estimates the parameters which show the average performance of the GLCs. Table 4.6 below shows the OLS estimates of average performance using CD production function.

The adjusted R^2 value of 0.96 shows that the inputs in the model are able to explain 96% variation in profit from the production of GLCs. The coefficients of labour and fixed assets are statistically significant and have expected signs. Total expenditure of GLCs is found to be insignificant to net profit. This may be due to the fact that there is no specification of total expenditure in contribution to the profit of GLCs. Hence, there is no effect of total expenditure to net profit of GLCs.

Table 4.6
OLS estimates of average performance using Cobb-Douglas production function

Variables	Parameters	Coefficients	t-ratios
Constant	β_0	0.198***	6.34
Fixed Assets	β_1	0.953***	172.87
Labour	β_2	0.019***	3.35
Total Expenditure	β_3	-0.002	-1.19

R^2 = 0.96, N= 170
***Significant at 1%

Fixed assets and Labour are found to be significant at 1% level and have expected positive sign to net profit. Thus, these two factors are used as inputs in this study and net profit as output to find the TE value of GLCs.

4.5 Cobb-Douglas Stochastic Frontier Model Estimation

The OLS estimates of the parameters of CD production function are obtained through grid search in the first step and then used to estimate the maximum-likelihood estimates of the parameters of CD stochastic frontier production model.

Table 4.7 shows that the maximum-likelihood estimate of the parameter for fixed assets input are 0.259 and 7.786 for the translog and half normal distributions model, respectively. It must be mentioned that the coefficient of fixed assets is highly significant at 1% level for translog model and half normal model.

Table 4.7
Maximum-likelihood estimates of the stochastic frontier production function: Half normal and Translog model

	Half Normal Model		Translog Model
Variables	Parameters	Coefficients	Coefficients
Constant	β_0	12.460***	32.410***
		(26.080)	(5.78)
Labour	β_1	0.095**	0.269**
		(2.18)	(2.41)
Fixed Assets	β_2	0.259***	7.786***
		(4.29)	(3.04)
	β_3		0.918***
			(2.93)
	β_4		0.040
			(0.90)
	β_5		0.034
			(0.81)
	Sigma Squared, σ^2	0.175***	0.183***
		(4.98)	(4.49)
	Gamma,γ	0.388***	0.415***
		(3.22)	(3.31)
	Mean TE	0.832	0.822
	Log Likelihood	-61.150	-61.534
	N	170	170

***Significant at 1%
**Significant at 5%

The coefficient for labour is statistically significant at 5% level in the translog and half normal distributions model. So, there is an overall indirect impact of their technical inefficiencies on profit of GLCs. The large difference is identified in the variance parameters arising from the two distributions. This difference in variance parameters could be due to the specification of the distribution of the error term. The value of γ is 0.388 and 0.415. The estimated mean TE are at 0.822 and 0.832 levels, respectively. It is evident that the estimates of σ^2 amount to 0.183 and 0.175 for translog and half-normal distributions, respectively. Based on Janang (2011), Likelihood ratio (LR) can be used to identify the appropriate model. Hence, in order to select an appropriate model, the value of the generalised LR is computed as :

$\lambda = LR$ = 2 (-61.534 + 61.150) = -0.768

Since the value is negative, we cannot reject the hypothesis and accept the model which assumes the half-normal distribution. Hence, analysis of the estimation in the second part would be as presented by the Half normal model. All variables are significant as presented in the Half normal model. Positive signs of the coefficients imply increase in input will ultimately increase the output level. The estimated elasticity of output in the Half normal model, with respect to fixed assets, is 0.259, which implies that any increase in fixed assets would increase output by 2.59%.

Table 4.8
Value of Technical Efficiency for the entire period of research

Technical Efficiency	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
Mean	0.974	0.771	0.762	0.987	0.823	0.991	0.809	0.712	0.740	0.752	0.832
Median	0.986	0.815	0.752	0.989	0.827	0.996	0.831	0.706	0.740	0.742	0.842
Maximum	0.999	0.998	0.997	0.999	0.956	0.999	0.971	0.999	0.999	0.996	0.991
Minimum	0.922	0.319	0.455	0.963	0.574	0.959	0.537	0.156	0.419	0.417	0.572
Standard Deviation	0.022	0.178	0.187	0.011	0.099	0.011	0.127	0.198	0.168	0.178	0.118

From Table 4.8, the value of TE as shown above in the period of 2004 to 2013 is 0.83 or 83%. The value of TE is around 70% to 80% for the same period except 2004, 2007 and 2009, whereby the value increased up to 90%.

This shows that at the beginning of the transformation programme, GLCs were able to increase their efficiency till it briefly declined due to economic crisis before bouncing back positively. Factors that influenced the changes in efficiency are analysed in the later part of this study. The average TE score only reaches 0.832, suggesting that GLCs in Malaysia produce the same output level, using 83.2 % of the inputs, which implies the GLCs' resources are wasted at a rate of 16.8%.

In summation, Figure 4.5 below represents the graphical presentation of the TE score of 17 GLCs from the period of 2004 to 2013. We can clearly see that these companies had faced inefficiency during the period of this study.

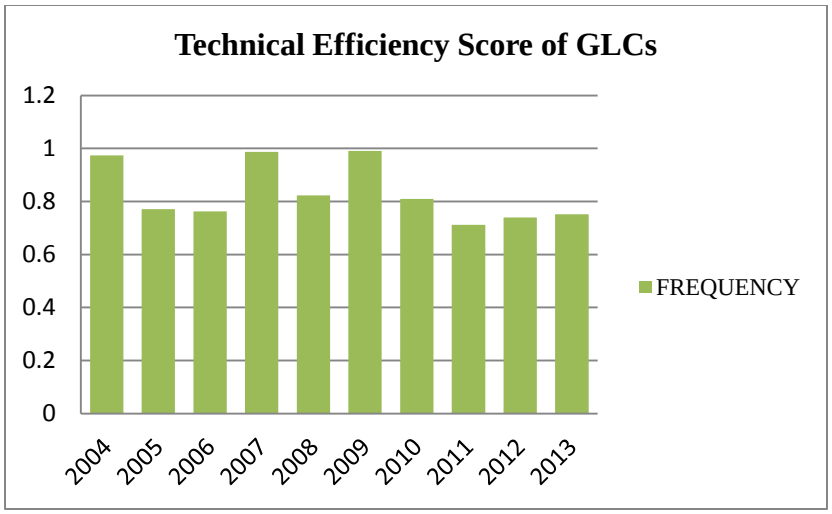

Figure 4.5
The Technical Efficiency Score of GLCs from 2004 to 2013

According to Banker *et al*. (1986), the chi-square statistic can be used to examine whether the efficiency ratings from any two methods are in broad agreement. This is similar to the study conducted by Chiang and Cheng (2014). The efficiency ratings are as follows:

(1) an efficiency value of "1" is classified as high;

(2) "0.9 or above" as medium; and

(3) "less than 0.9" as low value.

Thus, the value of TE of GLCs is low based on Chiang and Cheng (2014). Table 4.9 below shows the summary of efficiency value of all GLCs in the sample. Overall, the results show that during the study period, the GLCs are technically inefficient when it comes to utilising their resources and increasing their profits. The value of TE is less than

one and is found to be in a fluctuating pattern, whereby there is significant increase and decrease throughout the period of study.

Table 4.9
Value of Technical Efficiency from 2004 until 2013 for each GLCs

DMU	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AFFIN	0.989	0.808	0.981	0.997	0.749	0.996	0.696	0.709	0.661	0.690
TM	0.996	0.893	0.860	0.995	0.777	0.997	0.834	0.716	0.686	0.610
AXIATA	0.997	0.684	0.502	0.979	0.574	0.996	0.537	0.477	0.442	0.417
BIMB	0.997	0.965	0.455	0.979	0.729	0.995	0.668	0.644	0.598	0.616
BOUSTEAD	0.996	0.656	0.652	0.974	0.837	0.996	0.784	0.666	0.616	0.622
CCM	0.982	0.860	0.883	0.979	0.909	0.959	0.949	0.803	0.942	0.944
CIMB	0.997	0.913	0.909	0.989	0.804	0.997	0.919	0.999	0.799	0.816
AIRPORT	0.989	0.673	0.663	0.989	0.828	0.996	0.831	0.710	0.740	0.710
MAS	0.922	0.319	0.529	0.963	0.722	0.979	0.698	0.156	0.419	0.502
MBSB	0.954	0.864	0.948	0.977	0.867	0.998	0.792	0.813	0.846	0.975
MRC	0.951	0.812	0.926	0.982	0.893	0.998	0.894	0.813	0.872	0.922
SIME DARBY	0.986	0.825	0.741	0.998	0.956	0.999	0.616	0.950	0.892	0.778
TH PLANTATIONS	0.996	0.474	0.499	0.998	0.833	0.999	0.923	0.632	0.703	0.622
TNB	0.998	0.927	0.951	0.999	0.933	0.999	0.971	0.600	0.999	0.933
UMW	0.989	0.721	0.752	0.989	0.890	0.989	0.810	0.666	0.775	0.951
MAYBANK	0.999	0.998	0.997	0.999	0.912	0.987	0.899	0.927	0.653	0.742
UEM	0.964	0.893	0.702	0.995	0.942	0.974	0.924	0.854	0.940	0.996

The value of TE is near to 1 in 2004, 2007 and 2009, indicating fully efficient value. Firstly, the value of efficiency is different for each GLC across the same period and secondly, the values of TE among GLCs during the research period also fluctuate. This is because the value increased and declined for each GLC across the period.

For instance, in 2006, GLCs, such as CIMB, MRC, MBSB, TH Plantations and Maybank obtained efficiency valueof around 0.9 because of operational improvements (GTP Report, 2010). MAS, on the other hand, had the lowest TE value throughout the period because of high fuel cost and mismanagement since 2010 (MAS Report, 2014).

Therefore, it can be concluded that the value of TE of 17 GLCs is not consistent and at the same time, is also able to reach high efficient value during certain periods of time attributable to the impact of macroeconomic factors on the efficiency of the GLCs. Nevertheless, there are also GLCs that are unable to reach efficient value compared to other GLCs in the same period because of internal factors. Therefore, the second part of this study ventures into the analytical side of macroeconomic and internal variables in affecting GLCs' efficiency.

4.6 Conclusion

The resultant measurement of the TE by half normal assumption model shows that most GLCs are not fully efficient throughout the period of this research. Hence, the role of

GLCs should be clearly delineated and emphasised upon by the government to enhance Malaysia's economic growth. The subsequent chapter analyses thoroughly the effects of macroeconomic and internal factors on TE of GLCs.

CHAPTER FIVE

EMPIRICAL ANALYSIS AND FINDINGS: MACROECONOMIC AND INTERNAL FACTORS IMPACT ON GLCs' EFFICIENCY

5.1 Introduction

This chapter begins with a discussion on stationarity of the panel data using LLC and IPS tests, followed by fixed and random effects, panel cointegration and FMOLS. The possible explanations for the findings are discussed in each section, along with their implications. This chapter concludes with a discussion of the relationship of the findings to the theoretical model proposed in Chapter three.

5.2 Fixed Effect and Random Effect

As discussed in the methodology part, panel data estimation techiques start from fixed-effect and random effect models. However, before proceeding further, the Pearson correlation matrix are needed to test the relationship between the variables. There is indication of correlation between some variables. Table below shows that most variables have values greater than 0.7 except firm age and board structure under internal factors and exchange rate under macroeconomic factors. Therefore, variance inflation factor is tested for justification under fixed effect and random effect model.

Table 5.1
Correlation Matrix (Internal Factors)

	TE	lnREV	lnFC	ROA	lnAGE	lnSIZE	lnGOV	BD
TE	1.000							
lnREV	-0.701*	1.000						
lnFC	-0.774*	-0.766*	1.000					
ROA	0.789*	0.723*	0.720*	1.000				
lnAGE	-0.704*	0.609	0.560	0.562	1.000			
lnSIZE	0.774*	0.724*	0.659	0.702*	0.739*	1.000		
lnGOV	0.750*	0.730*	0.720*	0.712*	0.711*	0.660	1.000	
BD	0.715*	0.670	0.533	-0.560	0.520	0.578	0.590	1.000

Notes: (*) means > 0.7

Table 5.2
Correlation Matrix (Macroeconomic Factors)

	TE	lnINFRA	lnOPENNESS	INFL	UNEMP	RIR	lnGDP	lnER
TE	1.000							
lnINFRA	0.787*	1.000						
lnOPENNESS	0.873*	0.846*	1.000					
INFL	-0.809*	-0.752*	0.736*	1.000				
UNEMP	-0.720*	-0.720*	0.704*	-0.680	1.000			
RIR	-0.746*	0.747*	-0.729*	-0.759*	0.750*	1.000		
lnGDP	0.832*	0.777*	0.778*	0.719*	-0.788*	-0.618	1.000	
lnER	0.705*	0.660	0.690	0.642	-0.539	0.429	0.577	1.000

Notes: (*) means > 0.7

Table 5.3
Correlation Matrix (Interaction Terms)

	TE	lnGDP	lnINFRA	lnOPENNESS	INFL	RIR	UNEMP	lnER
TE	1.000							
lnGDP	0.838*	1.000						
lnINFRA	0.806*	-0.794*	1.000					
lnOPENNESS	0.795*	0.783*	0.760*	1.000				
INFL	-0.833*	0.788*	-0.707*	0.760*	1.000			
RIR	-0.764*	-0.710*	0.740*	-0.750*	-0.753*	1.000		
UNEMP	-0.810*	-0.806*	0.706*	0.710*	-0.664	0.782*	1.000	
lnER	0.761*	0.717*	0.699*	0.747*	-0.683	0.542	0.759*	1.000

Notes: (*) means > 0.7

Table 5.4
Fixed and Random Effects (Internal Factors)

Variable	Pooled OLS	Random Effect	Fixed Effect	OLS with heteroscedasticity & serial correlation
Constant	0.931*** (8.38)	1.119*** (4.60)	0.791** (1.94)	0.931*** (3.94)
$lnREV_{it}$	-0.004 (-1.57)	-0.005** (-2.33)	-0.005** (-2.15)	-0.007* (-1.92)
$lnFC_{it}$	-0.009 (-1.44)	-0.030** (-2.34)	-0.029** (2.47)	-0.008*** (-3.14)
$lnGOV_{it}$	0.005 (1.41)	0.008** (2.27)	0.007** (2.37)	0.006** (2.50)
$lnSIZE_{it}$	0.027*** (2.84)	0.049*** (2.65)	0.086*** (3.25)	0.027*** (3.02)
ROA_{it}	0.003*** (2.71)	0.002* (1.74)	0.003*** (2.81)	0.003** (2.19)
BD_{it}	-0.016* (1.92)	0.008 (0.41)	0.109** (2.13)	-0.016 (-1.21)
$lnAGE_{it}$	0.003 (0.36)	-0.009 (0.36)	0.005 (0.53)	-0.003 (-0.15)
Breush-Pagan LM test		105.31*** (0.00)		
Hausman Test			12.93 (0.09)	
Observations	170	170	170	170
Multicollinearity (VIF)	1.22			
Heteroskedasticity (χ^2 – stat)			1447.25*** (0.000)	
Serial Correlation (F-stat)			107.987*** (0.000)	

Note: (*) significant at 90% level, (**) significant at 95% level, (***) significant at 99% level

The result in Table 5.4 shows that increase in revenue of GLCs ($lnREV_{it}$) causes increase in TE of GLCs. The coefficient for this variable is negative (0.007) and statistically significant at 10% level. Overall, this indicates that an increase by 1% value of revenue will decrease the TE of GLCs by 0.007. Revenue determines efficient

operations, whereby firms optimally utilising their resources are able to reduce the overall cost of doing business and increase the profit and overall efficiency of their firms (Afza *et al*., 2014). In this study, the results obtained are negative and significant which reflect that revenue can lead to inefficiency. This is similar to the result obtained by Gorin & Belobaba (2004) and Joo & Fowler (2014).

Financial capital variable ($lnFC_{it}$) coefficient has a negative sign (0.008) and is statistically significant at the 1% level. This means an increase by 1% of financial capital will decrease TE by 0.008. In this study, the result shows negative and significant result that reflects financial capital does lead to inefficiency when GLCs fail to utilise their capital to increase the profitability and efficiency (Koehn & Santomero, 1980). This is in line with previous sudies (Almumani, 2013; Ajlouni & Hmedat, 2011).

Government ownership ($lnGOV_{it}$) has positive coefficient value (0.006) and is significant at 5% level. This means an increase by 1% of government ownership will increase TE by 0.006. This result refers to the significance of government ownership in enhancing the GLCs' efficiency (Ang & Ding, 2006). Government ownership is crucial because firms will be able to gain more investors' confidence, especially if their business is linked to government interests as it allows them more liberal access to financial resources and institutional knowledge. Even though previous literature has stated that companies controlled by the government and involving political bureaucrats are inferior (Lannotta *et al*.,2013), they can still create firm value as found by other researchers (Ghazali, 2010; Mrad & Hallara, 2012) and perform better. The result echoes that

government ownership in GLCs can produce positive effects of efficiency and more so during a financial crisis. Perhaps, with the strong commitment from the government and high demands from stakeholders, together with companies' awareness and concern (Rahman *et al*., 2011).

Size ($lnSIZE_{it}$) shows a positive sign (0.027) and is statistically significant at 1% level. This is similar to previous research by Mesa *et al.* (2014), whereby large size can increase the investment and overall TE of firms. These studies emphasised the importance of total assets to stimulate organisational contribution (Sufian & Habibullah, 2012). Firm size not only affects the business operations, but also attracts large amount of investment (Almumani, 2013). It has been exhaustively argued that the efficiency depends on firm size (Ajlouni & Hmedat, 2011; Andries, 2011; Ismail *et al*., 2013). Firm size also affects the profit of the organisation inversely. Based on a previous study by Sufian (2007), smaller banks are more profit-efficient than larger ones.

Return on assets (ROA_{it}) variable has a positive sign (0.003) and is significant at 5% level. This shows that return on assets does affect TE in this period of analysis. This means an increase by 1% of return on assets will increase the TE by 0.003. This is in line with previous authors, such as Sharma and Dalip (2014). Since the contribution of ROA in terms of measuring profit and determining the efficiency varies (Sharma & Dalip, 2014), this study conducted further analysis on the importance of ROA to determine efficiency. The comprehensive understanding of ROA is vital for optimal utilisation of the available resources. Previous studies have reported mixed results regarding the relationship between ROA and efficiency (Ahmad & Abdul Rahman, 2012; Alsarhan,

2009; Ismail *et al*., 2013; Pasiouras, 2008a; Sufian, 2007; Sufian & Noor, 2009;Yildirim, 2002).

Finally, board structure (BD_{it}) and firm age ($lnAGE_{it}$) variable have insiginifcant effects on TE of GLCs in Malaysia. The effects of board structure on GLCs' efficiency is not significant which is similar to previous findings (Cornett *et al*., 2009; Dolgopyatova, 2003). Firm age ($lnAGE_{it}$) shows insignificant value mainly because the focus is for improvement in cost minimisation in lieu with revenue and profit maximisation (Hassan *et al*., 2009) rather than depending on previous experience. Therefore, they do not pay more attention to firm age in order to increase the TE. Furthermore, the results indicate that activities and operations in GLCs are based on production diversification and technology.

Table 5.5
Fixed Effects and Random Effects (Macroeconomic Factors)

Variable	Pooled OLS	Random Effect	Fixed Effect	OLS with heteroscedasticity & serial correlation
Constant	7.366*** (6.36)	7.136*** (6.23)	6.581*** (4.45)	7.366*** (6.39)
$lnGDP_t$	0.016*** (7.75)	0.016*** (7.83)	0.016*** (8.13)	0.016*** (30.20)
$lnINFRA_t$	0.335*** (4.48)	0.323*** (4.36)	0.345** (2.55)	0.336*** (3.84)
$INFL_t$	-0.051*** (-7.98)	-0.051*** (-8.63)	-0.046*** (-8.32)	-0.052*** (-15.51)
RIR_t	-0.002*** (-2.16)	-0.002*** (-2.14)	-0.001 (-1.46)	-0.002** (-2.32)
$lnER_t$	0.013 (1.01)	0.002 (0.14)	0.011 (0.73)	0.013 (1.48)
$UNEMP_t$	-0.002 (0.892)	-0.004** (-2.22)	-0.009** (-2.13)	-0.036** (-2.07)
$lnOPENNESS_t$	0.780*** (6.50)	0.780*** (6.44)	0.630*** (5.34)	7.978*** (7.99)
Breush-Pagan LM test		59.69*** (0.00)		
Hausman Test			30.10 (11.4)	
Observations	170	170	170	170
Multicollinearity (VIF)	8.31			
Heteroskedasticity (χ^2 – stat)			301.28*** (0.000)	
Serial Correlation (F-stat)			253.154*** (0.000)	

Notes: (*) significant at 90% level, (**) significant at 95% level, (***) significant at 99% level

Based on Table 5.5, the result shows that increase in GDP growth in Malaysia ($lnGDP_{it}$) causes increase in TE of GLCs. The coefficient for this variable is positive (0.016) and statistically significant at 1% level. An increase by 1% of GDP will increase the TE by 0.016. Overall, this indicates that an increase in the value of GDP growth

causes increase in TE of GLCs as stated by previous researchers (Djokoto, 2013; Raphael, 2013; Timsina, 2014). Compared to other macroeconomic indicators, GDP tends to have the highest value of elasticity. This is due to the growth of GDP that can influence the profit of the companies rather than cost. For instance, when there is GDP growth in a country, it helps its companies to extend their markets and feel less pressured to control the expenses and become less cost efficient. The stable and positive growth of economic tends to increase the demand for the services and products produced by GLCs. Thus, this ultimately results in greater output.

The infrastructure variable ($lnINFRA_{it}$) coefficient has a positive sign (0.336) and is statistically significant at 1% level. This positive sign indicates that the infrastructure rate is directly related to TE. An increase by 1% of infrastructure development will increase the TE by 0.336. This is in line with previous authors, such as Mitra *et al*. (2013). It is reasonable because infrastructure development can cause increase in the TE of GLCs. Hence, improving infrastructure in the service sector can lead to increasing the GDP and overall efficiency of GLCs.

Inflation rate ($INFL_{it}$) has negative coefficient value (-0.052) and is significant at 1% level. An increase by 1% of inflation rate will decrease the TE by 0.052. This is supported by previous authors (Kanwal & Nadem, 2013; Zeitun, 2012) whereby in this period of analysis, when inflation increases, the efficiency level tends to decrease. Previous researchers (Francis, 2011; Kanwal & Nadem, 2013; Pasiouras & Kosmidou, 2007; Staikouras *et al*., 2008; Zeitun, 2012) proved that profitability measurement tends

to create negative inflation in most developing countries. For example, the banking sector would not be able to adjust rates and overhead costs in time that would increase faster than inflation and reduce the overall profit.

Real interest rate (RIR_{it}) shows a negative sign (- 0.002) and is statistically significant at 5% level. In basic monetary theory, it directly affects firms financially. An increase by 1% of real interest rate will decrease the TE by 0.002. This is similar to previous result by Roboli & Michaelides (2010). This is in line with the inflation rate; when there is higher inflation, real interest rate will tend to increase (Osamwonyi & Michael, 2014). According to Sastrosuwito and Suzuki (2012), when inflation variable is unanticipated as in this study, it will lead the companies, especially banks, to be slower in adjusting their interest rates which will increase the overall cost rather than the revenue which then will lead to negative profitability.

The unemployment variable ($UNEMP_{it}$) coefficient has negative sign (-0.036) and is significant at 5% level. This means that when unemployment level decreases in this particular period, the TE of GLCs increase. Thus, an increase by 1% of unemployment rate will decrease the TE by 0.036. This is supported by Garza-Garcia (2012). The negative effect of unemployment rate in Malaysia leads to low private income and increased financing. Based on theory, employment tends to increase when GDP rises and unemployment falls with rise in per capita income. Hence, higher growth tends to lower unemployment.

Finally, trade openness ($lnOPENNESS_{it}$) variable shows positive coefficient sign (7.978) and is statistically significant at 1% level. This shows that increase in trade openness can directly affect the TE of GLCs in Malaysia. This is in line with Djokoto (2013). An increase by 1% of trade openness will increase the TE by 7.978. Proponents of trade openness (Nishimizu and Page, 1991; Helleiner, 1989, 1994) have noted that trade openness promotes competition which in turn propagates pressure for increased efficiencies, product improvement, technical change and factor productivity, among other benefits. Finally, exchange rate ($lnER_{it}$) variable does not affect TE in the period of analysis.

Table 5.6
Fixed Effects and Random Effects (Interaction Terms)

Variable	Pooled OLS	Random Effect	Fixed Effect	OLS with heteroscedasticity &serial correlation
Constant	1.093*** (3.48)	1.182*** (3.64)	1.327*** (3.74)	1.093** (2.27)
$lnGDP_{it}$	0.003*** (8.80)	0.04*** (2.73)	0.003*** (8.32)	0.003*** (10.80)
$lnINFRA_{it}$	0.073*** (4.69)	0.062*** (4.17)	0.010*** (2.67)	0.073*** (5.99)
$INFL_{it}$	-0.014*** (-8.83)	-0.011*** (-4.32)	-0.010*** (-5.14)	-0.014*** (-7.09)
RIR_{it}	-0.001*** (-2.95)	-0.001*** (-2.96)	-0.001 (-2.47)	-0.001*** (-6.93)
$lnER_{it}$	0.231 (5.16)	0.211*** (4.82)	0.026 (0.27)	0.231*** (4.70)
$UNEMP_{it}$	-0.011** (2.11)	-0.032** (-2.21)	-0.015** (-1.86)	-0.021*** (-2.59)
$lnOPENNESS_{it}$	0.123*** (9.55)	0.193*** (9.75)	0.717*** (2.98)	0.123*** (15.26)
Breush-Pagan LM test		7.17*** (0.01)		
Hausman Test			7.02 (0.43)	
Observations	170	170	170	170
Multicollinearity (VIF)	9.85			
Heteroskedasticity (χ^2 – stat)			153.67*** (0.000)	
Serial Correlation (F-stat)			300.15*** (0.000)	

Notes: (*) significant at 90% level, (**) significant at 95% level, (***) significant at 99% level

Based on the result in Table 5.6, increase in GDP growth in Malaysia (GDP_t) causes increase in TE of GLCs, when there is government interaction in terms of ownership in GLCs. The coefficient for this variable is positive (0.003) and is statistically significant at

1% level. The infrastructure variable ($lnINFRA_t$) coefficient has a positive sign (0.073) and is statistically significant at 1% level.

This positive sign indicates that the infrastructure rate is directly related to TE. It is reasonable because infrastructure development can cause increase in the TE of GLCs with government intervention. Inflation rate ($INFL_t$) has negative coefficient value (0.014) and is significant at 1% level, whereby in this period of analysis, inflation decreases the efficiency level when there is government ownership in GLCs.

Real interest rate (RIR_t) shows a negative sign (0.001) and is statistically significant at 1% level. The exchange rate ($lnER_t$) variable has positive sign (0.231) and is significant at 1% level when there is interaction by government in the GLCs. This shows that exchange rate does affect TE in the period of analysis. The unemployment variable ($UNEMP_t$) coefficient has negative sign (0.021) and is significant at 1% level. This means that even though the unemployment level decreases in a particular period, the TE of GLCs increases.

Finally, trade openness ($lnOPENNESS_t$) variable shows positive coefficient sign (0.123) and is statistically significant at 1% level. This shows that increase in trade openness can directly affect the TE of GLCs in Malaysia if government ownership interacts with macroeconomic variables. Hence, government ownership can bring a better macroeconomic condition to enhance the TE of GLCs. This is supported by previous authors (Monanty *et al*., 2013; Jehu-Appiah *et al*., 2014), where government ownership can create a good value for GLCs.

Hence, ownership concentration and firm performance have a significant relationship. The equity owned by corporations, government, nominees and individuals eventually influence overall firm performance (Mat Nor, Shariff & Ibrahim, 2010). The government ownership has been used as an interaction term with macroeconomic variables that affect the overall TE of GLCs in this study. From the result, all macroeconomic variables, namely, GDP, infrastructure, inflation, real interest rate, real exchange rate, unemployment and trade openness significantly affect the level of TE in GLCs when there is government ownership that interacts with those variables.

The result shows that all variables significantly affect TE of GLCs except real exchange rate. However, when there is government ownership in those companies that plays an interacting role with exchange rate, the variable tends to be positively significant at 1% level. Hence, government ownership tends to play an important role as interaction variable in GLCs. This is supported by Lau and Tong (2008) who stated that government ownership can create value for GLCs (Jehu-Appiah *et al*., 2014; Monanty *et al*., 2013).

5.3 Results of Panel Unit Root Tests

It is important to know the stationarity properties of the data to ensure that incorrect inferences are not made. Testing for stationarity in panel data differs somewhat from conducting unit root tests in standard individual time-series; these differences are discussed as follows.

Conventional unit root tests, like the ADF test, have been found to have low testing power (Coakley *et al*., 1996; Coakley and Kulasi, 1997; Oh *et al*., 1999). The failure to reject the null of a unit root in the data by the conventional ADF unit root test may be due to low testing power of the test. Panel unit root tests have been found to have higher power than the individual unit root ADF tests. The panel unit root tests take into account both the cross-section and time-series variations in the data and these increase the power of the tests due to the increased number of observations that are available in the panel setting.

The panel unit test based on the LLC and IPS proceudres on the panel data are used to order to determine the presence of a unit root in a panel data setting and to confirm the results from the individual unit root of the ADF tests. When applying the LLC and the IPS tests, one has to be particularly careful in selecting the lag length for the ADF tests, since underestimating the true number of lags may lead to lack of power. Akaike's Information Criterion (AIC) is known for selecting the maximum relevant lag length (Shrestha and Chowdhury, 2005). McKinnon's tables provide the cumulative distribution of the LLC and the IPS test statistics. Table 5.7 and 5.8 below show the result of panel unit root test for macroeconomics and internal variables on TE of GLCs.

Table 5.7 reports the results of the LLC, IPS and ADF panel unit root tests for the data on TE (TE_{it}) of GLCs, Revenue ($lnRevenue_{it}$) of firm ***i,*** financial capital ($lnFC_{It}$), government ownership ($lnGOV_{it}$), firm size ($lnsize_{it}$), the return on assets (ROA_{it}),

board structure (BD_{it}) and firm age ($lnAge_{it}$) for both the scenarios of constant and constant plus time trend terms. The tests were run for the full sample of the 17 GLCs from the period of 2004 to 2013.

Table 5.8 reports the results of the LLC, IPS and ADF panel unit root tests for the data on TE (TE_t) of GLCs, GDP ($lnGDP_t$) of GLCs ***i,*** infrastructure ($lnINFRA_t$), inflation ($INFL_t$), real interest rate (RIR_{it}), the real exchange rate ($lnER_t$), unemployment rate ($UNEMP_t$) and trade openness ($lnOpenness_t$) for both the scenarios of constant and constant plus time trend terms. The tests were run for the full sample of the 17 GLCs from the period of 2004 to 2013.

Table 5.9 reports the results of the LLC, IPS and ADF panel unit root tests for the data on TE (TE_{it}) of GLCs, GDP ($lnGDP_{it}$) of country i, infrastructure ($lnINFRA_{It}$), inflation ($INFL_{it}$), real interest rate (RIR_{it}), the real exchange rate ($lnER_{it}$), unemployment rate ($UNEMP_{it}$) and trade openness ($lnOpenness_{it}$) for both the scenarios of constant and constant plus time trend terms when there is interaction by government ownership. The tests were run for the full sample of the 17 GLCs from the period of 2004 to 2013.

The results of the LLC, IPS and ADF panel unit root tests at the level indicating that all variables are *I*(0) constant of panel unit root regression. These results clearly show that the null hypothesis of a panel unit root in the level of the series cannot be rejected at various lag lengths. We assumed that there was no time trend. Therefore, we tested for stationarity allowing for a constant plus time trend.

As discussed above, we conclude that most of the variables are non-stationary with and without time trend specifications at level by applying the LLC, IPS and ADF tests which are also applied for heterogeneous panel to test the series for the presence of a unit root. The results of the panel unit root tests confirm that the variables are non-stationary at level.

Table 5.7, Table 5.8 and Table 5.9 also present the results of the tests at level and first difference for the LLC, IPS and ADF tests in constant and constant plus time trends. We can see that for all series, the null hypothesis of unit root test is rejected at 95% critical value (1% level). Hence, based on the LLC, IPS and ADF test, there is strong evidence that all the series are in fact integrated in first difference.

Table 5.7

Panel Unit Root Tests (Internal Factors)

	LEVEL						FIRST DIFFERENCE					
	Constant			Constant + Trend			Constant			Constant + Trend		
	LLC	IPS	ADF	LLC	IPS	ADF	LLC	IPS	ADF	LLC	IPS	ADF
TE_{it}	-2.060 (0.987)	-0.345 (0.365)	31.980 (0.567)	2.186 (0.986)	2.024 (0.979)	8.436 (1.000)	-7.376*** (0.000)	-2,771*** (0.003)	66.065*** (0.001)	-14.451*** (0.000)	-2.309** (0.011)	79.106*** (0.000)
$lnRevenue_{it}$	2.001 (0.977)	2.164 (0.985)	27.076 (0.795)	-1.450 (0.977)	1.365 (0.914)	21.706 (0.949)	-6.317*** (0.000)	-3.408*** (0.000)	70.417*** (0.000)	-12.814*** (0.000)	-4.253*** (0.000)	77.500*** (0.000)
$lnFC_{it}$	-3.792 (1.000)	-2.534 (0.932)	57.614 (0.981)	-1.127 (0.130)	-0.425 (0.336)	43.108 (0.136)	-17.547*** (0.000)	-7.004*** (0.000)	111.554*** (0.000)	-23.337*** (0.000)	-3.293*** (0.001)	86.479*** (0.000)
$lnGOV_{it}$	-38.357 (1.000)	-0.891 (0.186)	134.643 (1.000)	-12.331 (1.000)	-3.776 (1.000)	90.265 (0.853)	-8.031*** (0.000)	-5.307*** (0.000)	94.744*** (0.000)	-17.320*** (0.000)	-3.648*** (0.000)	106.462*** (0.000)
$lnSize_{it}$	-6.794 (0.989)	-1.315 (1.000)	60.420 (0.958)	-5.427 (0.970)	0.396 (0.654)	32.820 (0.525)	-10.304*** (0.000)	-4.000*** (0.000)	77.679*** (0.000)	-13.324*** (0.000)	-1.656** (0.050)	66.485*** (0.001)
ROA_{it}	9.968 (0.134)	5.243 (1.000)	85.583 (1.000)	12.152 (1.000)	1.842 (0.994)	72.475 (0.999)	17.111*** (0.000)	-0.516*** (0.000)	139.858*** (0.000)	21.872*** (0.000)	-2.256** (0.012)	98.715*** (0.000)
BD_{it}	-8.139 (1.000)	0.325 (0.627)	65.895 (0.300)	-1.390 (0.182)	2.495 (0.640)	13.400 (0.999)	-3.718*** (0.000)	8.431*** (0.000)	47.070* (0.067)	-12.561*** (0.000)	8.654*** (0.000)	95.242*** (0.000)
$lnAge_{it}$	-14.040 (0.584)	-4.932 (0.789)	77.716 (1.000)	-12.800 (0.113)	-0.615 (0.269)	57.783 (0.997)	-17.311*** (0.000)	-6.207*** (0.000)	128.231*** (0.000)	-15.374*** (0.000)	-3.035*** (0.001)	94.105*** (0.000)

Notes: The numbers in ( ) denote Probability value. The lag length is chosen on the basis of the Akaike's Information Criteria (AIC) where we specify maximum lag order (k) in autoregression and then we select appropriate lag order according to the AIC. For LLC *t*-stat, all reported values are distributed N(0,1) under null of unit root or no cointegration.

Table 5.8
Panel Unit Root Tests (Macroeconomic Factors)

	LEVEL						FIRST DIFFERENCE					
	Constant			Constant + Trend			Constant			Constant + Trend		
	LLC	IPS	ADF	LLC	IPS	ADF	LLC	IPS	ADF	LLC	IPS	ADF
TE_t	3.184 (0.999)	57.878 (1.000)	59.227 (1.000)	3.669 (0.999)	25.561 (1.000)	41.024 (0.132)	-11.152*** (0.000)	-6.087*** (0.000)	82.577*** (0.000)	-14.145*** (0.000)	2.940*** (0.002)	78.489*** (0.000)
$lnGDP_t$	-13.491 (0.998)	-6.437 (0.889)	106.297 (0.212)	-11.580 (0.224)	-1.908 (0.233)	61.568 (0.128)	-18.330*** (0.000)	-8.601*** (0.000)	142.432*** (0.000)	-15.979*** (0.000)	-2.618*** (0.004)	87.804*** (0.000)
$lnINFRA_t$	1.253 (0.155)	3.873 (0.999)	4.814 (1.000)	6.578 (1.000)	0.064 (0.475)	30.032 (1.000)	14.219*** (0.000)	6.471*** (0.000)	113.036*** (0.000)	13.517*** (0.000)	1.879** (0.030)	71.328*** (0.000)
$INFL_t$	-13.353 (0.999)	-6.400 (0.998)	105.759 (1.000)	11.890 (1.000)	-2.068 (0.119)	64.580 (0.211)	-19.942*** (0.000)	-9.580*** (0.000)	155.484*** (0.000)	-17.762*** (0.000)	-3.164*** (0.001)	99.618*** (0.000)
RIR_t	-11.292 (1.000)	-4.611 (0.871)	81.193 (0.999)	-13.820 (0.892)	-2.862 (0.953)	79.847 (0.434)	-20.749*** (0.000)	-10.019*** (0.000)	161.085*** (0.000)	-3.300*** (0.001)	-18.150*** (0.000)	102.872*** (0.000)
$lnER_t$	-6.496 (1.000)	-0.687 (0.246)	31.634 (0.584)	-13.748 (1.000)	-0.572 (0.284)	38.200 (0.284)	-13.183*** (0.000)	-5.330*** (0.000)	96.919*** (0.000)	-10.100*** (0.000)	-1. 712** (0.043)	67.755*** (0.001)
$UNEMP_t$	-16.737 (1.000)	-0.231 (0.409)	27.050 (0.796)	-14.572 (1.000)	-1.492 (0.932)	10.299 (1.000)	-11.564*** (0.000)	-3.439*** (0.000)	73.744*** (0.000)	-11.328*** (0.000)	0.873*** (0.001)	76.245*** (0.000)
$lnOPENNESS_t$	-1.142 (0.127)	3.655 (0.999)	5.349 (1.000)	-9.631 (1.000)	1.112 (0.869)	13.930 (0.999)	-7.550*** (0.000)	-2.104*** (0.018)	51.250** (0.029)	-5.991*** (0.000)	0.461*** (0.000)	33.215*** (0.000)

Notes: The numbers in ( ) denote Probability value. The lag length is chosen on the basis of the Akaike's Information Criteria (AIC) where we specify maximum lag order (k) in autoregression and then we select appropriate lag order according to the AIC. For LLC *t*-stat, all reported values are distributed N(0,1) under null of unit root or no cointegration.

Table 5.9
Panel Unit Root Tests (Interaction Terms)

	LEVEL						FIRST DIFFERENCE					
	Constant			Constant + Trend			Constant			Constant + Trend		
	LLC	IPS	ADF	LLC	IPS	ADF	LLC	IPS	ADF	LLC	IPS	ADF
TE_{it}	-2.060 (0.780)	-0.345 (0.365)	31.980 (0.567)	-1.295 (0.999)	2.024 (0.979)	8.436 (1.000)	-7.376*** (0.000)	-2.964*** (0.002)	66.065*** (0.001)	-14.451*** (0.000)	-2.309** (0.010)	79.106*** (0.000)
$lnGDP_{it}$	9.552 (0.455)	0.401 (0.656)	43.885 (0.119)	0.430 (0.666)	4.147 (1.000)	7.632 (1.000)	-2.709*** (0.003)	0.886*** (0.000)	16.388*** (0.000)	-14.432*** (0.000)	2.735*** (0.003)	89.990*** (0.000)
$lnINFRA_{it}$	7.589 (1.000)	0.333 (0.370)	61.365 (1.000)	9.746 (1.000)	3.595 (1.000)	3.257 (1.000)	9.316*** (0.000)	0.732*** (0.000)	63.535*** (0.002)	42.882*** (0.000)	4.438*** (0.000)	63.535*** (0.002)
$INFL_{it}$	-38.357 (1.000)	-13.458 (1.000)	134.643 (1.000)	24.738 (0.456)	-3.777 (1.000)	97.203 (1.000)	-12.879*** (0.000)	-5.307*** (0.000)	94.744*** (0.000)	-17.308*** (0.000)	-3.648*** (0.000)	106.462*** (0.000)
RIR_{it}	-3.560 (1.000)	-1.002 (0.158)	55.491 (1.000)	-12.550 (1.000)	-1.311 (1.000)	14.132 (1.000)	-16.692*** (0.000)	7.800*** (0.000)	128.800*** (0.000)	-9.100*** (0.000)	5.648*** (0.000)	143.585*** (0.000)
$lnER_{it}$	-8.673 (1.000)	-0.608 (0.272)	48.867 (0.447)	8.258 (0.888)	2.365 (0.991)	7.079 (1.000)	-7.773*** (0.000)	-1.357* (0.087)	57.730*** (0.007)	16.926*** (0.000)	-3.651*** (0.000)	106.026*** (0.000)
$UNEMP_{it}$	6.742 (1.000)	5.624 (1.000)	25.868 (0.840)	0.805 (0.790)	3.625 (1.000)	9.282 (1.000)	-2.561*** (0.005)	1.716*** (0.000)	33.404*** (0.000)	-11.824*** (0.000)	-1.495* (0.068)	66.961*** (0.001)
$lnOPENNESS_{it}$	4.005 (1.000)	2.087 (0.982)	62.241 (1.000)	-2.818 (1.000)	1.793 (0.964)	17.372 (0.992)	-6.571*** (0.000)	-5.002*** (0.000)	106.915*** (0.000)	-18.857*** (0.000)	-8.433*** (0.000)	118.134*** (0.000)

Notes: The numbers in ( ) denote Probability value. The lag length is chosen on the basis of the Akaike's Information Criteria (AIC) where we specify maximum lag order (k) in autoregression and then we select appropriate lag order according to the AIC. For LLC t-stat, all reported values are distributed N(0,1) under null of unit root or no cointegration.

5.4 Cointegration Test

The non-stationarity of the variables as shown by the unit root tests raises the problem of spurious regressions. The spurious regression problem can be addressed by employing cointegration methodology. However before the cointegration regression model can be estimated, it has to be first ascertained if the non-stationary variables are cointegrated with one another. The cointegration analysis is able to identify whether there is a non-spurious equilibrium relationship between the variables. Therefore, cointegration analysis was carried out on both individual and panel data to determine if the variables are cointegrated.

5.4.1 Panel Cointegration Tests

The next step is to test whether the variables are cointegrated using Pedroni's (1999, 2001, and 2004) methodology. This is to investigate whether in the long-run, steady state or cointegration exists among the variables and to confirm Oh *et al*. (1999) and Coiteux and Olivier (2000) who stated that the panel cointegration tests have much higher testing power than conventional cointegration test.

Since the variables are found to be integrated in order *I*(1), the analysis continued with the panel cointegration tests proposed by Pedroni (1999, 2001, and 2004). The results of cointegrations analyses are presented in Table 5.10 below.

Table 5.10
Panel cointegration tests
(Dependent Variable: Technical Efficiency)

	Constant		
	M1	M2	M3 (with interaction)
Panel-*v*	1.018	- 0.385	-1.930*
Panel-*ρ*	2.064**	4.126***	5.262***
Panel-*t*	-0.519	3.433***	-10.400***
Panel-*adf*	-0.976	3.562***	-3.374***
Group-*ρ*	2.232**	3.558***	8.118***
Group-*t*	-1.722*	2.388**	-2.992***
Group-*adf*	-2.045**	2.342**	0.280

Notes. All statistics are from Pedroni's procedure (1999) - the adjusted values can be compared to the N(0,1) distribution. Panel-v is a nonparametric variance ratio statistic. Panel-*p* and panel-*t* are analogous to the nonparametric. Phillips-Perron *p* and *t* statistics respectively. Panel-*adf* is a parametric statistic based on the augmented Dickey-Fuller ADF statistic. Group-*p* is analogous to the Phillips-Perron p statistic. Group-*t* and group-*adf* are analogous to the Phillips-Perron *t* statistic and the augmented Dickey- Fuller ADF statistic respectively. The Pedroni (2004) statistics are one-sided tests with a critical value of 1.64 ($k < -1.64$ implies rejection of the null), except the u-statistic that has a critical value of 1.64 ($k > 1.64$ suggests rejection of the null). Note that the means and variances used to calculate the Pedroni statistics are reported in Pedroni (1999).
***, **, * indicates rejection of the null hypothesis of no-cointegration at 1%, 5%, and 10% level of significance.
M1 to M3- refer to Model 1 to Model 3

Besides that, in M1 indicate that four out of seven statistics reject null by hypothesis of no cointegration at the 5% level of significance. Overall, results on the panel cointegration tests for GLCs with constant level represent a more reliable result. The independent variables do hold cointegration in the long-run for a group of GLCs and

between GLCs with respect to TE. As indicated by the non-parametric (*t*-statistic) and parametric (*adf*-statistic) statistics as well as group statistics that are analogous to the IPS-test statistics, the null hypothesis of non cointegration is rejected at 1% and 5% levels of significance.

Based on M2 value from Table 5.10 indicate that six out of seven statistics reject null by hypothesis of no cointegration at the 1% and 5% levels of significance except for the Panel-*v* which is not significant. Overall, results on the panel cointegration tests for GLCs with constant level represent a more reliable result. The independent variables do hold cointegration in the long-run for a group of GLCs and between GLCs with respect to TE. As indicated by the non-parametric (*t*-statistic) and parametric (*adf*-statistic) statistics as well as group statistics that are analogous to the IPS-test statistics, the null hypothesis of non cointegration is rejected at 1% and 5% levels of significance.

Finally, in M3 indicate that six out of seven statistics reject null by hypothesis of no cointegration at the 1%, 5% and 10% levels of significance, except for the Group-*adf* which is not significant. Overall, results on the panel cointegration tests for GLCs with constant level represent a more reliable result. The independent variables interacting with government ownership do hold cointegration in the long -for a group of GLCs and between GLCs with respect to TE. Overall in Table 5.10 indicate that most panel statistics are reliable.

5.5 Cointegration Estimation Results - FMOLS

The previous section confirms that all variables among the GLCs and between the GLCs are cointegrated. In other words, a long-run equilibrium exists among the variables. This section discusses the estimated long-run equation. Following Pedroni (2000 and 2001), cointegrating explanatory variables for the data is estimated using the FMOLS technique.

Dreger and Reimers (2005) pointed out that it is important to take note that the panel cointegration tests do not provide an estimate of the long-run relationship. More or less, the cointegration vector should be common for the panel members, as fundamental economic principles are involved. In fact, the asymptotic distribution of the OLS estimator depends on nuisance parameters. In a panel environment, this problem seems to be more serious, as the bias can accumulate with the size of the cross-section.

As Pedroni (2000) showed, the problem is amplified in a panel setting by the potential dynamic heterogeneity over the cross-sectional dimension. Specifically, as this dimension increases, second order biases could be expected to occur by the poor performance of the estimators designed for large samples as they are averaged over the panel's members. For this reason, the modified FMOLS methodology make inferences in cointegrated panels with heterogeneous dynamics as the cross-sectional dimension becomes large even with relatively short time-series (Al-Awad and Harb, 2005).

Table 5.11
FMOLS (Individual) Results, With Time Dummies
Dependent variable: Technical Efficiency ($lnTE_{it}$)(Internal Factors)

	$lnREV_{it}$	$lnFC_{it}$	$lnGOV_{it}$	$lnSIZE_{it}$	ROA_{it}	BD_{it}	$lnAGE_{it}$
AFFIN	-1.67 (-1.28)	-0.14 (-1.07)	0.09 (0.41)	0.05 (1.61)	0.19 (1.08)	0.12 (1.25)	-0.09 (-0.30)
TM	-2.41* (-1.71)	-0.25** (-2.50)	0.71*** (5.67)	0.03** (2.48)	-0.06 (-1.12)	0.10*** (3.72)	0.68** (2.02)
AXIATA	2.21** (2.36)	-0.18** (-2.04)	0.24*** (4.48)	0.20 (0.08)	-0.17*** (3.49)	-0.14 (-0.16)	0.01 (0.08)
BIMB	-0.16 (-0.76)	0.11 (0.58)	-0.26 (-0.65)	-0.24 (-0.54)	0.01* (1.90)	0.12 (0.11)	-0.03 (-0.73)
BOUSTEAD	1.30 (1.15)	-0.14* (-1.76)	0.61*** (3.84)	0.16*** (6.15)	0.07*** (2.80)	-0.01** (-2.44)	-0.74*** (-3.02)
CCM	-1.15 (-0.87)	0.28*** (3.01)	-0.09 (-0.08)	0.09*** (3.56)	0.11** (2.11)	0.14 (1.44)	0.23 (0.96)
CIMB	1.07* (0.84)	-0.23** (-2.44)	0.74*** (4.52)	0.12** (2.98)	0.08** (2.62)	-0.11** (-2.00)	-0.32 (-1.12)
AIRPORT	-1.06 (-0.45)	-0.12 (-0.81)	0.55 (1.53)	0.13* (1.87)	0.17*** (3.27)	-0.12 (-1.27)	-0.03 (-0.05)
MAS	-3.73*** (-3.79)	-0.25*** (-5.18)	-0.05*** (-2.92)	0.01 (1.22)	0.14*** (4.18)	-0.17 (-1.27)	0.13 (1.10)
MBSB	-3.96 (-0.80)	-0.18 (-0.29)	-0.19 (-0.74)	0.28*** (3.97)	0.10 (1.18)	0.24 (1.26)	1.25 (1.20)
MRC	-2.87 (-1.43)	0.04 (0.50)	0.06 (0.73)	-0.03 (-1.28)	0.02 (0.65)	-0.22 (-0.24)	0.89** (2.04)
SIME DARBY	8.03** (1.99)	0.37*** (2.75)	-0.03* (-1.77)	-0.01 (-1.85)	0.03 (0.70)	-0.20 (-1.43)	-1.91** (-2.51)
TH PLANTATIONS	-3.77*** (-2.63)	-0.13 (-1.44)	-0.15** (-2.92)	-0.26 (-0.93)	0.41 (0.22)	0.23 (0.42)	0.59 (1.90)
TNB	-3.09 (-0.95)	-0.11 (-0.63)	-0.30 (-0.89)	0.04 (1.09)	0.06 (1.10)	0.09** (2.22)	0.65 (0.92)
UMW	1.83*** (2.74)	0.05 (1.44)	-0.01** (-2.34)	0.02*** (6.62)	0.03** (2.11)	0.57 (0.62)	-0.43*** (-3.06)
MAYBANK	2.45 (1.15)	-0.65*** (-2.19)	0.70* (1.90)	-0.21 (-1.59)	0.12 (1.18)	-0.52* (-1.93)	-1.49*** (-2.65)
UEM	3.73 (1.23)	0.17** (2.34)	-0.03 (-0.46)	0.11 (0.18)	0.03 (0.50)	-0.23 (-0.63)	-1.12 (-1.55)

As can be seen from the Table 5.11, AFFIN shows that the estimate of coefficient for all independent variables is not significant. The results indicate that all independent variables do not have long-run cointegration to TE among all GLCs.

Table 5.11 indicates that the estimate of coefficient for rate of revenue ($lnREV_{it}$) for TM is negative (2.41) and statistically significant at 10% level, while rate of financial capital ($lnFC_{it}$) is negative (0.25) and statistically significant at 5% level. An increase by 1% in revenue and financial capital will decrease the TE by 2.41 and 0.25, respectively. The estimate of firm size ($lnSIZE_{it}$) and firm age ($lnAGE_{it}$) is both positive (0.03) and (2.02) and statistically significant at 5% level. Government ownership ($lnGOV_{it}$) and board structure (BD_{it}) are statistically significant at 1% level with the value of 0.71 and 0.01, respectively. An increase by 1% in firm size, firm age, board structure and government ownership will increase the TE of TM by (0.03), (2.02), (0.71) and (0.01), respectively. The results show that only one independent variable, that is return on assets (ROA_{it}) does not have long-run cointegration to TE among GLCs.

Axiata shows the estimate of coefficient for government ownership ($lnGOV_{it}$) and return on assets (ROA_{it}) is positive (0.24) and negative (0.07) and statistically significant at 1% level. The estimate of coefficient rate of financial capital ($lnFC_{it}$) is negative (- 0.08) and statistically significant at 5% level. An increase in financial capital and government ownership by 1% will decrease the TE by (0.08) and (0.07), respectively. Similarly, value of rate of revenue ($lnREV_{it}$) is positive with the value of (2.21) and statistically significant at 5% level. An increase by 1% per cent in return on assets (ROA_{it}) and

revenue will increase the TE by (0.24) and (2.21), respectively. The results show that only four independent variables have long-run cointegration to TE.

BIMB coefficient value indicates that only the estimate of coefficient for return on assets (ROA_{it}) is significant with a positive value (0.01). An increase by 1% in return on assets will increase the TE by 0.01. These results show that all independent variables do not have long-run cointegration to TE among all GLCs except for return on assets.

For Boustead, the estimate of coefficient for government ownership($lnGOV_{it}$), firm size ($lnSIZE_{it}$), return on assets (ROA_{it}), and firm age ($lnAGE_{it}$) are statistically significant at 1% level with positive value (0.61), (0.06) and (0.07), respectively, except for firm age with negative value (0.74). An increase in government ownership, firm size and return on assets by 1% will increase the TE by (0.61), (0.06) and (0.07), respectively. The estimate of board structure (BD_{it}) is negative (0.01) and statistically significant at 5% level. The estimate of rate of financial capital ($lnFC_{it}$) is negative (0.14) and statistically significant at 10% level. An increase in firm age, board structure and financial capital will decrease the TE by (0.74), (0.01) and (0.14), repectively. These results show that six independent variables (except rate of revenue) have long-run cointegration to TE among all GLCs.

For CCM, it is apparent that very few variables show siginifcant value towards TE. The estimate of coefficient for rate of financial capital ($lnFC_{it}$) and firm size ($lnSIZE_{it}$) is positive (0.28) and (0.09) and statistically significant at 1% level. Moreover, the estimate of

coefficient for return on assets (ROA_{it}) is positive (0.11) and statistically significant at 5% level. An increase by 1% in financial capital, firm size and return on assets will increase the TE by (0.28), (0.09) and (0.11), respectively. These results show that only three independent variables have long-run cointegration to TE among all GLCs.

For CIMB in Table 5.11, the estimate of coefficient for government ownership ($lnGOV_{it}$) is positive (0.74) and statistically significant at 1% level. An increase by 1% in government ownership will increase the TE by (0.74). Four variables are significant at 5% level, rate of financial capital ($lnFC_{it}$), firm size ($lnSIZE_{it}$), return on assets (ROA_{it}), board structure (BD_{it}) with negative value (0.23), (0.02), (0.08) and (0.01), respectively. An increase by 1% in financial capital, firm size, return on assets and board structure will decrease the TE by (0.23), (0.02), (0.08) and (0.01), respectively. These results show that all independent variables (except rate of revenue and firm age) have long-run cointegration to TE among all GLCs.

For Airport in Table 5.11, the estimate of coefficient for all variables is not significant except for return on assets and firm size. The estimate of coefficient for return on assets (ROA_{it}) is positive (0.17) and statistically significant at 1% level while firm size ($lnSIZE_{it}$) is statistically significant at 10% level with positive coefficient value (0.03). An increase by 1% in return on assets and firm size will increase the TE by (0.17) and (0.03), respectively. These results show only return on assets and firm size have long-run cointegration to TE among all GLCs.

For MAS in Table 5.11, the estimate of coefficient for rate of revenue ($lnREV_{it}$), rate of financial capital ($lnFC_{it}$), government ownership ($lnGOV_{it}$) and return on assets (ROA_{it}) is significant at 1% level with negative value (-3.73), (-0.25), (-0.05) and positive value (0.14), respectively. An increase by 1% in revenue, financial capital and government ownership will decrease the TE by (3.73), (0.25) and (0.05), respectively; while, an increase by 1% in return on assets will increase the TE by (0.14). Hence only firm age, firm size and board structure do not have long-run cointegration to TE among all GLCs.

MBSB in Table 5.11 shows the estimate of coefficient for most independent variables is not significant. Only firm size ($lnSIZE_{it}$) is significant at 1% level with positive value (0.28). An increase by 1% in firm size will increase the TE by (0.28). These results show that all independent variables do not have long-run cointegration to TE among all GLCs, except firm size.

MRC shows the estimate of coefficient for most independent variables is not significant. Only firm age ($lnAGE_{it}$) is significant at 5% level with positive value (0.89). An increase by 1% in firm age will increase the TE by (0.89). These results show that all independent variables do not have long-run cointegration to TE among all GLCs, except firm age.

Sime Darby shows the estimate of coefficient for rate of revenue ($lnREV_{it}$) and firm age ($lnAGE_{it}$) is significant at 5% level with positive value (8.03) and negative value (-

1.91). The rate of financial capital ($lnFC_{it}$) is significant at 1% level with positive value (0.37). An increase by 1% in revenue and financial capital will increase the TE by (8.03) and (0.37). The estimate of coefficient for government ownership ($lnGOV_{it}$) is significant at 10% level with negative value (-0.03). An increase by 1% in government ownership and firm age will decrease the TE by (0.03) and (1.91), respectively.

For TH Plantations in Table 5.11, the estimate of coefficient for rate of revenue ($lnREV_{it}$) is negative (3.77) and statistically significant at 1% level. The estimate of coefficient for government ownership ($lnGOV_{it}$) is negative (-0.05) and statistically significant at 5% level. An increase by 1% in revenue and government ownership will decrease the TE by (3.77) and (0.05), respectively. These results show that all independent variables (except rate of revenue and government ownership) do not have long-run cointegration to TE among all GLCs.

For TNB in Table 5.11, it shows there is one independent variable that is significant at 10% level with positive value (0.09), that is the estimate of coefficient for board structure (BD_{it}). An increase by 1% in board structure will increase the TE by (0.09). Hence all independent variables do not have long-run cointegration to TE among all GLCs, except board structure.

For UMW in Table 5.11, it shows the estimate of coefficient for rate of revenue ($lnREV_{it}$), government ownership ($lnGOV_{it}$), firm size ($lnSIZE_{it}$), return on assets (ROA_{it}) and firm age ($lnAGE_{it}$) is significant. The variables, rate of revenue

($lnREV_{it}$), firm size ($lnSIZE_{it}$) and firm age ($lnAGE_{it}$) show significant sign at 1% level with positive value (1.83) and (0.02) and negative value (0.43). An increase by 1% in revenue and firm size will increase the TE by (1.83) and (0.02), respectively. The estimate of coefficient for government ownership ($lnGOV_{it}$) and return on assets (ROA_{it}) is significant at 5% level with negative value (0.01) and (0.03), respectively. An increase by 1% in firm age, government ownership and return on assets will decrease the TE by (0.43), (0.01) and (0.03), respectively. Hence, board structure and financial capital do not have long-run cointegration to TE among all GLCs.

Maybank in Table 5.11 shows the estimate of coefficient for rate of financial capital ($lnFC_{it}$) and firm age ($lnAGE_{it}$) is negative (0.65) and (1.49) and statistically significant at 1% level. The estimate of coefficient for government ownership ($lnGOV_{it}$) is negative (0.65) and statistically significant at 5% level. Similarly, the estimate of coefficient for board structure (BD_{it}) is negative (0.01) and statistically significant at 10% level. An increase by 1% in financial capital, firm age and government ownership will decrease the TE by (0.65), (1.49) and (0.65), respectively. These results show that four independent variables (except rate of revenue, firm size and return on assets) have long-run cointegration to TE among all GLCs.

UEM shows there is one independent variable that is significant at 5% level with positive value (0.17), that is the estimate of coefficient for rate of financial capital ($lnFC_{it}$). An increase by 1% in financial capital will increase the TE by (0.17). Hence, all independent

variables do not have long-run cointegration to TE among all GLCs except financial capital.

Table 5.12
FMOLS (Group) Results With Time Dummies
Dependent variable: Technical Efficiency ($lnTE_{it}$)(Internal Factors)

$lnREV_{it}$	$lnFC_{it}$	$lnGOV_{it}$	$lnSIZE_{it}$	ROA_{it}	BD_{it}	$lnAGE_{it}$
-0.19	-0.08**	0.18**	0.02***	0.05***	0.08	-0.10
(0.78)	(-2.36)	(2.50)	(6.21)	(5.09)	(0.12)	(-1.16)

In relationship between the GLCs in Table 5.11, most of variables reported that the tests reject the null hypotheses of non-cointegration at 1%, 5% and 10% levels.

It also applies to Table 5.12 that almost all variables are statistically significant at 1% and 5% levels, whereby tests reject the null hypotheses of non-cointegration, except rate of revenue, board structure and firm age. These results suggest that there is an association between internal factors of GLCs on TE, except for rate of revenue, board structure and age of firms. An increase by 1% in government ownership, firm size and return on assets will increase the TE by (2.50), (6.21) and (5.09), respectively; while, increase by 1% in rate of financial capital will decrease the TE by (2.36).

Table 5.13
FMOLS (Individual) Results, With Time Dummies
Dependent variable: Technical Efficiency ($lnTE_{it}$)(Macroeconomic Factors)

	$lnGDP_t$	$lnINFRA_i$	$INFL_i$	RIR_t	$lnER_t$	$UNEMP_t$	$lnOPENNESS_t$
AFFIN	-0.40 (-0.53)	-0.89 (-1.58)	-0.28 (-0.30)	-0.09* (-1.71)	-0.19* (-1.66)	0.08 (0.63)	4.31** (2.31)
TM	-0.41 (-0.56)	0.17 (0.20)	2.44* (1.80)	-0.10 (-1.35)	-0.23 (-1.35)	0.11 (0.84)	2.25 (0.82)
AXIATA	-0.04*** (-3.36)	1.37*** (3.70)	2.07*** (3.40)	0.13*** (3.85)	0.29*** (3.75)	0.22 (0.49)	-1.75 (-1.43)
BIMB	0.24 (1.45)	-0.16 (-0.94)	-0.16 (-1.42)	-0.16 (-0.62)	-0.13* (-1.90)	-0.18 (-0.00)	-0.36 (-1.60)
BOUSTEAD	0.08* (2.20)	-1.24*** (-4.14)	-1.63*** (-3.30)	-0.09*** (-3.34)	0.06 (0.94)	-0.09 (-1.37)	3.18*** (3.20)
CCM	-0.05*** (-3.70)	-2.14*** (-5.21)	1.05 (1.55)	-0.15*** (-3.94)	0.42*** (4.91)	-0.01 (-1.39)	10.37*** (7.68)
CIMB	-0.02* (-1.81)	-0.93*** (2.71)	-0.56 (-0.99)	-0.10*** (-3.06)	-0.02 (-0.35)	-0.12* (-1.95)	6.30*** (5.57)
AIRPORT	0.11 (0.63)	-1.28** (2.50)	-1.69** (-2.00)	-0.19*** (-3.99)	0.25** (2.37)	-0.02*** (-3.06)	2.01* (1.19)
MAS	0.12 (0.28)	0.38 (0.85)	1.04 (1.41)	-0.06 (-1.47)	-0.04 (-0.44)	-0.01 (-1.04)	0.53 (0.36)
MBSB	0.13** (2.35)	3.29*** (7.08)	1.33* (1.74)	-0.12 (-0.48)	0.24** (2.52)	-0.13 (-0.73)	-3.73** (-2.43)
MRC	-0.12 (-0.22)	-1.48*** (-4.46)	-2.51*** (-4.61)	0.01 (0.08)	0.42*** (6.11)	-0.12 (-1.03)	5.36*** (4.91)
SIME DARBY	0.13*** (4.10)	-1.54*** (-5.86)	-3.39*** (-7.86)	-0.04* (-1.87)	0.17 (1.25)	-0.10 (-0.87)	-1.04 (-1.20)
TH PLANTATIONS	0.04*** (4.38)	-0.59** (-1.99)	-1.12** (-2.31)	0.11 (0.38)	-0.03 (-0.43)	0.11* (1.87)	-1.65* (-1.70)
TNB	-0.12 (-0.18)	0.86 (1.20)	1.59 (1.34)	-0.15** (-2.21)	0.11 (0.71)	-0.10 (-0.37)	2.55 (1.07)
UMW	-0.13 (-0.23)	-0.37 (-1.44)	0.06 (0.14)	-0.15** (-2.18)	0.11 (0.15)	-0.20 (-1.21)	1.52* (1.79)
MAYBANK	0.16*** (7.14)	-0.27 (-0.36)	-5.80*** (-4.77)	-0.03 (-0.40)	-0.51*** (-3.34)	-0.10 (-0.13)	-14.96*** (-6.15)
UEM	0.12 (0.73)	-1.01 (-1.41)	-0.94 (-0.80)	-0.16** (-2.42)	-0.25* (-1.69)	-0.12 (-0.46)	1.47 (0.62)

AFFIN in Table 5.13 shows the estimate for real interest rate (RIR_t) is negative (-0.09) and statistically significant at 10% level. The estimate for the real exchange rate ($lnER_t$) is negative (-0.19) and statistically significant at 10% level. An increase by 1% in real interest rate and inflation will decrease the TE by (0.09) and (0.19), respectively. The estimate of trade openness ($lnOPENNESS_t$) is positive (4.31) and statistically significant at 5% level. An increase by 1% in trade openness will increase the TE by (4.31). These results show that all only three independent variables, which are real interest rate, exchange rate and trade openness, have long-run cointegration to TE among all GLCs.

For TM in Table 5.13, the estimate of coefficient for inflation ($INFL_t$) is positive (2.44) and statistically significant at 10% level. An increase by 1% in inflation will increase the TE by (2.44). These results show that only one independent variable, that is inflation rate, has long-run cointegration to TE among GLCs.

Axiata shows the estimate of coefficient for real gross domestic product ($lnGDP_t$) is negative (0.04) and statstically significant at 1% level. The estimate of coefficient for infrastructure ($lnINFRA_t$) is positive (1.37) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_t$) is positive (2.07) and statistically significant at 1% level. The estimate of real interest rate (RIR_t) is positive and statistically significant at 1% level. The estimate of real exchange rate ($lnER_t$) is positive (0.29) and statistically significant at 1% level. An increase by 1% in GDP, infrastructure, inflation, real interest rate and exchange rate will increase the TE by (0.04), (1.37), (2.07) and (0.29),

respectively. These results show that all independent variables have long-run cointegration to TE among all GLCs, except unemployment and trade openness.

For BIMB in Table 5.13, the estimate for the real exchange rate ($lnER_t$) is negative (0.13) and statistically significant at 10% level. An increase by 1% in real exchange rate will decrease the TE by (0.13). These results show that all independent variables do not have long-run cointegration to TE among all GLCs, except exchange rate.

For Boustead in Table 5.13, the estimate of coefficient for real gross domestic product ($lnGDP_t$) is positive (0.08) and statistically significant at 10% level. The estimate of coefficient for infrastructure ($lnINFRA_t$) is negative (1.24) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_t$) is negative (1.63) and statically significant at 1% level. The estimate for real interest rate (RIR_t) is negative (0.09) and statistically significant at 1% level. An increase by 1% in infrastructure, inflation and real interest rate will decrease the TE by (1.24), (1.63) and (0.09), respectively. The estimate of trade openness ($lnOPENNESS_t$) is positive (3.18) and statistically significant at 1% level. An increase by 1% in GDP and trade openness will increase the TE by (0.08) and (3.18), respectively. These results show that five independent variables, except exchange rate and unemployment, have long-run cointegration to TE among all GLCs.

For CCM in Table 5.13, the estimate of coefficient for real gross domestic product ($lnGDP_t$) is negative (0.05) and statistically significant at 1% level. The estimate of

coefficient for infrastructure ($lnINFRA_t$) is negative (1.24) and statistically significant at 1% level. The estimate of real interest rate (RIR_t) is negative (0.15) and statistically significant at 1% level. An increase by 1% in GDP, infrastructure and real interest rate will decrease the TE by (0.05), (1.24) and (0.15), respectively. The estimate of real exchange rate ($lnER_t$) is positive (0.42) and statistically significant at 1% level. The estimate of trade openness ($lnOPENNESS_t$) is positive (10.37) and statistically significant at 1% level. An increase by 1% in real exchange rate and trade openness will increase the TE by (0.42) and (10.37), respectively. These results show that all independent variables, except inflation rate and unemployment, have long-run cointegration to TE among all GLCs.

For CIMB in Table 5.13, the estimate of coefficient for real gross domestic product ($lnGDP_t$) is negative (0.02) and statistically significant at 10% level. The estimate of coefficient for infrastructure ($lnINFRA_t$) is negative (0.93) and statistically significant at 1% level. The estimate for real interest rate (RIR_t) is negative and statistically significant at 1% level. The estimate of coefficient for unemployment rate ($UNEMP_t$) is negative (0.01) and statistically significant at 10% level. An increase by 1% in GDP, infrastructure, real interest rate and unemployment will decrease the TE by (0.02), (0.93) (0.01) and (0.12), respectively. The estimate for trade openness ($lnOPENNESS_t$) is positive (6.30) and statistically significant at 1% level. An increase by 1% in trade openness will increase the TE by (6.30). These results show that all independent variables (except inflation rate and exchange rate) have long-run cointegration to TE among all GLCs.

For Airport in Table 5.13, the estimate of coefficient for three independent variables, infrastructure ($lnINFRA_t$), inflation ($INFL_t$) and real exchange rate ($lnER_{it}$) is negative (-1.28) and (-1.69) and positive (0.25) and statistically significant at 5% level while real interest rate (RIR_t) and unemployment rate ($UNEMP_t$) are statistically significant at 1% level with negative coefficient value (0.19) and (0.02), respectively. An increase by 1% in infrastructure, inflation, real interest rate and unemployment will decrease the technical efficiency by (1.28), (1.69), (0.19) and (0.02), respectively. The estimate of coefficient for trade openness ($lnOPENNESS_t$) is positive (2.01) and statistically significant at 10% level. An increase by 1% in real exchange rate and trade openness will increase the TE by (0.25) and (2.01), respectively. These results show that all independent variables (except Gross Domestic Product) have long-run cointegration to TE among all GLCs.

For MAS in Table 5.13, the estimate of coefficient for all independent variables is not significant. These results show that all independent variables do not have long-run cointegration to TE among all GLCs. For MBSB in Table 5.13, the estimate of coefficient for real gross domestic product ($lnGDP_t$) is positive (0.03) and statistically significant at 5% level. The estimate of coefficient for infrastructure ($lnINFRA_t$) is positive (3.29) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_t$) is positive (1.33) and statistically significant at 10% level. The estimate of the real exchange rate ($lnER_t$) is positive (0.24) and statistically significant at 5% level. An increase by 1% in GDP, infrastructure, inflation and real exchange rate will

increase the TE by (0.03), (3.29), (1.33) and (0.24), respectively. The estimate of trade openness ($lnOPENNESS_i$) is negative (3.73) and statistically significant at 5% level. An increase by 1% in trade openness will decrease the TE by (3.73). These results show that all independent variables (except real interest rate and unemployment) have long-run cointegration to TE among all GLCs.

For MRC in Table 5.13, the estimate of coefficient for infrastructure ($lnINFRA_t$) is negative (1.48) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_t$) is negative (2.51) and statistically significant at 1% level. An increase by 1% in infrastructure and inflation will decrease the TE by (1.48) and (2.51), respectively. The estimate for the real exchange rate ($lnER_t$) is positive (0.42) and statistically significant at 1% level. The estimate for trade openness ($lnOPENNESS_t$) is positive (5.36) and statistically significant at 1% level. An increase by 1% in real exchange rate and trade openness will increase the TE by (0.42) and (5.36), respectively. These results show that all independent variables (except real interest rate and unemployment rate) have long-run cointegration to TE among all GLCs.

For Sime Darby in Table 5.13, the estimate of coefficient for real gross domestic product ($lnGDP_t$) is positive (0.13) and statstically significant at 1% level. An increase by 1% in GDP will increase the TE by (0.13). The estimate of coefficient for infrastructure ($lnINFRA_t$) is negative (1.54) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_t$) is negative (3.39) and statistically significant at 1% level. The estimate of real interest rate (RIR_t) is negative (0.04) and statistically

significant at 10% level. An increase by 1% in infrastructure, inflation and real interest rate will decrease the TE by (1.54), (3.39) and (0.04), respectively. These results show that all independent variables have long-run cointegration to TE among all GLCs (except real exchange rate, unemployment rate and trade openness).

For TH Plantations in Table 5.13, the estimate of coefficient for real gross domestic product ($lnGDP_t$) is positive (0.04) and statistically significant at 1% level. The estimate of coefficient for infrastructure ($lnINFRA_t$) is negative (0.59) and statistically significant at 5% level. The estimate of coefficient for inflation ($INFL_t$) is negative (1.12) and statistically significant at 5% level. The estimate of coefficient for unemployment rate ($UNEMP_t$) is positive (0.11) and statistically significant at 10% level. An increase by 1% in GDP and unemployment will increase the TE by (0.04) and (0.11), respectively. The estimate for trade openness ($lnOPENNESS_t$) is negative (1.65) and statistically significant at 1% level. An increase by 1% in infrastructure, inflation and trade openness will decrease the TE by (0.59), (1.12) and (1.65), respectively. These results show that all independent variables (except real interest rate and exchange rate) have long-run cointegration to TE among all GLCs.

For TNB in Table 5.13, the estimate of coefficient for all independent variables is not significant except real interest rate (RIR_t) with negative coefficient (0.15) and statistically significant at 5% level. An increase by 1% in real interest rate will decrease the TE by (0.15). These results show that all independent variables do not have long-run cointegration to TE among all GLCs (except real interest rate).

For UMW in Table 5.13, the estimate of coefficient for all independent variables is not significant except real interest rate (RIR_{it}) with negative coefficient (0.15) and statistically significant at 5% level and trade openness ($lnOPENNESS_t$) is positive (1.52) and statistically signifanct at 10% level. An increase by 1% in trade openness will increase the TE by (1.52); while, an increase by 1% in real interest rate will decrease the TE by (0.15). These results show that all independent variables do not have long-run cointegration to TE among all GLCs (except real interest rate and trade openness).

For Maybank in Table 5.13, the estimate of coefficient for real gross domestic product ($lnGDP_t$) is positive (0.16) and statistically significant at 1% level. An increase by 1% in GDP will increase the TE by (0.16). The estimate of coefficient for inflation ($INFL_t$) is negative (5.80) and statistically significant at 1% level. The estimate for the real exchange rate ($lnER_t$) is negative (0.51) and statistically significant at 1% level. The estimate for trade openness ($lnOPENNESS_t$) is negative (4.31) and statistically significant at 1% level. An increase by 1% in inflation, real exchange rate and trade openness will decrease the TE by (5.80), (0.51) and (4.31), respectively. These results show that all independent variables (except infrastructure, real interest rate and unemployment rate have long-run cointegration to TE among all GLCs.

For UEM in Table 5.13, the estimate of coefficient for all independent variables is not significant except real interest rate (RIR_t) with the negative coefficient (0.15) and statistically significant at 5% level and real exchange rate ($lnER_t$) with negative

coefficient (0.25) and statistically significant at 10%. An increase by 1% in real interest rate and real exchange rate will decrease the TE by (0.15) and (0.25), respectively. These results show that all independent variables do not have long-run cointegration to TE among all GLCs (except real interest rate and real exchange rate).

Table 5.14
FMOLS (Group) Results, With Time Dummies
Dependent variable: Technical Efficiency ($lnTE_{it}$)(Macroeconomic Factors)

$lnGDP_t$	$llnINFRA_{it}$	$INFL_t$	RIR_t	$lnER_t$	$UNEMP_t$	$lnOPENNESS_t$
0.11***	0.34***	-0.50***	-0.06***	0.13	-0.10**	0.96***
(3.10)	(4.75)	(-4.12)	(-6.00)	(0.03)	(-2.37)	(3.64)

From Table 5.13, most of variables reported that the tests reject the null hypotheses of non-cointegration at 1%, 5% and 10% levels. It also applies to Table 5.14, where almost all variables are statistically significant at 1% and 5% levels, whereby the tests reject the null hypotheses of non-cointegration, except exchange rate. An increase by 1% in GDP, infrastructure, and trade openness will increase the TE by (0.11), (0.34) and (0.96), respectively. On the other hand, increase by 1% in inflation, real interest and unemployment will decrease the TE by (0.50), (0.06) and (0.10), respectively.

Table 5.15

FMOLS (Individual) Results, With Time Dummies

Dependent variable: Technical Efficiency ($lnTE_{it}$)(Interaction Terms)

	$lnGDP_{it}$	$lnINFRA_{it}$	$INFL_{it}$	RIR_{it}	$lnER_{it}$	$UNEMP_{it}$	$lnOPENNESS$
AFFIN	0.04 (0.22)	-0.13 (-0.92)	-0.14** (-2.20)	-0.01 (-1.30)	-0.01 (-0.75)	0.01 (0.87)	0.35 (1.35)
TM	0.07 (0.41)	-0.08 (-0.78)	0.04 (0.37)	-0.01 (-1.35)	-0.02 (-0.67)	0.02 (0.88)	0.09 (0.32)
AXIATA	-0.16*** (-4.39)	-0.05 (-0.68)	0.21*** (6.55)	0.01*** (3.10)	0.02*** (2.95)	0.14 (0.59)	-0.08 (-0.59)
BIMB	0.15 (0.17)	0.01 (0.86)	0.01 (0.90)	-0.32 (-0.40)	-0.01* (-1.92)	0.12 (0.14)	-0.02 (-0.90)
BOUSTEAD	0.21 (0.49)	-0.14*** (-4.12)	-0.09 (-1.50)	-0.01 (-1.50)	0.01 (1.00)	-0.20 (-0.77)	0.34*** (3.47)
CCM	-0.10 (-0.08)	-0.33*** (-3.38)	-0.18*** (-2.68)	-0.02*** (-2.88)	0.05*** (2.63)	-0.27 (-1.13)	0.71*** (3.49)
CIMB	-0.12 (-1.46)	-0.24*** (-4.83)	-0.12*** (-2.82)	-0.01*** (-3.74)	-0.02** (-2.12)	-0.18** (-1.99)	0.60*** (6.03)
AIRPORT	0.02*** (3.59)	0.10** (1.88)	-0.17 (-4.35)	-0.02*** (-5.05)	0.03*** (3.13)	-0.02*** (-3.30)	-0.08 (-0.69)
MAS	0.01*** (2.78)	-0.05 (-0.85)	-0.02 (-0.42)	-0.01** (-1.96)	0.03 (0.37)	-0.04 (-0.68)	0.07 (0.51)
MBSB	0.01*** (4.84)	0.31*** (3.83)	0.11 (1.19)	-0.01 (-1.62)	0.07*** (4.03)	-0.02 (-1.13)	-0.62*** (-3.49)
MRC	-0.02 (-0.29)	-0.26*** (-5.74)	-0.42*** (-8.92)	-0.14 (-0.67)	0.05*** (5.49)	-0.03 (-1.35)	0.84*** (7.17)
SIME DARBY	-0.10 (-0.59)	-0.09** (-2.57)	-0.14** (-2.24)	-0.02 (-1.26)	0.01 (0.99)	-0.14 (-0.72)	0.29*** (2.75)
TH PLANTATIONS	0.02 (1.11)	-0.07 (-0.83)	0.02 (0.40)	0.01 (1.39)	0.01 (0.64)	0.03** (2.40)	0.10 (0.58)
TNB	0.06** (2.00)	0.08 (1.24)	0.03 (0.50)	-0.01** (-1.95)	0.02 (0.07)	-0.12 (-0.13)	-0.16 (-0.98)
UMW	0.07 (0.40)	-0.04 (-1.24)	0.01 (0.19)	-0.01 (-1.49)	0.04 (0.26)	-0.02 (-1.35)	0.05 (0.66)
MAYBANK	0.01*** (4.12)	0.62*** (4.12)	0.29*** (3.40)	0.01 (0.72)	-0.07*** (-3.34)	0.12 (0.60)	-1.45*** (-3.95)
UEM	0.06 (0.25)	-0.08 (-0.88)	-0.01 (-0.10)	-0.01 (-1.41)	-0.02 (-1.30)	-0.03 (-0.06)	0.16 (0.63)

The estimate of coefficient for inflation ($INFL_{It}$) in Affin is negative (0.14) and statistically significant at 5% level. These results show that only inflation rate has long-run cointegration to TE when interacting with government ownership among all GLCs. An increase by 1% in inflation rate will decrease the TE by (0.14). Besides that, TM also shows that none of the independent variables has long-run cointegration to TE when interacting with government ownership among all GLCs.

For Axiata in Table 5.15, the estimate of coefficient for real gross domestic product ($lnGDP_{it}$) is negative (0.16) and statistically significant at 1% level. An increase by 1% in GDP will decrease the TE by (0.16). The estimate of coefficient for inflation ($INFL_{It}$) is positive (0.21) and statistically significant at 1% level. The estimate of real interest rate (RIR_{it}) is positive (0.01) and statistically significant at 1% level. The estimate of the real exchange rate ($lnER_{it}$) is positive (0.02) and statistically significant at 1% level. An increase by 1% in inflation rate, real interest rate and real exchange rate will increase the TE by (0.21), (0.01) and (0.02), respectively. These results show that four independent variables, gross domestic product, inflation, real interest rate and real exchange rate, have long-run cointegration to TE when interacting with government ownership.

For BIMB in Table 5.15, the estimate for the real exchange rate ($lnER_{it}$) is negative (0.01) and statistically significant at 1% level. An increase by 1% in real exchange rate will decrease the TE by (0.01). These results show that only real exchange rate has long-run cointegration to TE when interacting with government ownership among all GLCs.

Boustead shows the estimate coefficient for infrastructure ($lnINFRA_{it}$) is negative (0.14) and statistically significant at 1% level. An increase by 1% in infrastructure will decrease the TE by (0.14). The estimate of trade openness ($lnOPENNESS_{it}$) is positive (0.34) and statistically significant at 1% level. An increase by 1% in trade openness will increase the TE by (0.34). These results show that infrastructure and trade openness have long-run cointegration to TE whenever interacting with government ownership among all GLCs.

For CCM in Table 5.15, the estimate of coefficient for infrastructure ($lnINFRA_{it}$) is negative (0.33) and statistically significant at 1% level. The estimate for real interest rate (RIR_{it}) is negative (0.02) and statistically significant at 1% level. An increase by 1% in infrastructure and real interest rate will decrease the TE by (0.33) and (0.02), respectively. The estimate for the real exchange rate ($lnER_{it}$) is positive (0.05) and statistically significant at 1% level. The estimate for trade openness ($lnOPENNESS_{it}$) is positive (0.71) and statistically significant at 1% level. An increase by 1% in real exchange rate and trade openness will increase the TE by (0.05) and (0.71), respectively. These results show that all independent variables that interact with government ownership (except gross domestic product and unemployment) have long-run cointegration to TE among all GLCs.

For CIMB in Table 5.15, the estimate of coefficient for infrastructure ($lnINFRA_{it}$) is negative (0.24) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_{It}$) is negative (0.12) and statistically significant at 1% level. The estimate for real interest rate ($lnRIR_{it}$) is negative (0.01) and statistically significant at 1% level.

The estimate for the real exchange rate ($lnER_{it}$) is negative (0.02) and statistically significant at 5% level. An increase by 1% in infrastructure, inflation rate, real interest rate and real exchange rate will decrease the TE by (0.24), (0.12), (0.01) and (0.02), respectively. These results show infrastructure, inflation rate, real interest rate and real exchange rate have long-run cointegration to TE when interacting with government ownership among all GLCs. The estimate of coefficient for unemployment rate ($UNEMP_{it}$) is negative (0.18) and statistically significant at 5% level. An increase by 1% in unemployment rate will decrease the TE by (0.18). The estimate of trade openness ($lnOPENNESS_{it}$) is positive (0.60) and statistically significant at 1% level. An increase by 1% in trade openness will increase the TE by (0.60). These results show that all independent variables (except gross domestic product) have long-run cointegration to TE when interacting with government ownership among all GLCs.

For Airport in Table 5.15, the estimate of coefficient for real gross domestic product ($lnGDP_{it}$) is positive (0.02) and statistically significant at 1% level. The estimate of coefficient for infrastructure ($lnINFRA_{it}$) is positive (0.10) and statistically significant at 5% level. The estimate of coefficient for inflation ($INFL_{It}$) is negative (0.17) and statistically significant at 1% level. The estimate for real interest rate (RIR_{it}) is negative (0.02) and statistically significant at 1% level. The estimate for the real exchange rate ($lnER_{it}$) is positive (0.03) and statistically significant at 1% level. An increase by 1% in GDP, infrastructure and real exchange rate will increase the TE by (0.02), (0.10) and (0.03), respectively. The estimate of coefficient for unemployment rate ($UNEMP_{it}$) is negative (0.02) and statistically significant at 1% level. An increase by 1% in inflation

rate, real interest rate and unemployment rate will decrease the TE by (0.17), (0.02) and (0.02), respectively. These results show that all independent variables (except trade openness) have long-run cointegration to TE when interacting with government ownership.

For MAS in Table 5.15, the estimate of coefficient for all independent variables is not significant except real gross domestic product ($lnGDP_{it}$) and real interest rate (RIR_{it}) with positive value (0.01) and negative value (0.01). An increase by 1% in GDP will increase the TE by (0.01). On the other hand, increase by 1% in real interest rate will decrease the TE by (0.01). These results show that all independent variables have long-run cointegration to TE when interacting with government ownership (except real gross domestic product and real interest rate) among all GLCs.

For MBSB in Table 5.15, the estimate of coefficient for real gross domestic product ($lnGDP_{it}$) is positive (0.01) and statistically significant at 1% level. The estimate of coefficient for infrastructure ($lnINFRA_{it}$) is positive (0.31) and statistically significant at 1% level. The estimate of the real exchange rate ($lnER_{it}$) is positive (0.07) and statistically significant at 1% level. An increase by 1% in GDP, infrastructure and real exchange rate will increase the TE by (0.01), (0.31) and (0.07), respectively. The estimate of trade openness ($lnOPENNESS_{it}$) is negative (0.62) and statistically significant at 1% level. An increase by 1% in trade openness will decrease the TE by (0.62). These results show that four independent variables, real gross domestic product, infrastructure,

exchange rate and trade openness, have long-run cointegration to TE when interacting with government ownership among all GLCs.

For MRC in Table 5.15, the estimate of coefficient for infrastructure ($lnINFRA_{it}$) is negative (0.26) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_{It}$) is negative (0.42) and statistically significant at 1% level. An increase by 1% in infrastructure and inflation rate will decrease the TE by (0.26) and (0.42), respectively. The estimate for the real exchange rate ($lnER_{it}$) is positive (0.05) and statistically significant at 1% level. The estimate for trade openness ($lnOPENNESS_{it}$) is positive (0.84) and statistically significant at 1% level. An increase by 1% in real exchange rate and trade openness will increase the TE by (0.05) and (0.84), respectively. These results show that all independent variables that interact with government ownership (except real gross domestic product, real interest rate and unemployment) have long-run cointegration to TE among all GLCs.

For Sime Darby in Table 5.15, the estimate of coefficient for infrastructure ($lnINFRA_{it}$) is negative (0.09) and statistically significant at 5% level. The estimate of coefficient for inflation ($INFL_{It}$) is negative (0.14) and statistically significant at 5% level. An increase by 1% in infrastructure and inflation will decrease the TE by (0.09) and (0.14), respectively. The estimate for trade openness ($lnOPENNESS_{it}$) is positive (0.29) and statistically significant at 1% level. An increase by 1% in trade openness will increase the TE by (0.29). These results show that all independent variables that interact with

government ownership do not have long-run cointegration to TE (except infrastructure, inflation rate and trade openness) among all GLCs.

For TH Plantations in Table 5.15, the estimate of coefficient for all independent variables is not significant except unemployment rate ($UNEMP_{it}$) with positive coefficient value (0.03) and statistically significant at 5%. An increase by 1% in unemployment rate will increase the TE by (0.03). These results show that all independent variables do not have long-run cointegration to TE when interacting with government ownership (except unemployment rate) among all GLCs.

For TNB in Table 5.15, the estimate of coefficient for all independent variables is not significant except real gross domestic product ($lnGDP_{it}$) and real interest rate (RIR_{it}) with positive coefficient value (0.06) and negative value (0.01) and statistically significant at 5% level. An increase by 1% in GDP will increase the TE by (0.06). On the other hand, increase by 1% in real interest rate will decrease the TE by (0.01). These results show that all independent variables have long-run cointegration to TE when interacting with government ownership (except real gross domestic product and real interest rate) among all GLCs.

UMW shows that the estimates of coefficient for all independent variables is not significant. These results show that all independent variables do not have long-run cointegration to TE when interacting with government ownership among all GLCs.

For Maybank in Table 5.15, the estimate of coefficient for real gross domestic product ($lnGDP_{it}$) is positive (0.01) and statistically significant at 1% level. The estimate of coefficient for infrastructure ($lnINFRA_{it}$) is positive (0.62) and statistically significant at 1% level. The estimate of coefficient for inflation ($INFL_{It}$) is positive (0.29) and statistically significant at 1% level. An increase by 1% in GDP, infrastructure and inflation will increase the TE by (0.01), (0.62) and (0.29), respectively. The estimate for the real exchange rate ($lnER_{it}$) is negative (0.07) and statistically significant at 1% level. The estimate for trade openness ($lnOPENNESS_{it}$) is negative (1.45) and statistically significant at 1% level. An increase by 1% in real exchange rate and trade openness will decrease the TE by (0.07) and (1.45), respectively. These results show that all independent variables have long-run cointegration to TE when interacting with government ownership (except real interest rate and unemployment rate) among all GLCs.

Similar to UMW and TM, UEM shows the estimate of coefficient for all independent variables is not significant. These results show that all independent variables do not have long-run cointegration to TE when interacting with government ownership among all GLCs.

Table 5.16
FMOLS (Group) Results, With Time Dummies
Dependent variable: Technical Efficiency ($lnTE_{it}$)(Interaction Terms)

$lnGDP_{it}$	$llnINFRA_{i}$	$INFL_{it}$	RIR_{it}	$lnER_{it}$	$UNEMP_{it}$	$lnOPENNESS_{it}$
0.04***	0.03***	-0.03***	-0.01***	0.01***	-0.02**	0.07***
(3.29)	(3.61)	(-2.84)	(-5.19)	(2.78)	(-1.73)	(3.96)

In Table 5.15, all variables reported that the tests reject the null hypotheses of non-cointegration at 1% and 5% levels. In Table 5.16, a more surprising outcome is obtained, whereby almost all variables are statistically significant at 1% and 5% levels, whereby the tests reject the null hypotheses of non-cointegration. Anincrease by 1% in GDP, infrastructure, real exchange rate and trade openness will increase the TE by (0.04), (0.03), (0.01) and (0.07), respectively. On the other hand, a 1% increase in inflation rate, real interest rate and unemployment rate will decrease the TE by (0.03), (0.01) and (0.02), respectively.

The results obtained from FMOLS for internal, macroeconomic and interaction term models are similar to Fixed and Random Effect Models. Thus, the relationship between the variables and TE have been clearly explained.

5.6 Conclusion

This chapter is devoted to analyse the empirical model as discussed in Chapter Three to figure out the outcome of the third and fourth objectives of this study. Section 5.1

examines the nature of each variable in panel unit root test as well as equations. In general, the integration order of the series is consistently *I*(1). For this reason, panel cointegration (Pedroni; 1999 and 2004) approach is applicable.

This chapter also provides the panel cointegration test based on Pedroni's procedure (1999 and 2004). Generally, all the variables are cointegrated in the model. Therefore, the long-run equation is extracted from the Fixed and Random Effects and also from FMOLS analysis (Pedroni; 1996, 2000, 2001).

CHAPTER SIX

CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Introduction

This chapter delineates the discussion and conclusion of this study. The overall aim of this research is to provide better insight on the impact of macroeconomic and internal factors on GLCs' efficiency. The study also systematically and empirically investigates the interaction terms effect, namely government ownership, on macroeconomic factors to GLCs' efficiency. This study is conducted through a quantitative approach, whereby data are collected from Thomson DataStream, annual reports and WDIs.

6.2 Conclusions

Several important conclusions can be drawn from the study. The first attempt of this study is to identify the efficiency score of GLCs during the period of study (2004 –2013). Overall, GLCs' efficiency score obtained from the analysis is 0.832. Based on Chiang and Cheng (2014), GLCs efficiency score is considered low with a value of less than 0.900. On the other hand, according to Gulati (2011), the GLCs' technical efficiency score is in stage 4 (between 0.70 and 0.88). Thus, we can conclude that the efficiency score of GLCs is average and needs to be improved for a better outcome in future.

This study also establishes that internal factors of GLCs need to be tested for efficiency which is the second objective. GLCs should adjust their internal resources and factors in tandem with the change in business environment. Previous researchers focused on the internal factors of firms which are huge but studies on GLCs are limited.

Thirdly, the needs of macroeconomic factors for long-term approach to achieve efficiency. The intensification of macroeconomic factors enhances the efficiency of GLCs. The evidence corroborated earlier findings (Abid *et al*., 2014; Bremus, 2015; Osman *et al*., 2015; Sharma & Sehgal, 2010 and Sufian & Habibullah, 2012), whom reported how macroeconomic factors, such as GDP, infrastructure, inflation, real interest rate, exchange rate, unemployment and trade openness, influence efficiency. Previous studies (Sufian, 2009; 2012) which focused on the banking sector, emphasised how the Malaysian economy is very susceptible to external factors.

Finally, this study also provides an interesting outlook concerning the interaction impact of government ownership on the relationship between macroeconomic factors and GLCs' technical efficiency. The result suggests the the government plays a significant role in terms of ownership by providing more stable environment for enhancement of the firms' technical efficiency. As clearly stated in previous research, an ownership structure invariably affects a firm's efficiency and this approach was then employed to define the government's role not only as a significant internal factor but also as an interaction factor with macroeconomic variables that contribute to the technical efficiency of the respective GLCs. This finding suggests that an expansion of government ownership in GLCs can

augment its technical efficiency through macroeconomic factors. Finally, FMOLS is employed to look into the impact of the internal and macroeconomic factors on GLCs' efficiency. Previous studies fixated more on Tobit's analysis and simple regression OLS to find the relationship. This study employs FMOLS method to thoroughly analyse the impact of the internal and macroeconomic factors on GLCs' efficiency.

Table 6.1
Summary of the sign of impact (Fixed and Random Effects Model)

Variables	**(Model 1)**	**(Model 2)**	**(Model 3) Interaction**
$lnRevenue_{it}$	-		
$lnFC_{it}$	-		
$lnGOV_{it}$	+		
$lnSize_{it}$	+		
ROA_{it}	+		
BD_{it}	Insignificant		
$lnAge_{it}$	Insignificant		
$lnGDP_{it}$		+	+
$lnINFRA_{it}$		+	+
$INFL_{it}$		-	-
RIR_{it}		-	-
$lnER_{it}$		Insignificant	+
$UNEMP_{it}$		-	-
$lnOPENNESS_{it}$		+	+

Table 6.2
Summary of the sign of the FMOLS Estimates

Variables	**(Model 1)**	**(Model 2)**	**(Model 3) Interaction**
$lnRevenue_{it}$	-		
$lnFC_{it}$	-		
$lnGOV_{it}$	+		
$lnSize_{it}$	+		
ROA_{it}	+		
BD_{it}	Insignificant		
$lnAge_{it}$	Insignificant		
$lnGDP_{it}$		+	+
$lnINFRA_{it}$		+	+
$INFL_{it}$		-	-
RIR_{it}		-	-
ER_{it}		Insignificant	+
$UNEMP_{it}$		-	-
$lnOPENNESS_{it}$		+	+

Table 6.1 and Table 6.2 represent the results obtained using Fixed Effect and Random Effect Model and FMOLS. From the table, we can conclude that both analysis show the same result, whereby internal variables under Model 1 affect the technical efficiency of GLCs, except board structure and firm age. For the macroeconomic variables under Model 2, all variables tend to affect the level of efficiency except exchange rate. Finally, Model 3 represents the needs of government through interaction terms which bring significant effects for all variables in affecting the technical efficiency of GLCs.

The motive for using this method is that it provides advantage to work with a cointegrated panel approach that allows researchers to selectively pool the long-run information contained in the panel while permitting the short-run dynamics and fixed effects to be heterogeneous among different members of the panel.

6.3 Policy Implications

A number of important implications for policy-makers arises from the results of this study. GLCs have demonstrated average efficiency which constraints the growth and development of the Malaysian economy. Therefore, government regulations and supervision should mandate the GLCs to focus on enhancing their efficiency by improving the quality of existing activities, improving management and upgrading human resources.

The question of government role's vitality arises in terms of legal contraints that shape the growth directly through their effects on markets and indirectly through policy implementation. Thus, the involvement of government ownership can help the firms encounter new challenges and oppurtunities. Furthermore, government role should be well defined and be more supportive.

Government ownership affects GLCs' performance in financial and operational. This happens in GLCs when the government, through Khazanah Nasional and seven other investment bodies (as mentioned earlier) became major shareholders in the mainstream service and utilities provider (electricity, telecommunications, postal services, airlines, airport, public transport, water and sewerage, banking and financial services) of our nation. With this at stake, the government will be proactive in avoiding circumstances of underperformance of their investment companies.

Generally, we can conclude that there is sufficient evidence to suggest that government ownership is an important determinant of efficiency. Government policies seem to play an essential role in minimising rent seeking, attracting more investments and increasing the overall growth. Government ownership in GLCs will not only maximise forecasted profits, but would also avoid suboptimal performances of their investment companies which may lead towards adverse financial shock. Thus, ownership rights and executive control must be clearly defined in order to increase the efficiency of firms. Furthermore, they have to appoint board of directors based on qualification and relevant industry experience

Main internal variables are found to exert strong influence over the GLCs' efficiency. Revenue management or pricing along with cost containment affects overall efficiency (TE). However, higher costs would not lead to higher operating efficiency (Joo and Fowler, 2014). The result reveals that revenue of GLCs is inadequate to increase efficiency of GLCs. Furthermore, higher financial capital may impact the shareholders' surplus which reduces the banks market value, particularly when shareholders fail to monitor the firms' performance efficiently. In summary, the result discloses that GLC's financial capital is incapable of upsurging the efficiency of GLCs. As such, the government should ensure that the capital market in Malaysia is moulded in a capital system that is able to work independently, in the midst of a crisis, in accordance with international capital adequacy rules.

Furthermore, firm size is responsible for shaping the efficiency to achieve the goals of GLCs. Therefore, large firms, such as GLCs, may be generally efficient owing to their ability to produce maximum output. Hence, cost minimisation and adoption of technology are essential to increase the technical efficiency of GLCs. Profit measurement for an organisation is important for its survival, development and efficiency (Mathuva, 2009; Mesa *et al*., 2013; Tripe, 1998). Furthermore, the result shows positive and significant impact of ROA on GLCs' efficiency. Thud, more attention, diversification and investment on ROA by giving importance to investment abroad are needed.

In terms of number of directors on board, it shows that there is a lack of awareness among GLCs on structure or number of directors on the board to enhance efficiency. This is due to the fact that there is lack of focus among GLCs' shareholders in determining managerial discipline and its effectiveness. In addition, the board structure also varies according to the size of the company. Malaysian company law is not designed to secure a higher level of independence on the board of directors. In terms of GLCs, they primarily focus on other factors, such as daily business functions and productivity to achieve efficiency.

In terms of firm age, it shows that although a firm grows larger and older, it does not necessarily accumulate more experience to achieve high economies of scale and increased efficiency. This key indicator implies that the production process is more experienced through learning and greater 'know-how', which leads to greater capacity for carrying out activities in a more efficient way.

Many macroeconomic variables are found to exert strong influence over the GLCs' efficiency in Malaysia. The technical efficiency of GLCs is positively influenced by the real GDP per capita, infrastructure and trade openness. Therefore, the policy-makers should further strengthen the regional economy in order to increase the technical efficiency of the GLCs. Precautionary steps are also necessary in the implementation of monetary policy in the selected countries in this region as they are prone to the effects brought by the macroeconomics variables.

The positive relationship between the real GDP per capita serves as an important indicator to the policy-makers in terms of the steadiness of the country's economy in influencing GLCs' efficiency level. Also from the result, we find that in the long-run, infrastructure tends to have positive effects on technical efficiency of GLCs. Poor infrastructure may lead to lack of competitiveness from trade between countries. There are certain issues or determinants that have to be considered: firstly, cost and quality of infrastructural services are important determinants. They should focus more on quality with stringent regulation and spur private investment by cutting the federal corporate income tax.

Inflation and interest rate show negative relationship with technical efficiency. Besides that, high interest rates tend to lower the efficiency as the consumption declines. The real interest rate increases because of high returns through savings. Thus, investment will decline because the user's cost of capital is higher, reducing the desired capital stock and

investment. Thus, the government should play a role through GLCs in lowering monetary policy rate (MPR), low rate of inflation through effective application of contractionary and expansionary monetary policy and growth in output to increase the profitability and overall efficiency of GLCs. These could have a positive impact on the economy.

Exchange rate shows insignificant effects. This is because exchange rate tends to have an effect on banks' efficiency compared to other companies. Therefore, for the pooled group, the result is insignificant. Thus, GLCs must be prudent in terms of their activities and at the same time, the government should provide an effective fiscal and monetary sector to attract more foreign investors and reduce foreign loans and increase more investment.

Malaysia's able to sustained unemployment rate around 3 per cent indicating that policies are in place to face any adversity. The government should be proactive on implementing policy through programmes like HRDF and SL1M for unemployed graduates, regulate courses offered to ensure the quality and relevancy to our current market trend. Furthermore, our country needs to increase more SMEs to reduce unemployment rate and overall globalised Malaysia human capital resources (e.g Indians and Americans).

Trade openness is found to positively affect the technical efficiency of the GLCs. More effective trade policies to maximise benefits of economic openness such as ensure more globalised arena, incentives to local enterprises to compete internationally and be welcoming to FDI and create more joint venture ship. Apart from that, government should create more domestic and international trade policies to maximise the benefits of

economic openness which are consistent and channelled towards increased productivity and efficiency.

6.4 Implications for Academic Researchers

The results could also be useful to academic researchers studying efficiency. This study provides evidence that industry characteristics and macroeconomic factors play important roles in determining GLCs' efficiency. It would also be worthwhile to diversify the study to other markets in the future, especially the emerging markets.

6.5 Implication for Management/Executives

The results presented in this study would also be essential to management/executive personnel who are concerned with improving efficiency of their companies. It should create awareness among managers of the importance of specific internal characteristics in enhancing the efficiency. Findings of this study provide crucial information regarding internal factors that significantly affect efficiency of GLCs. These characteristics should be duly considered by the management if it intends to improve technical efficiency. Owners and shareholders may also find the results of this study to be of utmost value.

With respect to the critical role of macroeconomic and internal factors in determining GLCs' efficiency as revealed in this study, the findings serve as a wake-up call for GLCs'

management as well as policy-makers to optimise their resources and improve the macroeconomic environment. The findings lean towards suggesting that managers should be authoritative and manage their resources and business cycle well against their rivals in a dynamic environment. This would help them to formulate and implement policies for a resilient G20 industry.

6.6 Implication to the Theory

One of the implications of the study is the introduction of one new and relevant variable, namely infrastructure, as a macroeconomic determinant for GLCs' efficiency. Hence, this study verifies the importance of a comprehensive set of variables that are found to be significant determinants for GLCs' efficiency. Furthermore, the role of government is examined thoroughly as internal factor and as an interaction variable on GLCs' efficiency.

In the application of infrastructure as an interaction term, this study differs from others. It also extends the existing body of knowledge on efficiency studies while maintaining the GLCs as its setting. Moreover, production theory, arbitrary price theory, agency theory and resource-based theories are tested and supported in this study.

This study also contributes to the understanding of the utilisation of FMOLS for individual firms. It contributes to the current body of knowledge on interaction terms

analysis by providing a deeper understanding of the more traditional and limited OLS and Tobit's analysis.

6.7 Limitations of Study

This study is not without restrictions. First, the examination of efficiency of GLCs is limited due to the data limitation that makes the input-output unit and the number of GLCs limited as well. In addition, this study only encompasses a particular period of time, from 2004 to 2013, which represents the post-transformation programme period of GLCs. Therefore, this study does not cover the long period of GLCs before 2004 due to unavailability of data. Due to limitations of data accessibility and transparency within the GLCs, this study did not explore other variables that may affect efficiency, such as CEO's characteristics and experience.

The study also pays attention to the estimation of technical efficiency scores for GLCs from year 2004 to 2013. However, estimation associated with cost and profit efficiencies is excluded. Therefore, it could be useful to conduct further analyses on the level of cost and profit efficiency of GLCs.

6.8 Suggestions for Future Studies

Future researchers could conduct comparative studies between GLCs and non-GLCs. Another direction for future research is analysing samples across countries. Finally, as noted by previous studies as well as the present study, incomplete archival databases is one of the main obstacles to conduct further studies on efficiency issues of the GLCs in Malaysia. Hence, this study strongly endorses that the GLCs should maintain a complete database for further research.

Some additional variables concerning regulations can also lead to model enhancement. Other modifications can be done by using control variables. From the efficiency aspect, researchers can conduct more thorough analysis in terms of cost and profit. Another venture for future research would be to analyse impact of internal factors on GLCs' efficiency such CEO's education level, skills and experience.

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