THE DETERMINANTS OF BANK EFFICIENCY
IN MALAYSIAN BANKING INDUSTRY

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ABSTRACT

It is noted that the study of bank efficiency and its determinants has become a focal point in the banking literature. Unexpected situation in the economy system such as the financial crisis is found to give a negative impact to the bank efficiency performance. In addition, the presence of foreign banks in the local banking system also affects the bank efficiency. For Islamic banks, the prohibited elements such as riba, gharar and maisir are the key for the increments of Islamic banks efficiency performance as compared to conventional banks. Hence, this study is aims to examine the impact of determinants of bank efficiency components; namely financial crisis, origins of bank ownership (foreign banks versus domestic banks) and types of bank (Islamic banks versus conventional banks); on three components of bank efficiency which are technical efficiency, pure technical efficiency and scale efficiency. This study covers 404 observations of commercial banks from the year 2004 to 2015. Thus, this study only analyzes one crisis which is the 2007-2008 U.S. financial crisis. This study employ the Data Envelopment Analysis (DEA) approach to find the bank efficiency followed by Tobit regression model to test the relationship between the financial crisis, origins of bank ownership (foreign banks versus domestic banks), types of bank (Islamic banks versus conventional banks) and bank efficiency. This study discovers that financial crisis has a significant and positive impact on bank efficiency (technical efficiency and pure technical efficiency). As for the origins of bank ownership, foreign banks with better skills, expertise and technology, outperformed the domestic banks in scale efficiency. In contrast, domestic banks perform better in technical and pure technical efficiencies as compared to their foreign counterparts. Finally, the findings highlight that Islamic banks are technically and scale efficient than conventional banks. Meanwhile conventional banks performed better in pure technical efficiency than their Islamic counterparts. Therefore, these findings provide some policy implications to the policy makers and the bank management in continuously assess the performance of Malaysian banks.

Keywords: Bank efficiency, data envelopment analysis, financial crisis, origins of bank ownership, types of bank.

ABSTRAK

Didapati bahawa kajian tentang tahap kecekapan bank dan faktor-faktor penentunya menjadi tumpuan kepada kesusasteraan perbankan. Walau bagaimanapun, kejadian yang tidak diduga dalam ekonomi seperti krisis sistem kewangan akan menjejaskan prestasi kecekapan bank. Seterusnya, kehadiran bank asing dalam sistem perbankan tempatan juga akan memberi kesan terhadap tahap kecekapan prestasi bank. Bagi bank-bank Islam, unsur-unsur larangan seperti riba, gharar dan maisir adalah kunci kepada peningkatan tahap kecekapan prestasi sesebuah bank Islam berbanding dengan bank konvensional. Justeru, kajian ini bertujuan untuk mengkaji kesan faktor-faktor penentu komponen tahap kecekapan bank; iaitu krisis kewangan, asal-usul pemilikan bank (bank asing berbanding dengan bank tempatan) dan jenis bank (bank Islam berbanding dengan bank konvensional); kepada tiga komponen kecekapan bank iaitu kecekapan teknikal, kecekapan teknikal tulen dan kecekapan skala. Kajian ini merangkumi 404 pemerhatian bank komersial dari tahun 2004 hingga 2015. Oleh itu, kajian ini hanya menganalisis satu krisis iaitu krisis kewangan AS 2007-2008. Kajian ini menggunakan DEA untuk mengukur tahap kecekapan bank dan menggunakan model regresi Tobit untuk menguji hubungan di antara krisis kewangan, asal-usul pemilikan bank (bank asing berbanding dengan bank tempatan), jenis bank (bank Islam berbanding dengan bank konvensional) dan tahap kecekapan bank. Kajian ini mendapati bahawa krisis kewangan memberi kesan yang signifikan dan positif kepada tahap kecekapan bank (kecekapan teknikal dan kecekapan teknikal tulen). Bagi asal usul pemilikan bank, bank-bank asing dengan kemahiran yang lebih baik, kepakaran dan teknologi, mengatasi bank-bank tempatan dalam kecekapan skala. Sebaliknya, bank-bank tempatan prestasi yang lebih baik dalam kecekapan teknikal teknikal dan tulen berbanding dengan negara-negara luar. Akhir sekali, hasil kajian juga mendapati bahawa bank-bank Islam secara teknikal dan skala lebih cekap berbanding dengan bank-bank konvensional. Sementara itu bank-bank konvensional yang lebih cekap dalam teknikal tulen berbanding dengan bank-bank Islan. Oleh itu, penemuan ini menyediakan beberapa implikasi dasar kepada pembuat dasar dan pengurusan bank untuk meneruskan penilaian prestasi terhadap bank-bank Malaysia.

Kata kunci: Tahap kecekapan bank, DEA, krisis kewangan, asal-usul pemilikan bank, jenis bank

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BCC Model	Banker, Charnes and Cooper (1984)'s model
BIMB	Bank Islam Malaysia Berhad
BNM	Bank Negara Malaysia
BOA	Bank of America
BOC	Bank of China
BOTM	Bank of Tokyo-Mitsubishi UFJ
CCR Model	Charnes, Cooper and Rhodes (1978)'s model
CPI	Consumer Price Index
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
DMUs	Decision Making Units
FSMP	Financial Sector MasterPlan
GCC	Gulf Cooperation Council
GDP	Growth Domestic Products
HLEONG	Hong Leong Bank
HLEONG-I	Hong Leong Islamic
INCEIF	International Centre for Education in Islamic Finance
INDIAINTER	India International Bank
ICBC	Industrial and Commercial Bank of China
MYR	Malaysian Ringgit
NBAD	National Bank of Abu Dhabi
OCBC-I	OCBC Al-Amin Bank
OECD	Organization for Economic Cooperation and Development
OIC	Organisations of Islamic Conference
PWSBH	Perbadanan Wang Simpanan Bakal-Bakal Haji
ROA	Return on Assets
ROE	Return on Equity

STDCHARTERED   Standard Chartered Bank

SFA   Stochastic Frontier Analysis

VRS   Variable Return to Scale

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Banking institution is highly regulated because of their significant roles in the economic development (Freixas & Rochet, 2006; Kawai & Prasad, 2011). The important goal of the banking regulations is to safeguard the soundness of the banking system to ensure that the public interest is protected throughout the entire period. In addition, in the stable condition, the banks are able to operate efficiently by providing the products and services at the lower cost of productions (Berger, 2007; Berger, DeYoung, Genay, & Udell, 2000). Bank efficiency is the capacity of the banks to minimize the inputs and maximize the outputs is one of the important performance measurements of a bank (Sherman & Zhu, 2006). Due to that, the bank efficiency has become an important issue for the regulators since this measurement also indicates the bank success in providing their products and services at the competitive prices. Similarly, from the academic standpoint, the study of bank efficiency and its determinants has become a focal point in the banking literature (Alzubaidi & Bougheas, 2012; Anayiotos, Toroyan & Vamvakidis, 2010; Siddiquee, 2012). Hence, the information provided by the previous studies aid the understanding of the policy makers, banks' management and depositors on the bank efficiency's determinants.

In the recent years, the impact of financial crisis[1] on bank efficiency has become an interest to the researchers (Akhtar, 2013; Anayiotos et al., 2010; Matkovskyy, 2016). It is noted that the financial crisis experienced by one country

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[1] Financial crisis is defined as a significant drop in the value of financial institutions or their assets because of various factors such as the unstable of economic conditions and spillover of the financial crisis from other countries.

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would affect the economy of that country and other countries in the world. For example, following the U.S. 2007-2008 financial crisis, other countries exhibit a declined pattern in their GDP for the first quarter of 2009; Germany-14.4%, Japan-15.2%, United Kingdom-7.4%, Latvia-18%, Euro-9.8%, Mexico-21.5% and Malaysia-2.53% (Baily & Elliot, 2009; BNM, 2009; Rizga, 2009). In addition to that, the banking institutions are also negatively affected by this crisis (Akthar, 2013; Alzubaidi and Bougheas, 2012; and Siddiquee, 2012). The reduction in the level of deposits and loans following the crisis has led to inefficient flow of funds between the surplus units and deficit units. According to Callender (2009), the disruptions in the bank intermediation process would create interruptions in the financing activities and finally dampen the economic developments.

Under the theory of financial liberalization developed by McKinnon (1973) and Shaw (1973), the increase in the role of foreign banks in the local banking industry is one of the important parts of the financial liberalization. According to Ataullah, Cockerill and Hang (2004), financial liberalizations refer to the relaxation of government restriction imposed earlier on the banking institutions and therefore minimize the role of the government in the banking operations. Thus, realizing the needs of the foreign banks' involvement in the domestic banking system, banking institutions around the world have been gradually liberalized. In Malaysia, the foreign banks have been observed since 1859 with the establishment of Chartered Bank of India, London and China in Penang. Thereafter, the growing numbers of foreign banks are noted in its banking system. In addition, the strong emphasize on foreign banks' presence in the domestic banking system is also highlighted in the Financial Sector MasterPlan (FSMP-2001) and Financial Sector Blueprint (the Blueprint-2011). Moreover, the present literature also highlights the vital role of foreign banks'

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participation in improving the bank efficiency (Albayrak, 2009; Sufian & Habibullah, 2012; Matthews & Ismail, 2006). These studies argue that the involvement of foreign banks would create competitions and transfer the knowledge, skills and technology to the local banking system that may result in the higher overall banking performance.

Being an Islamic country, Malaysia has introduced the Islamic banking system since 30 years ago. Since the launch of Bank Islam Malaysia Berhad (BIMB) in 1983, the total number of Islamic banks has increased significantly. To date, there are 16 Islamic banks in Malaysian banking industry. Islamic banking system practices which are based on Al-Quran and As-Sunnah provide alternative sources of financing to the public. Islamic banks prohibit the involvement of interest, speculative trading and uncertainties in the banks' operations which helps to maintain the equality and justice within the society (Al-Suwailem, 2009). Other than that, these Islamic principles would also reduce the overall risk in the banking operations. There is a group of studies that focus on analyzing the bank efficiency performance for both Islamic and conventional banks (Abbas, Azid & Hj. Besar, 2016; Sillah & Harrathi, 2015; Ahmad & Abdul Rahman, 2012). Although, previous studies produce mixed findings, they argue that the inclusion of Islamic banks in the banking system is important because they provide an alternative to the conventional banks.

1.2   Problem Statement

The financial costs of financial crisis to the economy could be severe. From the banking literature perspective, the major cost includes the reduction in banking performance following the crisis. According to Kindleberger and Aliber (2000) and Laeven and Valencia (2008), investors often sell off their assets or withdraw their investment from the banks when the assets' value of a bank decreases because of the

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financial crisis. This situation will create bank panic that could affect the banks in the short term and long term (Kindleberger & Aliber, 2000; Laeven & Valencia, 2008). In the short term, the banks would experience the loss of money and also reduction in lending to their consumers. Meanwhile, in the long run, the ability of bank to efficiently provide services would also reduce when the resources are getting low. Besides that, in the worst situations, banking institutions would experience bankruptcy (Acharya, Philippon, Richardson, & Roubini, 2012).

For example, the U.S. 2007-2008 financial crisis has led to a failure of one-third of commercial banks in the United States. In addition, this crisis has negatively impacted the banking system in other countries as well (Allen, Babus & Carletti, 2009; William, 2010). In Malaysia, Khoon and Lim (2010) discover a significant drop in the level of capital injected to the Malaysian financial sectors during the crisis period. The negative flow of capital has resulted in the declining of the bank's reserves in the second half of 2008. Meanwhile, in the banking sector, Abdul-Majid, Saal and Battisti (2008) reveal that Malaysian banking industry is inefficient following the financial crisis in 1997-1998; that is due to the increasing in the non-performing loans (NPL). Thus, it is noted that, financial crises have given a negative impact on Malaysian banking institutions. Therefore, this study will examine the link between bank efficiency and financial crisis. The findings will contribute to the current literature on the relationship between bank efficiency and financial crisis using Malaysia as a case study.

One of the reasons for the foreign banks' entry is to increase the performance of the domestic banks. The contestable markets would create higher competitions to the domestic banks and force them to become more efficient in providing their services (Miller, 2004). In addition, the spillover effects from an open banking

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industry would also increase the banks' performance (Zhu, 2011). However, to date, the past literature provides inconclusive findings on the comparisons of efficiency between foreign banks and domestic banks. From the literature, a group of studies supported the global advantage hypothesis developed by Berger et al., (2000). This hypothesis states that foreign banks perform better than domestic banks (Burki & Niazi, 2009; Matthews & Ismail, 2006; Sufian & Habibullah, 2012). In contrast, other group of literature find that domestic bank outperform their foreign counterparts and thus, supporting the home field advantage hypothesis (San et al., 2011; Sufian, 2011; Tahir & Bakar, 2009).

According to Bank Negara Malaysia (2005), only high performance foreign banks can be selected into the domestic banking system. Therefore, if domestic banks outperform foreign banks, the main concern is whether Malaysia has selected the right foreign banks to participate in the local banking industry. Thus, this present study will examine the relationship between the origins of bank ownership (foreign banks versus domestic banks) and bank efficiency. The results provided by this study are expected to help the policy makers in the process of selecting the qualified foreign banks.

The Islamic banks operate in accordance to the Shariah principles such as eliminations of interest, gharar and maisir (Al-Suwailem, 2009). With this, it is expected that the Islamic banks would outperform conventional banks because they are not allowed to take excessive risks. However, the previous literature provides mixed findings. According to Johnes, Izzeldin and Pappas (2014), conventional banks have better efficiency performance than Islamic banks because the latter have to handle various Islamic contracts that would increase the operational costs. On the other hand, Abdul-Majid et al. (2008; 2011) posit that Islamic banks' outperform their conventional counterparts because they are operating under principles that would

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reduce the overall business risks and may positively influence their performance. Hence, this present study will add into the present literature by assessing the relationship between types of bank (Islamic banks versus conventional banks) and bank efficiency. Therefore, this study will include three types of bank efficiency scores which are technical[2], pure technical[3] and scale[4] efficiencies to produce a detail assessment of bank efficiency performance in Malaysia.

1.3   Banking Industry in Malaysia

Banking industry in Malaysia is the backbone of the economy. It provides major financing to the business activity to generate the economic activities. The history of banking industry in Malaysia started off in 1859 when the Chartered Bank of India, London and China was established in Penang. In 1950s, the local banking system was largely dominated by foreign banks. They were established mainly to provide financing to tin and rubber industries. However, in 1990s, the presence of domestic banks has been significantly felt. Due to the important of foreign banks' participation, the Financial Sector MasterPlan (FSMP-2001) and Financial Sector Blueprint (the Blueprint-2011) have emphasized more on the opening of foreign banks into the local banking industry. Currently, there are 18 domestic banks and 25 foreign banks in Malaysia (ABM 2015; BNM, 2015). Although, the number of foreign banks exceeds the domestic banks, the size of foreign banks is still small as opposed to the local banks.

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[2] Technical efficiency is aimed at minimizing the inputs and maximizing the outputs.
[3] Pure technical efficiency is measured by the capacity of the management in maximizing the ratio of selected inputs / actual outputs.
[4] Scale efficiency is the banks' ability in producing an optimal productions scale.

The introduction of Islamic banking practices in Malaysia started in 1963 when the Perbadanan Wang Simpanan Bakal-Bakal Haji (PWSBH) was launched to help the process of Malaysian performing pilgrimage to Mecca. In addition, the first Islamic bank that is operated fully under the Shariah is the Bank Islam Berhad which was established in 1983 to offer Islamic banking services. This was followed by the establishment of the Bank Muamalat Berhad on 1st October 1999. Due to the growing needs of Islamic banking products, the number of Islamic banks has increased significantly throughout the years. To date, Malaysian banking industry has 16 Islamic banks. In 2006, BNM launched an Islamic higher educational institution which is the International Centre for Education in Islamic Finance (INCEIF). This institution is aimed at training the qualified expert in the area of Islamic finance and banking. Interestingly, the customers for Islamic banks do not only cover the Muslim populations but also the non-Muslims which indicate the growing needs of Islamic banking products in Malaysia.

The list of banks accordance to the origins of bank ownership (foreign banks versus domestic banks) and types of bank (Islamic banks versus conventional banks) in Malaysia can be seen in the Appendix B.

1.4 Research Questions

Based on the above discussion, three important bank efficiency determinants (financial crisis, origins of bank ownership and types of bank) are selected in constructing the following research questions:

a) To what extent does the financial crisis influence the bank efficiency?

b) Do the origins of bank ownership (foreign banks versus domestic banks) affect the bank efficiency?

c) To what extent do the types of bank (Islamic banks versus conventional banks) influence bank efficiency?

1.5 Research Objectives

The objectives of the present study are:

a) To examine the impact of financial crisis on bank efficiency.

b) To investigate the influence of origins of bank ownership (foreign banks versus domestic banks) on bank efficiency.

c) To assess the effect of types of bank (Islamic banks versus conventional banks) on bank efficiency.

1.6 Significance of the Study

The importance of the study can be classified into two categories. Firstly, to the policy makers, these findings would help them to formulate and assess the current banking regulations to ensure the stability of the banks during the financial crisis. In addition,

this study will give information on the performance of foreign banks and domestic banks which is also the main concern of the policy makers.

Secondly, for the bank management, the findings could help them in revising the banking strategies during the financial crisis. Other than that, this study also provides information on the factors that would influence the efficiency performance and also the sources of inefficiency. Thus, this information will allow them to assess and to monitor their efficiency performance.

1.7   Scope of the Study

This study employed only Malaysian commercial banks in the dataset. The dataset covers from the year 2004 to 2015. Therefore, only one crisis which is the U.S. 2007-2008 financial crisis can be investigated.

1.8   Organization of the Thesis

The study is arranged into five chapters. Chapter one provides the background of the study, issues and problem statement, research questions and research objectives. Chapter two discusses the current literature on the relationship between financial crisis, origins of bank ownership, types of banks and bank efficiency. Chapter three will discusses the research methodology. Next, Chapter four highlights the findings and followed by the discussion of the results. Lastly, Chapter five concludes the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the relevant literature related to the relationship between the financial crisis, origins of banks ownership (foreign banks versus domestic banks), types of bank (Islamic banks versus conventional banks) and bank efficiency. This chapter is arranged as follows. Firstly, Section 2.2 presents the discussion on the relationship between the financial crisis and bank efficiency. Next, Section 2.3 discusses the past literature on the origins of bank ownership (foreign banks and domestic banks) and bank efficiency. Section 2.4 is on the link between the types of bank (Islamic banks and conventional banks) and bank efficiency. Section 2.5 presents the research framework. Lastly, Section 2.6 is the conclusion of the chapter.

2.2 Financial Crisis and bank efficiency

According to Crabtree, Dallwitz, Gibbs and Watson (2015), financial crisis refers to a situation that involved huge losses in the nominal value of the financial assets. For example, the crash of stocks market burst of the financial bubble, currency crises and sovereign defaults. These situations have often led to a bank panic which could result in a significant reduction in the deposits and loans activities. The global financial crises such as the Asian financial crisis (1997-1998) and the U.S. financial crisis (2007-2008) which caused by the subprime mortgage crisis[5] have negatively impacted

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[5] Subprime mortgage crisis refers to a nationwide banking crisis that occurred between years 2007-2010, which contributed to the U.S. financial crisis (Duca, 2014). The subprime mortgage crisis started when the house prices declined following the collapse of housing bubbles which then leads to a fall in the prices of securitized subprime mortgages. This subprime mortgage crisis has given negative effects to the financial markets all over the world (Allen et al., 2009; Demyank & Van Hemert, 2011).

the banking industry around the world (BNP Paribas, 2007; Williams, 2010). Hence, this section would discuss the past studies that have looked into the relationship between the financial crisis and bank efficiency. This part is structured into two groups. First group will investigate the impact of these variables in Asian countries while the second part focuses on the literature in other countries.

From the literature review, the studies conducted in Asian countries are found to have mixed conclusions. On the positive side, Hoque, Kim and Pyun (2007) discover that the banks in Malaysia are becoming more efficient after the Asian financial crisis. They argue that the Malaysian banking industry was able to perform better after the crisis due to drastic actions made in reforming the regulations on capital requirements, liquidity, mergers and acquisitions. Similarly, Sufian and Habibullah (2012) also discover that Malaysian banks are more efficient in the post-crisis period. They argue that these banks performed better in the pure technical efficiency than scale efficiency. In addition, it is noted that the pure technical efficiency to be the main source of efficiency. Although, both studies are conducted in different time periods (Hoque et al., 2007; 1990 to 2004 & Sufian & Habibullah, 2012; 1995 to 2008), they agree that Malaysian banking efficiency improved following the crisis.

On the negative side, few studies conclude that bank efficiency reduces after the financial crisis. In Taiwan, Li, Hu and Chiu (2004) discover that the local banks are inefficient after the 1997/1998 Asian financial crisis. They find that the technical efficiencies for public and private banks decline prior to the crisis. Thus, the economic instability has reduced the banks' ability to perform better in providing services in the most efficient way.

Similarly, in Malaysian banking industry, Abdul-Majid, Saal and Battisti, (2008) reveal that Malaysian banks are negatively impacted by the Asian financial crisis (1997-1998). They find that the decreasing in efficiency is due to the increment in the non-performing loans. Likewise, this conclusion is also supported by Chansarn (2005) and Chunhachinda and Li (2010) in the context of Thai banks. They highlights that the liquidity and non-performing loans as the major causes of inefficiency in Thai banking industry after the crisis.

The impact of the U.S. financial crisis (2007-2008) on bank efficiency is also found to be mixed. According to Garza-Garcia (2011), Mexican banking industry had experienced technical, pure technical and scale inefficiencies during the financial crisis. Conversely, the improvement in efficiency is noted after the crisis. This result is also consistent with Matkovskyy (2016). This study discovers the efficiency improvement in more than 53% of OECD countries in post-crisis period.

In contrast, it is also discovered that the Malaysian banks have performed better after the financial crisis (San, Theng, & Heng, 2011). They show that that the pure technical efficiency is not affected by the banking crises in 2008. Few possible reasons for this finding are highlighted; high international reserves, strong capitalization and sufficient liquidity. Similarly, Mohamad and Wahab (2016) find that Malaysian Islamic banks are more efficient after the U.S. crisis. This positive performance could be due to the implementations of Islamic principles which is aimed at reducing the operational risks of the Islamic banks.

On the negative side, in Saudi Arabia, Akhtar (2013) discovers that the banks' cost efficiency declines after the U.S. crisis in 2007; over the period of the study (2000-2009). This study reveals that the weakening of bank efficiency is due to the

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increments in the bank's costs of production which has impacted the efficiency performance negatively following the 2007/2008 U.S. financial crisis.

In addition, study by Alzubaidi and Bougheas (2012) discloses a declining of efficiency scores in Belgium, Denmark, Ireland and Greece banking sector after the global financial crisis. They find an overall reduction of 12.3% in technical efficiency after the crisis. Moreover, the decline in the technical efficiency is due to the pure technical inefficiency level. Besides, the scale efficiency reduces to 83.50% after the crisis as opposed to 90.20% before the crisis.

Similarly, in Europe, Anayiotos et al. (2010) has shown that the banking industry performance declines after the crisis. Likewise, Siddiquee (2012) discovers a reduction in efficiency performance of four major Australian banks after the financial turbulence. In addition, other study in Australian banking industry proves that the Australian banks' scale and pure technical efficiency reduce after the crisis (Moradi-Motlagh & Babacan, 2015).

2.3   Origins of Bank Ownership (foreign banks versus domestic banks) and Bank Efficiency

Financial liberalization theory argues that the deregulation process is aimed at removing the distortions in banking operations to boost the healthy competition between the domestic banks and foreign banks and to increase the banks' operational flexibility. Therefore this part of literature will discuss the comparisons of efficiency between foreign banks and domestic banks. Guided by two hypotheses founded by Berger et al. (2000), this discussion is grouped into two parts. Firstly, the strand of literature that agrees with the argument made under the home field advantage

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hypothesis. This theory suggests that local banking institutions have better efficiency performance than their foreign competitors. This hypothesis argues that the domestic banks perform better because they have superior knowledge in the local language, culture, currency and the regulatory structure than their foreign counterparts.

From the review of the literature, the first discussion will be on the studies that support the home field advantage hypothesis. Tahir and Bakar (2009) find that Malaysian domestic banks outperformed their foreign counterparts in scale, pure technical and technical efficiencies. Similarly, San et al. (2011) and Sufian (2011) agree that the local originated banks have superior performance than the foreign banks in pure technical and scale efficiencies. Thus, it can be concluded that the domestic banks are better at managing the inputs and outputs to arrive at higher efficiency performance than the foreign banks.

Likewise, a study conducted in few countries by Fang, Hasan and Marton (2011) find that foreign banks exhibit lower level of efficiency scores as compared to the domestic banks. They argue the higher operational costs and the rationalizations of mergers and acquisitions in banking industry as the reasons for this finding.

The next groups of studies support the global advantage hypothesis. In Pakistan, Usman, Wang, Mahmood and Shahid, (2010) examine the bank efficiency using DEA approach. The results reveal that foreign banks have higher performance in all efficiency measures (technical, pure technical and scale efficiencies) as compared to their domestic counterparts. This result supports the findings from Burki and Niazi (2009) which also indicates that foreign banks outperform the domestic state and private banks. They highlight that the government-owned banks are the worst performers as opposed to other group of banks.

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In Turkey, Akin, Bayyurt and Zaim (2013) employ the DEA approach and discover higher efficiency for foreign banks in pure technical efficiency during the financial crisis periods (2007-2010). They argue that the lower level of efficiency in domestic banks is due to the excess number of employees which increases the banks costs of production. Similarly, using the financial ratio to measures the efficiency scores, Albayrak (2009) also supports the global advantage hypothesis.

In Malaysia, few literatures agree with the global advantage hypothesis. According to Sufian and Habibullah (2012), Malaysian foreign banks are found to have higher level of efficiency scores than their local counterparts in all efficiency measures (technical, pure technical and scale efficiencies). These results are also supported by the earlier study conducted by Matthews and Ismail (2006). They discover that foreign banking institutions have higher capability in the operational management that allows them to have better ability in reducing inputs and maximizing outputs.

The next group of literature supports both hypotheses. Jagwani (2012) find that local originated banks outstrip the foreign banks in technical and scale efficiencies. This study reveals that the domestic banks in India managed to minimize wastage of inputs and also succeeded in achieving optimum scales. Meanwhile, foreign banks are found to have higher pure technical efficiency scores as compared to their domestic counterparts.

Similarly, Sathye (2005) conducted a study in Asia and Pacific countries which also include Malaysia. Employing the DEA approach, the study reveals that local banking institutions exhibit higher technical efficiency than the foreign banks.

However, using deposits and number of staffs as the inputs variables, foreign banks are found to outperform domestic banks.

In Turkey, Denizer, Dinc and Tarimcilar (2007) discover no differences between the efficiency level of foreign banks and domestic banks in all efficiency measures (technical, pure technical and scale efficiencies). Thus, this study does not support both hypotheses originated by Berger et al., (2000).

2.4   Types of Bank (Islamic banks versus conventional banks) and Bank Efficiency

This part discusses on the efficiency performance between Islamic banks and conventional banks. The first discussion will be based on the results that indicate better performance of Islamic banks as opposed to the conventional banking institutions. In Malaysia, Fatin Syazwani (2014) examine the Malaysian banks efficiency using DEA approach and posit that Islamic banks outperformed the conventional banks. The prohibition elements of riba, gharar and maisir in the Islamic banking activities have influenced their bank efficiency in a positive way. Similarly, Wahid (2016) discovers that Islamic banks exhibit higher technical efficiency measure than conventional banks between 2004-2013.

In contrast, Abbas, Azid and Hj Besar (2016) argue that conventional banks are more efficient than their Islamic banking competitors in Pakistani banking industry. Using the non-parametric approach (DEA approach) to calculate the efficiency scores, this study posit that conventional banking institutions outperformed the Islamic banks under both CRS and VRS models. This study states that the Islamic

banks are still in their initial development and their size is much smaller than the conventional banks.

Using the same approach, Sillah and Harrathi (2015) conduct a study on the Gulf Cooperation Council (GCC) countries using 20 Islamic banks and 28 conventional banks in the dataset. The study has shown that the conventional banks perform better than Islamic banking institutions after the financial crisis (2009-2010). They reveal that, in Bahrain and United Arab Emirates, conventional banks are more efficient than Islamic banks. However, no significant differences are discovered between the efficiency performance of Islamic banks and conventional banks in Saudi Arabia, Kuwait and Qatar.

In the Malaysian context, a study by Ahmad and Abdul Rahman (2012) has examined the efficiency of the local banks from 2003 to 2007 using DEA approach. The result shows the superior performance of conventional banks than the Islamic banks in all efficiency measures (technical, pure technical and scale efficiencies). They indicate two factors that could explain the findings; the superior management capability and technological advancement of the conventional banks. In addition, Islamic banks are found to suffer from the scale inefficiency due to the high operational costs from managing the various Islamic banking contracts and services.

Finally, a cross-country study conducted by Hassan, Mohamad and Bader (2009) discover no significant differences of bank efficiency between conventional and Islamic banking institutions in 11 Organisations of Islamic Conference (OIC) countries from the year 1990 to 2005. Despite that, the banks are able to generate revenue and profits efficiently using their inputs. In addition, the banks manage to minimize operation costs and maximize revenue.

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In conclusions, the review of the past literatures shows inconclusive findings for the three groups of literature; (1) financial crisis and bank efficiency, (2) origins of bank ownership (foreign banks versus domestic banks) and bank efficiency and (3) the types of bank (Islamic banks versus conventional banks) and bank efficiency.

2.5   Conceptual Framework

In line with the problem statements, research objectives and the literature review, the following research framework is presented in Figure 2.1.

Independent Variables   **Dependent Variables**

1. Financial crisis 2. Origins of the bank ownership (foreign banks versus domestic banks) 3. Types of bank (Islamic banks versus conventional banks)	*Bank Efficiency* 1. Technical Efficiency 2. Pure Technical Efficiency 3. Scale Efficiency
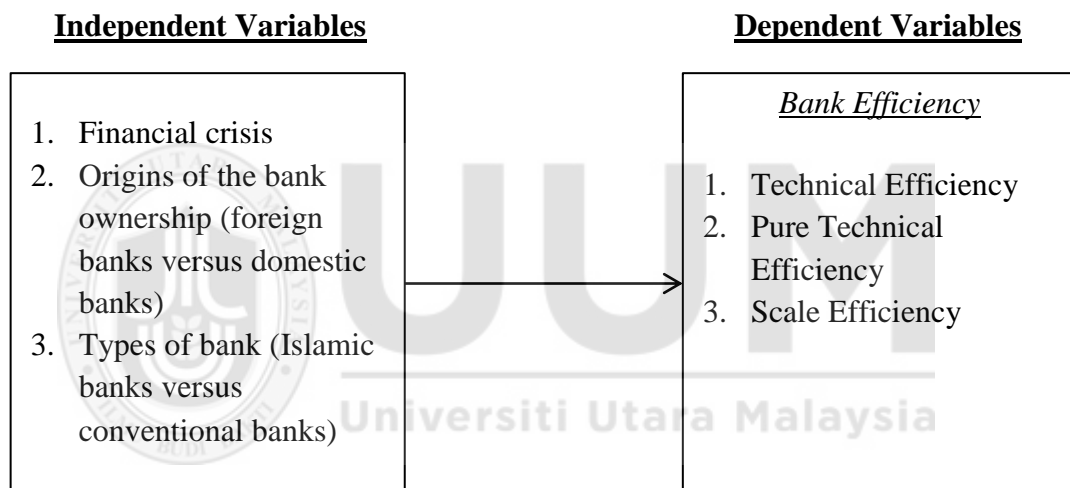
Figure 2.1
The Research Framework of the Study.
Sources: (Sufian, 2009a, 2009b; Sufian & Habibullah, 2012)

From the research framework, the main independent variables are the financial crisis, the origins of the bank ownership (foreign banks versus domestic banks) and type of bank (Islamic banks and conventional banks) while the dependent variables is the bank efficiency (technical, pure technical and scale efficiencies). Based on the discussion on the literature review, the relationships between the three main variables and bank efficiency are expected to be mixed.

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2.6   Conclusion

In conclusions, this chapter provides discussions on the previous studies that investigated the relationships between the financial crisis, origins of bank ownership (foreign banks and domestic banks) and types of banks (Islamic banks and conventional banks) with the bank efficiency and its components (technical efficiency, pure technical efficiency and scale efficiency). Lastly, the research framework of this presents study is also presented in Section 2.5.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology employed in this study. Section 3.2 describes the definitions and concepts of efficiency. Section 3.3 explains the Data Envelopment Analysis (DEA) approach that used to compute bank efficiency scores. Next, Section 3.4 explains the Tobit regression model employed to examine the relationship between financial crisis, origins of bank ownership, types of bank and bank efficiency. Section 3.5 discusses on the research design of this present study which consists of the discussions on the data collection and data analysis. Lastly, Section 3.6 summarizes the chapter.

3.2 The Efficiency: Definitions and Concepts

In banking industry, the efficiency refers to the capability of the bank in minimizing the inputs for a given level of outputs or maximizing the productions of outputs for a given level of inputs (Mokhtar, Al-Habshi & Abdullah, 2006). The discussion on the concepts of efficiency from firm level's perspective was initially conducted by Koopmans and Debreu (1951) and Farrell (1957). According to Farrell (1957), efficiency can be divided into five components which are technical efficiency, pure technical efficiency, scale efficiency, allocative efficiency and cost efficiency. However, due to the data limitations, this study only focuses on three types of efficiency which are technical, pure technical and scale efficiencies.

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Technical efficiency is attained when the firm is able to maximize the outputs for a given level of inputs (output-orientation) or minimize the utilizations of inputs for a certain level of outputs (input-orientation) (Kumbhakar & Lovell, 2003). In other words, the wastage of inputs could be minimized in the productions.

In addition, pure technical efficiency is defined as the ability of management in utilizing the minimum level of inputs in the banks' productions. The term pure technical efficiency refers to the technical efficiency which is influenced by the actual level of productions scale (Burki & Niazi, 2009). While, the scale efficiency is described as the firms' ability in operating at optimum level and thus, avoids wastage of production costs (Sherman & Zhu, 2006).

3.3   Data Envelopment Analysis (DEA): An Approach to Measure Bank Efficiency

Berger and Humphrey (1997) suggest two approaches to measure the bank efficiency which are parametric and non-parametric methods. Due to the simplifications in employing the non-parametric approach, DEA is selected. This method does not require the specification of production functions or the prior assumptions about the errors. In addition to that, DEA also allows for the detail assessment of bank efficiency performance.

Building on efficiency concepts develop by Farrell (1957), Charnes, Cooper and Rhodes (1978) built the CCR model. This model is a linear programming that used to measure the efficiency of DMUs[6] which converts multiples of inputs into

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[6] DMUs are a decision making units which refer to a firm or production unit that converts inputs into outputs. For the purpose of this study, DMU refers to bank. As the name indicates, DMU has some degree of freedom in setting goals and constructing ways to achieve those goals (Kumar & Gulati, 2009).
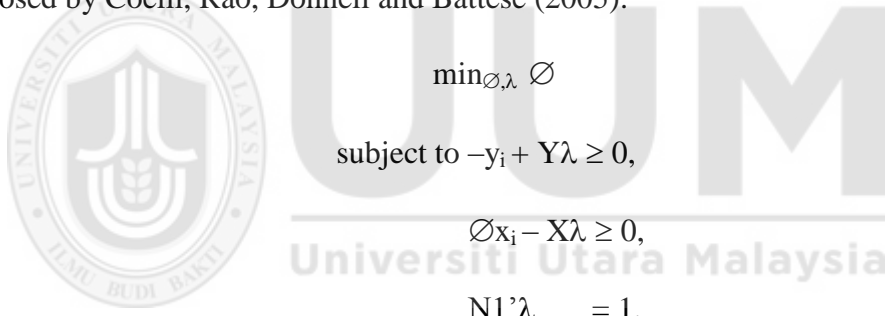
multiples of outputs. This approach will envelop all the data into a production frontier where all the best efficiency performers (100% efficiency performance) are located. In contrast, the less efficient DMUs are not located on the frontier. Thus, the inefficiency level is measured from the distance between the inefficient unit and the production frontier. According to Avkiran (1999), the efficiency scores are ranging from 0 to 1. The DMUs are said to be fully efficient when it achieve efficiency score of 1 and vice versa.

According to Sherman and Zhu (2006), the DEA method provides two techniques to measure bank efficiency. They are input-oriented and output-oriented. Under input-oriented, the inputs are being minimized at an optimum level while the outputs are held constant. Meanwhile, the output-oriented describes the ability of the DMUs to maximize the productions of outputs while the inputs are fixed at certain level. The selection of these techniques depends on the capability of the management; either to control the inputs usage (input-oriented) or to control the production of outputs (output-oriented). This study employs the input-oriented method because the management is said to have better control in inputs generation in the banking operations. In accordance to the intermediation role played by the banking system, the ability of the banks to provide loans (output) depends largely on their capacity to generate deposits (input). The selections of input-oriented technique is also consistent with Isik and Hassan (2002), Rezvanian, Rao and Mehdian (2008) and Sufian (2010).

Return to scale is an important concept in DEA approach. This concept explains the behavior of the rate of increment or reduction in outputs in relation to the increase in the inputs. As suggested by Charnes et al. (1978), there are two assumptions of CCR model (1) the input orientation and (2) constant return to scale

(CRS)[7]. With these assumptions, the technical efficiency is developed. Technical efficiency presumes that the DMUs are operating at the optimal scale of productions. However, CRS does not consider the economies of scale in measuring the efficiency. In addition, factors like imperfect competition and constraints in the financial market could challenge the accurateness of assumptions made by CCR model (Casu & Girardone, 2000). Due to that, Banker, Charnes, and Cooper (1984) introduced the BCC model with VRS[8] assumption. With BCC model, pure technical efficiency and scale efficiency are constructed. This model reflects the normal condition in the firms' operation (Berg, Førsund, Hjalmarsson, & Suominen, 1993).

Below is the equation for CRS linear programming with input-oriented proposed by Coelli, Rao, Donnell and Battese (2005):

$$\min_{\varnothing,\lambda} \varnothing$$

$$\text{subject to} -y_i + Y\lambda \geq 0,$$

$$\varnothing x_i - X\lambda \geq 0,$$

$$N1'\lambda = 1,$$

$$\lambda \geq 1, \tag{1}$$

Where, $\varnothing$: scalar; λ: $N \times 1$ vector of constant. The efficiency score, $\varnothing$, for each DMU is computed in the range of 0 to 1. The CRS assumption is modified by including the convexity constraints of $N1'\lambda = 1$.

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[7] CRS refers to the one unit increment in output when there is an increment in one unit of the input.
[8] VRS refers to the increase in inputs that results in increasing (increasing return to scale-IRS) or decreasing (decreasing return to scale-DRS) in outputs.

Meanwhile, VRS linear programming for input-oriented is:

$$\min {}_{\varnothing},\lambda,\varnothing$$

$$\text{subject to } -{}_{\varnothing}y_i + Y\lambda \geq 0$$

$$x_i - X\lambda \geq 0$$

$$N1'\lambda = 1$$

$$\lambda \geq 0 \qquad\qquad (2)$$

Where, $\varnothing$: scalar ($1 \geq \varnothing \leq \infty$), λ: N x 1 vector of constant, N: number of DMUs; y_i and x_i: M $\times$ N and K $\times$ N outputs and inputs vectors, respectively. Y comprises data for all N DMUs.

The calculation of the DEA efficiency scores (technical, pure technical and scale efficiencies) is conducted using the inputs and the outputs selected based on the intermediation approach. As illustrates in Figure 3.1, the input variables chosen are personnel expenses, capital and deposits. Personnel expenses refer to the labour cost that the banks pay to the employees. These include the wages, salaries, bonus and defined contribution plans (Rezvanian et al., 2008; Sufian, 2004, 2009b; Sufian & Habibullah, 2010; Yudistra, 2003). Meanwhile, capital refers to the book value of premises and fixed assets (Rezvanian et al., 2008; Sufian, 2004, 2009b; Sufian & Habibullah, 2010). Moreover, the deposits include the total amount of deposits receive from customers, cash and short term funding (Rezvanian et al., 2008; Sufian, 2004, 2009b; Sufian & Habibullah, 2010).
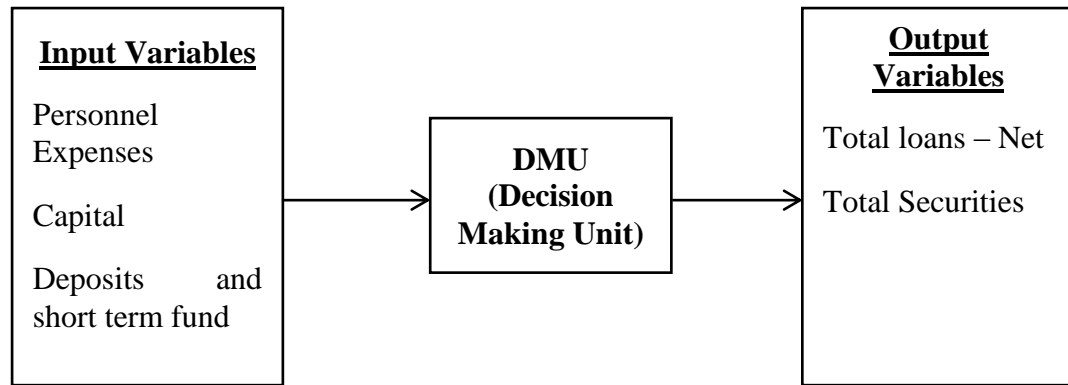
Figure 3.1
Inputs and Outputs Variables in the Study (Intermediation Approach)
Sources: (Rezvanian et al., 2008; Sufian, 2004, 2009b; Sufian & Habibullah, 2010; Yudistra, 2003)

On the other hand, two outputs variables are the total loans and total securities. The amount of loans, advance and financing denotes the total loans while total securities refer to the total investment and dealing securities (Sufian, 2004, 2009b; Sufian & Habibullah, 2010). According to the intermediation approach, the banks utilize the personnel expenses, capital and deposits and short term fund (inputs) and convert them into outputs (loans and securities investments) (Berger & Humphrey, 1997).

3.3.1 Advantage and Disadvantage of using the Data Envelopment Approach (DEA)

There are several advantages and disadvantages of using the DEA. Firstly, DEA allows the utilization of multiple inputs and multiple outputs with varying scales to find the efficiency scores (Coelli et al., 2005). Secondly, it enables the efficiency to be decomposed into few components: technical efficiency, pure technical efficiency and scale efficiency. The decomposition of the bank efficiency allows for the detail assessment of the efficiency performance. For example, lower technical efficiency could be caused by inability to minimize the inputs or maximize the outputs while

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lower scale efficiency may be related to producing at non-optimal production scales. Thus, this information would help the management to tackle the efficiency problems in more accurate ways.

However, the applications of DEA have several disadvantages. Firstly, the efficiency scores are assumed to be free from errors of measurements. Besides that, the bank efficiency calculated is only limited to the dataset of the study. It means that the efficiency scores are relative but not absolute measures. As a consequence, the efficiency scores can only be compared within the DMUs used in the dataset (Sherman and Zhu, 2006). Secondly, the DEA doesn't highlight the methods to improve the best practice units (100% of efficiency scores) in the production frontier.

3.4   Tobit Regression Model

Tobit regression model is a tool employed to test the relationship between the financial crisis, origins of bank ownership, types of bank and bank efficiency. This model is appropriate when the regression model has a limited dependent variables (Rosman, Wahab, & Zainol, 2014; Tobin, 1958; Shah, Shah, & Ahmad, 2012). Since the DEA efficiency scores are ranged between 0 and 1, the Tobit regression model is selected in this study.

The standard Tobit model can be presented using the following equations:

$$y_{it}^* = \beta' x_{it} + \mu_{it} + v_{it}$$

$$y_{it} = y_{it}^*, \text{ if } y_{it}^* \geq 0, \text{ and}$$

$$y_{it} = 0, \text{ otherwise} \qquad (3)$$

where y denotes the efficiency scores (technical efficiency, pure technical efficiency, and scale efficiency) for each DMU (*i*) for the time period (*t*); x is a set of explanatory

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variables that explain variations in the DMUs efficiency; β is the parameter to be estimated, variation $[\mu_{it} + v_{it}] = \sigma^2_\mu \sigma^2_v =$ Variation $[\varepsilon_{it}] \sim N[0, \sigma^2]$ and $i = 1, \ldots, N$ and $t = 1, \ldots, T$.

The efficiency scores computed from the DEA model are used as the dependent variables that are technical efficiency, pure technical efficiency and scale efficiency. The efficiency scores are regressed on a set of independent variables. The model is written as:

$$y^j_{it} = \beta_0 + \beta_1 SIZE_{it} + \beta_2 LOANS/TA_{it} + \beta_3 LOANS/DEP_{it} + \beta_4 ROA_{it} + \beta_5 ROE_{it} +$$
$$\beta_6 GDP_{it} + \beta_7 CPI_{it} + \beta_8 POST\_CRISIS_{it} + \beta_9 OWN_{it} + \beta_{10} TYPE_{it} + \varepsilon_{it} \qquad (4)$$

Where, y represents the dependent variables which consist of three types of bank efficiency (j = technical efficiency, pure technical efficiency, and scale efficiency) for ith DMU at time t for the period of 2004-2015. The parameters to be estimated are β_0 to β_{10} and the ε_{it} is the disturbance term.

The first set of variables is the bank-specific determinants. Bank size (SIZE) enters the regression model in log-transformation form to assess the correlation between the total asset and the bank efficiency (Mahesh & Rajeev, 2008; Rosman et al., 2014; Sufian & Abdul-Majid, 2008). Larger banks with competitive advantages, economies of scale, capital and technology are expected to be more efficient than the smaller banks. Therefore, the bank size is expected to have a positive relationship with the bank efficiency.

Credit risk variable (LOANS/TA) is represented by the ratio of total loans to total assets to measure the level of credit risk in the banks (Sok-Gee & Karim, 2010). It is noted that credit risk is one of the important risks because providing loans and

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financing are the major activities of the banking institutions (Mukherjee, Ray, & Miller, 2001). In addition, default loans or non-performing loans would also reduce the liquidity and finally decreases the banks' efficiency performance. Since loans are the least liquid assets, failure in managing the credit risk might dampen the banks' stability and performance (Gup & Kolari, 2005; and Mukherjee et al. (2001). Thus, credit risks is expected to have a negative link with the bank efficiency.

Next is the intermediation role (LOANS/DEP) variable which is measured by the total loans to total deposits ratio. This ratio shows the bank's ability in converting deposits into loans and financing (Heffernan, 2005; Kasman & Yildirim 2006). Higher intermediation role would allow the banks to enter into a broader and competitive markets and therefore, it would boost the economies of scale and force the bank to become more efficient (Berger et al., 2000). Hence, it is expected that the intermediation role influences the bank efficiency positively.

The banks' profitability is measured by the ROA and ROE. Return on assets (ROA) is computed by dividing the net return to the total assets while return on equity (ROE) is measured by ratio of the net return over the total equity. ROA would measure the level of profit generated by utilizing the assets. On the other hand, ROE indicates the ability of the banks to maximize the shareholders' wealth (Chodnicka, 2014; Golin, 2001). According to Sufian and Abdul-Majid (2008), customers are inclined towards profitable banks and thus, this would allow them to generate a large share of deposits and creditworthy borrowers. Hence, these profitability ratios are expected to have a positive influence on the bank efficiency (Hasan & Marton, 2003; Isik & Hassan, 2002; Sufian & Abdul-Majid, 2008).

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The economic variables included in the regression model are economic growth (GDP) and inflation (CPI). Economic growth is expected to have a positive relationship with the bank efficiency (Denizer et al., 2007; Kasman, 2005). This is because a favorable economic condition would stimulate business activities and provide conducive surroundings for the banks to operate. In addition, inflation is expected to have a negative relationship with the bank efficiency because it would create variability in the banks' interest margin and increasing the costs of production (Kasman & Yildirim, 2006)

Post-crisis is the first main variable used in the regression model. This variable is measured using a dummy variable; POST_CRISIS denotes the value of 1 for post-crisis period (2009-2015) and value of 0 for pre and during the crisis period (2004-2008) (Cardona & Lawrence, 2013; Kasteren, 2012; Kilic, Chelikani & Coe, 2014; Papadakis, 2013). Financial crisis is said to have a mixed influence on the bank efficiency (Alzubaidi & Bougheas, 2012; Anayiotos et al., 2010; Matkovskyy, 2016; San et al, 2011). According to Alzubaidi and Bougheas (2012) and Anayiotos et al.(2010) shows that the efficiency performance of banks reduces following the financial crisis. However, few studies show that bank efficiency improve after the crisis (Matkovskyy, 2016; Mohamad & Wahab, 2016; San et al., 2011). Therefore, the mixed relationship is expected between the post-crisis variable and bank efficiency.

Second main variable is the origins of bank ownership (OWN). It is assessed using the dummy variable (OWN) that takes the value of 1 for foreign banks and 0 for domestic banks (Sufian, 2009a). The presences of foreign banks will encourage the bank competition and therefore forces the local banks to perform better (Levine, 1996). Berger et al. (2000) developed two hypotheses to assess the efficiency performance between domestic banks and foreign banks. Those hypotheses are the

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home field advantage and the global advantage hypothesis. The first hypothesis (home field advantage) suggests that domestic banks are more efficient than foreign banks (Delfino, 2007). Domestic banks which operate in the local banking market have more knowledge in the culture, language, currency and regulations than their foreign counterparts.

Meanwhile, the second hypothesis (global advantage hypothesis) argues that foreign banks outperform domestic banks as they have more skills, expertise and technology (Sturm & Williams, 2004: Sufian, 2009a). Hence, based on the arguments made under both hypotheses, the directions of findings between the origins of bank ownership and bank efficiency are expected to be mixed.

The last main variable is the types of bank (TYPE) which holds the value of 1 for Islamic banks and 0 for conventional banks (Altaee, Talo & Adam, 2013; Saddique, Ahmad, Mumtaz & Arif, 2016). In line with the research objective, this variable enters into the regression model to identify the impact of types of bank (Islamic banks versus conventional banks) on bank efficiency. Johnes, Izzeldin and Pappas (2014) suggest that conventional banks are more efficient than Islamic banks. This is because Islamic banks have to handle various Islamic contracts, such as profit and loss sharing contracts and Ijarah contracts that are customized base on relevant parameters in accordance to Islamic principles. In addition, Johnes et al. (2014) highlight that this requirements would increase the operational costs to the Islamic banks. In contrast, Abdul-Majid et al. (2008; 2011) argue that Islamic bank outperform conventional banks because the Islamic banks are operating under few principles that would reduce the overall business risks and could positively influence their performance. Among the principles are risk sharing, real assets transactions and prohibitions of gharar, maisir and riba. Hence, the relationship between types of bank

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and bank efficiency is predicted to be mixed. The main independent variables are the financial crisis, origins of bank ownership (foreign banks versus domestic banks) and types of bank (Islamic banks versus conventional banks). The control variables are comprised of bank-specific variables (bank size, credit risk, intermediation role, profitability) and economic variables (economic growth and inflation).

Table 3.1

Descriptions and Expected Findings of Variables used in the Tobit Regression Model.

Variables	Descriptions	Expected findings
Dependent Variables:		
Technical efficiency, pure technical efficiency and scale efficiency	The banks technical efficiency, pure technical efficiency and scale efficiency are derived from the DEA approach.	NA
Bank-Specific Variables:		
Bank size (SIZE)	Log transformation of total assets of the banks.	+ve
Credit risk (LOANS/TA)	Ratio of total loans to total asset.	+ve
Intermediation role (LOANS/DEP)	Ratio of total loans to total deposits.	+ve
Profitability (ROA)	Ratio of total return to total assets.	+ve
Profitability (ROE)	Ratio of total return to total equity.	+ve
Economic Variables:		
Economic growth (GDP)	annual percentage (%) of GDP growth	+ve
Inflation (CPI)	annual percentage (%) of consumer price index	-ve

Table 3.1 (Continued)

Variables	Descriptions	Expected findings
Main Variables:		
Financial crisis (POST_CRISIS)	Dummy variable, which takes the value of 0 for pre and during the crisis period and 1 for post-crisis period.	+ve/-ve
Origins of bank ownership (OWN)	Dummy variable, which takes the value of 0 for domestic banks and 1 for foreign banks.	+ve/-ve
Types of bank (TYPE)	Dummy variable, which takes the value of 0 for conventional banks and 1 for Islamic banks.	+ve/-ve

3.5 Research Design

This section explains the data selection, collection and analysis employed in this study.

3.5.1 Data

This study uses secondary and unbalanced panel data which are collected from various sources. The data for bank characteristics, inputs and outputs variables are gathered from the individual's bank financial statements. All financial variables are measured in Malaysian Ringgit (MYR) and the inputs and outputs variables are deflated using GDP deflator with 2010 as the base year to facilitate comparison (Spulbăr, Niţoi, & Anghel, 2015).

This study covers 404 observations of all commercial banks operated in Malaysia from 2004 to 2015. There are 21 missing observations due to the data unavailability. From the total observations, 18 are domestic banks and 25 are foreign banks. As for the types of bank, 14 are Islamic banks and 29 are conventional banks.

Due to the small number of samples per year, the data is pooled using the common frontier technique to increase the degree of freedom (Chortareas, Girardone, & Ventouri, 2009). Table 3.2 and Table 3.3 present the lists of all banks used in the dataset.

Table 3.2
List of Conventional Banks According to its Origins of Bank Ownership and the Sample Period

No	Conventional Banks	Origins of Bank Ownership	Sample Period
1	ABN Amro (M) Bank	Foreign bank	2004-2007
2	Affin Bank Bhd.	Domestic bank	2004-2015
3	Alliance Bank Bhd.	Domestic bank	2004-2015
4	AmBank Bhd.	Domestic bank	2004-2015
5	Bangkok Bank (M) Bhd.	Foreign bank	2004-2015
6	Bank of America (M) Bhd.	Foreign bank	2004-2015
7	Bank of China (M) Bhd.	Foreign bank	2004-2015
8	Bank of Tokyo-Mitsubishi UFJ (M) Bhd.	Foreign bank	2004-2015
9	CIMB Bank Bhd.	Domestic bank	2004-2015
10	Citibank (M) Bhd.	Foreign bank	2004-2015
11	Deutsche Bank (M) Bhd.	Foreign bank	2004-2015
12	EON Bank Bhd.	Domestic bank	2004-2010
13	Hong Leong Bank Bhd.	Domestic bank	2004-2015
14	HSBC Bank (M) Bhd.	Foreign bank	2004-2015
15	India International Bank (M) Bhd.	Foreign bank	2013-2015
16	Industrial and Commercial Bank of China (M) Bhd.	Foreign bank	2012-2015
17	J.P. Morgan Chase Bank (M) Bhd.	Foreign bank	2004-2015
18	Malayan Banking Bhd.	Domestic bank	2004-2015
19	Mizuho Corporate Bank (M) Bhd.	Foreign bank	2012-2015
20	National Bank of Abu Dhabi (M) Bhd.	Foreign bank	2012-2015
21	OCBC Bank (M) Bhd.	Foreign bank	2004-2015
22	Public Bank Bhd.	Domestic bank	2004-2015
23	RHB Bank Bhd.	Domestic bank	2004-2015
24	Southern Bank Bhd.	Foreign bank	2004-2005
25	Standard Chartered Bank (M) Bhd.	Foreign bank	2004-2015
26	Sumitomo Mitsui Banking Corporation (M) Bhd.	Foreign bank	2012-2015
27	The Bank of Nova Scotia (M) Bhd.	Foreign bank	2004-2015
28	The Royal Bank of Scotland (M) Bhd.	Foreign bank	2008-2015
29	United Overseas Bank (M) Bhd.	Foreign bank	2004-2015

(Source: BNM, 2015 retrieved on 1 Mac 2016)

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Table 3.3

List of Islamic Banks According to its Origins of Bank Ownership and the Sample Period

No	Islamic Banks	Origins of Bank Ownership	Sample Period
1	Affin Islamic Bank Bhd.	Domestic bank	2007-2015
2	Al-Rajhi Banking & Investment Corporation (M) Bhd.	Foreign bank	2008-2015
3	Alliance Islamic Bank Bhd.	Domestic bank	2009-2015
4	AmIslamic Bank Bhd.	Domestic bank	2007-2015
5	Asian Finance Bank Bhd.	Foreign bank	2007-2015
6	Bank Islam Malaysia Bhd.	Domestic bank	2004-2015
7	Bank Muamamalat Malaysia Bhd.	Domestic bank	2004-2015
8	CIMB Islamic Bank Bhd.	Domestic bank	2009-2015
9	Hong Leong Islamic Bank Bhd.	Domestic bank	2006-2015
10	HSBC Amanah (M) Bhd.	Foreign bank	2009-2015
11	Kuwait Finance House (M) Bhd.	Foreign bank	2006-2015
12	OCBC Al-Amin Bank Bhd.	Foreign bank	2008-2015
13	Public Islamic Bank Bhd.	Domestic bank	2011-2015
14	RHB Islamic Bank Bhd.	Domestic bank	2005-2015

(Source: BNM, 2015 retrieved on 1 Mac 2016)

3.5.2 Data analysis

The DEA bank efficiency is calculated using the MaxDEA version 5.2 software developed by Cheng and Qian (2009). On the other hand, Tobit regression model which is used to find the relationships between financial crisis, origins of bank ownership, types of bank and bank efficiency is regressed using the Eviews 9 software.

3.6 Conclusion

This chapter provides the discussions on the research methodologies employed in this study. The concepts and definitions of efficiency were explained in detail in this chapter. Besides, the uses of DEA and the selections of inputs and outputs variables are also highlighted. Moreover, the Tobit regression model is constructed to examine

the relationships between financial crisis, origins of bank ownership, types of banks and bank efficiency controlling for the impacts of several bank-specific and economic variables. Towards the end of this chapter, research design that consists of data collections and data analysis are discussed.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1   Introduction

Chapter four covers the findings and discussions of the study. This chapter begins with section 4.2 which discusses on descriptive statistics of the inputs and outputs used in the study. Then, section 4.3 presents efficiency results while section 4.4 presents findings on the relationships between financial crisis, origins of bank ownership, type of bank and bank efficiency. Finally, section 4.5 concludes the chapter.

4.2   Descriptive Statistics

This section presents the descriptive statistics of the inputs and outputs variables. The input variables used in this study are personnel expenses, capital and deposits and short term funding. In addition, the output variables consist of total loans and total securities. Table 4.1 presents the summary of descriptive statistics of input and output variables employed in DEA approach.

Table 4.1
Descriptive Statistics of Input and Output variables

Variable Description	Mean	Minimum	Maximum	Standard Deviation
FULL SAMPLE				
Full Period (2004-2015)				
Inputs (RM'000)				
Personnel expenses	307.04	1.11	3,374.33	499.57
Capital	159.63	0.04	1,443.31	257.08
Deposits and short term funding	41,604.41	48.42	376,429.50	58,617.77
Output (RM'000)				
Total loans	26,176.96	0.55	263,675.60	40,799.11
Total securities	7,026.77	9.54	82,007.33	11,390.70
Pre and during crisis period (2004-2008)				
Inputs (RM'000)				
Personnel expenses	274.38	1.11	1,751.58	356.39
Capital	204.50	0.30	1,443.31	283.12
Deposits and short term funding	38,449.94	992.16	240,951.20	48,820.45
Output (RM'000)				
Total loans	22,818.64	44.78	151,636.40	31,400.89
Total securities	5,561.99	36.44	31,863.70	7,087.68
Post-crisis period (2009-2015)				
Inputs (RM'000)				
Personnel expenses	324.36	2.90	3,374.33	560.73
Capital	135.83	0.04	1,278.81	239.31
Deposits and short term funding	43,277.23	48.42	376,429.50	63,224.38
Output (RM'000)				
Total loans	27,957.89	0.55	263,675.60	44,948.13
Total securities	7,803.55	9.54	82,007.33	13,058.23
ORIGINS OF BANK OWNERSHIP				
Foreign Banks				
Full Period (2004-2015)				
Inputs (RM'000)				
Personnel expenses	126.32	1.11	629.41	164.16
Capital	62.771	0.68	396.09	98.10
Deposits and short term funding	17,899.86	48.42	88,433.83	21,855.64
Output (RM'000)				
Total loans	9,903.70	0.55	65,270.44	13,753.06
Total securities	2,461.03	9.54	14,543.88	3,204.06

Table 4.1 (Continued)

Variable Description	Mean	Minimum	Maximum	Standard Deviation
Pre and during crisis period (2004-2008)				
Inputs (RM'000)				
Personnel expenses	128.97	1.11	542.28	152.08
Capital	87.20	0.84	396.09	123.61
Deposits and short term funding	17,624.47	992.16	63,131.32	18,790.00
Output (RM'000)				
Total loans	9,655.24	44.78	29,622.72	11,446.39
Total securities	2,730.26	36.44	10,224.09	3,083.92
Post-crisis period (2009-2015)				
Inputs (RM'000)				
Personnel expenses	124.97	28.97	6,294.13	170.49
Capital	50.303	6.77	3,206.22	79.76
Deposits and short term funding	18,040.40	484.23	884,338.30	23,325.84
Output (RM'000)				
Total loans	10,030.50	5.49	652,704.40	14,828.33
Total securities	2,323.63	95.41	145,438.80	3,265.57
Domestic Banks				
Full Period (2004-2015)				
Inputs (RM'000)				
Personnel expenses	520.97	5.31	3,374.33	655.59
Capital	274.28	0.04	1,443.31	330.10
Deposits and short term funding	69,665.47	3,176.87	376,429.50	74,156.95
Output (RM'000)				
Total loans	45,440.99	1,930.37	263,675.60	52,281.49
Total securities	12,431.62	160.95	82,007.33	14,759.10
Pre and during crisis period (2004-2008)				
Inputs (RM'000)				
Personnel expenses	437.42	5.31	1,751.58	441.12
Capital	336.01	0.30	1,443.31	347.89
Deposits and short term funding	61,799.70	7,437.52	240,951.20	60,440.20
Output (RM'000)				
Total loans	37,577.61	1,930.37	151,636.40	39,280.60
Total securities	8,736.95	160.95	31,863.70	8,796.62

Table 4.1 (Continued)

Variable Description	Mean	Minimum	Maximum	Standard Deviation
Post-crisis period (2009-2015)				
Inputs (RM'000)				
Personnel expenses	567.31	6.52	3,374.33	746.28
Capital	240.05	0.04	1,278.81	316.13
Deposits and short term funding	74,028.00	3,176.87	376,429.50	80,678.70
Output (RM'000)				
Total loans	49,802.19	2,480.24	263,675.60	57,952.35
Total securities	14,480.77	585.92	82,007.33	16,887.11
TYPES OF BANK				
Islamic Banks				
Full Period (2004-2015)				
Inputs (RM'000)				
Personnel expenses	77.393	1.11	430.03	90.60
Capital	29.854	0.04	208.74	47.98
Deposits and short term funding	16,593.21	2,101.60	49,992.28	12,152.88
Output (RM'000)				
Total loans	9,512.97	101.06	37,040.85	8,246.64
Total securities	3,042.91	36.44	15,260.42	2,936.71
Pre and during crisis period (2004-2008)				
Inputs (RM'000)				
Personnel expenses	66.90	1.11	214.65	64.20
Capital	38.45	0.30	143.28	41.91
Deposits and short term funding	12,077.59	2,121.23	31,019.97	7,126.71
Output (RM'000)				
Total loans	5,163.51	101.06	11,271.23	3,000.00
Total securities	1,841.68	36.44	4,319.60	1,355.63
Post-crisis period (2009-2015)				
Inputs (RM'000)				
Personnel expenses	80.45	6.52	430.03	97.03
Capital	27.35	0.04	208.74	49.53
Deposits and short term funding	17,910.27	2,101.60	49,992.28	13,000.96
Output (RM'000)				
Total loans	10,781.56	721.03	37,040.85	8,848.24
Total securities	3,393.27	82.26	15,260.42	3,177.18

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Table 4.1 (Continued)

Variable Description	Mean	Minimum	Maximum	Standard Deviation
Conventional Banks				
Full Period (2004-2015)				
Inputs (RM'000)				
Personnel expenses	408.74	2.90	3,374.33	568.37
Capital	217.10	0.68	1,443.31	289.22
Deposits and short term funding	52,680.79	48.42	376,429.50	67,058.99
Output (RM'000)				
Total loans	33,556.73	0.55	263,675.60	46,864.91
Total securities	8,791.06	9.54	82,007.33	13,169.44
Pre and during crisis period (2004-2008)				
Inputs (RM'000)				
Personnel expenses	326.25	5.38	1,751.58	380.11
Capital	246.01	0.84	1,443.31	302.08
Deposits and short term funding	45,043.02	992.16	240,951.20	52,469.11
Output (RM'000)				
Total loans	27,232.42	44.78	151,636.40	33,678.87
Total securities	6,492.06	40.04	31,863.70	7,622.07
Post-crisis period (2009-2015)				
Inputs (RM'000)				
Personnel expenses	463.74	28.97	33,743.28	660.35
Capital	197.82	6.77	12,788.09	279.57
Deposits and short term funding	57,772.64	484.23	3,764,295.00	74,951.65
Output (RM'000)				
Total loans	37,772.94	5.49	2,636,756.00	53,578.73
Total securities	10,323.72	95.41	820,073.30	15,659.72

Note: Descriptive statistics for full sample include all 404 observations throughout the period of 2004 to 2015. Personnel expenses represent the total expenditure on the employee which consists of wages, salaries, bonuses, and defined contributions plans. Capital refers to the book value of premises and fixed assets. Deposits and short term funding refer to the total deposits and short term funding of the banks. Total loans comprise of total loans, advances and financing. Total securities are measured using the total investment and dealing securities.

Table 4.1 shows the descriptive statistics of the inputs and outputs for full

sample, origins of bank ownership (foreign banks and domestic banks) and types of

bank (Islamic banks and conventional banks). The first part of the discussion is on the full sample which consists of all observations. The input variables for full sample in the three periods are mainly contributed by the deposits and short term funds with RM41,604 million (full period), RM38,450 million (pre and during the crisis) and RM43,277 million (post-crisis period). Meanwhile, the total loans are the main output variables as shows by the highest mean scores. Consistent with the input variable (deposit and short term funding), the level of mean is the highest for the post-crisis period which is RM27,958 million followed by full period (RM26,177 million) and pre and during the crisis periods (RM22,819 million).

Consistent with the full sample analysis, deposits and short term funding and total loans remain as the main input and output variables when the observations are divided into foreign banks and domestic banks. The statistics shows that domestic banks generate highest mean of deposits and short term fund (full period) as compared to foreign banks with an average of RM69,665 million and RM17,899 million respectively. Similarly, the same conclusion can be made for the total loans in which the domestic banks dominates their foreign counterparts for all periods (full period, pre and during the crisis period and post-crisis period).

Looking at the statistic for type of banks, conventional banks dominate Islamic banks for the deposits and short term funds and the total loans for all three periods. As shown in the Table 4.1, for the deposits and short term funds, the mean is the highest for the post-crisis period (RM57,773 million - conventional banks; RM17,910 million - Islamic banks) followed by full period (RM33,557 million - conventional banks; RM16,593 million - Islamic banks) and pre and during the crisis period (RM45,043 million - conventional banks; RM12,078 million - Islamic banks). As for the total loans, the highest values is RM37,773 million in the post-crisis period for

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conventional banks. In contrast, the Islamic banks exhibit the lowest value which is RM5,164 million in the pre and during the crisis period.

In conclusions, Table 4.1 demonstrates that the main input and output variable are the deposits and short term fund and total loans respectively. The analysis of descriptive statistics for the full sample, origins of bank ownership, and types of banks show that the level of both variables increases after the crisis. It is also noted that for all main variables, domestic banks dominates the foreign banks in all three period (full period, pre and during the crisis period and post-crisis period). In addition, the conventional banks take the lead role in generating deposits and short term funding and providing loans and advances as compared to Islamic banks.

4.3   Efficiency Results

Section 4.3 provides efficiency results computed using DEA approach. According to Sherman and Zhu (2006), this linear programming calculates the bank efficiency by incorporating multiple inputs and outputs. For this study, three components of efficiency scores are produced which are technical efficiency, pure technical efficiency, and scale efficiency. The discussion on the efficiency scores is focusing on the efficiency performance and sources of inefficiency over the period of 2004 to 2015.

4.3.1   Efficiency performance and sources of inefficiency

An analysis on the efficiency performance and sources of inefficiency are presented in Table 4.2. Consistent with the research objectives, the discussion is divided into two parts. Firstly is the discussion on the origins of bank ownership (foreign banks versus

domestic banks). Secondly, the analysis is made on the types of bank (Islamic banks versus conventional banks). Furthermore, the sources of inefficiency are highlighted to identify which components of efficiency that need further improvement. Finally, the discussion would also incorporate three periods which are full period (2004-2015), pre and during crisis period (2004-2008) and post-crisis period (2009-2015).

Table 4.2
Mean Efficiency Scores and Sources of Inefficiency

Bank	Technical Efficiency {Technical Inefficiency - %}*	Pure Technical Efficiency {Pure Technical Inefficiency - %}*	Scale Efficiency {Scale Inefficiency - %}*
Full Period (2004-2015)			
Full Sample	0.44824	0.65038	0.69918
(43 banks)	*{55.18%}*	*{34.96%}*	*{30.08%}*
Foreign banks	0.37790	0.55384	0.69180
(25 banks)	*{62.21%}*	*{44.62%}*	*{30.82%}*
Domestic banks	0.53150	0.76466	0.70792
(18 banks)	*{46.85%}*	*{23.53%}*	*{29.21%}*
Islamic banks	0.56805	0.66303	0.85053
(14 banks)	*{43.20%}*	*{33.70%}*	*{14.95%}*
Conventional banks	0.39518	0.64478	0.63216
(29 banks)	*{60.48%}*	*{35.52%}*	*{36.78%}*
Pre and during crisis period (2004-2008)			
Full Sample	0.40636	0.62858	0.67235
(34 banks)	*{59.36%}*	*{37.14%}*	*{32.77%}*
Foreign banks	0.36967	0.59218	0.65607
(19 banks)	*{63.03%}*	*{40.78%}*	*{34.39%}*
Domestic banks	0.44748	0.66938	0.69059
(15 banks)	*{55.25%}*	*{33.06%}*	*{30.94%}*
Islamic banks	0.43403	0.51971	0.82512
(10 banks)	*{56.60%}*	*{48.03%}*	*{17.49%}*
Conventional banks	0.39944	0.65579	0.63415
(24 banks)	*{60.06%}*	*{34.42%}*	*{36.58%}*

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Table 4.2 (Continued)

Bank	Technical Efficiency {Technical Inefficiency - %}*	Pure Technical Efficiency {Pure Technical Inefficiency - %}*	Scale Efficiency {Scale Inefficiency - %}*
Post-crisis period (2009-2015)			
Full Sample	0.47045	0.66194	0.71341
(41 banks)	*{52.96%}*	*{33.81%}*	*{28.66%}*
Foreign banks	0.38211	0.53427	0.71003
(23 banks)	*{61.79%}*	*{46.57%}*	*{29.00%}*
Domestic banks	0.57809	0.81750	0.71754
(18 banks)	*{42.19%}*	*{18.25%}*	*{28.25%}*
Islamic banks	0.60714	0.70483	0.85794
(14 banks)	*{39.29%}*	*{29.52%}*	*{14.21%}*
Conventional banks	0.39234	0.63743	0.63083
(27 banks)	*{60.77%}*	*{36.26%}*	*{36.92%}*
Changes**			
Overall	15.77%	5.31%	6.11%
Foreign banks	3.36%	(9.78%)	8.22%
Domestic banks	29.19%	22.13%	3.90%
Islamic banks	39.88%	35.62%	3.98%
Conventional banks	(1.78%)	(2.80%)	(0.52%)

* Note: The inefficiency scores are denotes by the percentage in the parenthesis [{ }]. Formula: (1 − efficiency) × 100 is used to compute inefficiency scores.
** Lower efficiency performance for post-crisis period as compared to pre and during the crisis period are denotes by the percentage in the parenthesis [( )]. Formula: [mean efficiency (post) − mean efficiency (pre and during)] / mean efficiency (pre and during) is used to calculate the changes between them.

Based on Table 4.2, efficiency results on the origins of bank ownership highlight that domestic banks outperform foreign banks in all efficiency scores. It shows that domestic banks in Malaysia perform better than foreign banks in pre, during and post-crisis periods. With regards to the highest efficiency scores, pure technical efficiency appears to be the highest for domestic banks in the overall (0.76466) and post-crisis periods (0.81750). It indicates superior management capability in minimizing the inputs in the banks' operation during that period of time.

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However, for the pre and during crisis period, domestic banks perform better in scale efficiency (0.69059). The results show that during that time they manage to optimize their production skills. In contrast, the foreign banks score the highest in scale efficiency in the three periods (0.69180 - full period; 0.65607 - pre and during the crisis period; and 0.71003 - post-crisis period). As compared to their domestic counterpart, foreign banks are better at optimizing the usage of input in outputs' production.

For both group of banks, it is noted that they suffer the most from the technical inefficiency. However, foreign banks show higher technical inefficiency level (62.21% - full period; 63.03% - pre and during the crisis period; 61.79% - post-crisis period) as compared to their domestic counterparts (46.85% - full period; 55.25% - pre and during the crisis period; and 42.19% - post-crisis period). The results also show that both groups of banks have made improvement in the post-crisis period. This result shows that the skills in minimizing the input wastage have improved following the crisis for both domestic banks and foreign banks. Besides that, it is noted that domestic banks shows the positive changes in three types of efficiency scores discussed earlier (29.19% - technical efficiency; 22.13% - pure technical efficiency; and 3.90% - scale efficiency). From the results, it shows that the domestic banks make the highest improvement in technical efficiency as compared to other efficiency scores. On the other hand, foreign banks have two improvements which are in technical efficiency (3.36%) and scale efficiency (8.22%). On the contrary, pure technical efficiency is negatively affected by the 2007/2008 U.S. financial crisis.

The next discussion is on the efficiency performance focusing on the types of bank (Islamic banks and conventional banks). As shown in Table 4.2, Islamic banks perform better than conventional banks in all types of efficiency scores in all periods.

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The results reveal that Islamic banks perform better in scale efficiency as compared to other efficiency scores (0.56805 - technical efficiency; 0.66303 - pure technical efficiency; and 0.85053 - scale efficiency). This result indicates that Islamic banks have achieved optimum production's scale in production as compared to conventional bank. On the other hand, for conventional banks, pure technical efficiency scores are the highest as compared to the other types of efficiency scores (0.39518 - technical efficiency; 0.64478 - pure technical efficiency; and 0.63216 - scale efficiency). These results indicate strong management capability in minimizing inputs for the production.

Similar to the results for origins of bank ownership, the main source of inefficiency for Islamic banks and conventional banks is technical inefficiency. It is also found that the technical inefficiency for conventional banks is higher than Islamic banks counterparts in those three periods. The comparison of technical inefficiency for both types of banks is as follows: full period (60.48% - conventional banks; 43.20 - Islamic banks), pre and during the crisis period (60.06% - conventional banks; 56.60% - Islamic banks) and post-crisis period (60.77% - conventional banks; 39.29% - Islamic banks). From the results, it can be concluded that the Islamic banks have made a larger improvement in technical efficiency following the crisis as compared to the conventional banks. This result also indicates that the conventional banks are having difficulties in minimizing their input wastage in the production.

The last of discussion on the types of banks is made on the overall changes in efficiency scores between the pre and during crisis periods and post-crisis period. From the statistics, it is evident that the Islamic banks have made an improvement in all efficiency scores (39.88% - technical efficiency; 35.62% - pure technical efficiency; and 3.98% - scale efficiency). These results show that the principles of

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Islamic banking which are based on Al-Quran and As-Sunnah prove to mitigate the negative impacts of the financial crisis on efficiency performance. Meanwhile, the reductions in efficiency performance for conventional banks are noted for all efficiency scores (1.78% - technical efficiency; 2.80% - pure technical efficiency; and 0.52% - scale efficiency). The statistics prove the pure technical efficiency is mostly affected in the pre and during the crisis period which affected the ability of management to produce in an efficient manner.

In conclusion, for the origins of bank ownership, the efficiency results reveal that domestic banks have better efficiency performances (technical efficiency, pure technical efficiency and scale efficiency) than foreign banks for all periods (full period; pre and during the crisis period; and post-crisis period). Similarly, for the types of bank, Islamic banks are found to outperform its conventional counterparts in all efficiency scores. Moreover, efficiency improvements are noted for domestic banks in all efficiency scores. As for foreign banks, only technical efficiency and scale efficiency improved following the 2007/2008 U.S. financial crisis. Meanwhile, none of the efficiency scores for conventional banks increased after the crisis. As predicted in the literature, Islamic banks show positive changes in all efficiency scores which prove that these banks are insulated from the negative impact of 2007/2008 U.S. financial crisis.

4.4   Tobit Regression Results

Tobit regression is conducted to assess the relationships between financial crisis, origins of bank ownership, types of bank and bank efficiency. Table 4.3 presents results for Tobit regression which include three components of bank efficiency (technical efficiency, pure technical efficiency, and scale efficiency) as the dependent

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variables. The independent variables used are origins of the bank ownership (OWN), type of banks (TYPE), and post-crisis (POST_CRISIS) while the control variables are the bank size (SIZE), credit risk (LOANS/TA), intermediation role (LOANS/DEP), profitability (ROA and ROE), economic growth (GDP), and inflation (CPI). The results presented in Table 4.3 is arranged according to their respective efficiency components namely; model 1 (technical efficiency), model 2 (pure technical efficiency), and model 3 (scale efficiency).

Table 4.3
Results on Tobit Regression

Variables	(1) Technical Efficiency	(2) Pure Technical Efficiency	(3) Scale Efficiency
Constant	0.3349	0.3977	0.7729
	(0.1120)*	(0.1460)*	(0.1524)*
Bank-Specific Variables:			
SIZE	-0.0184	-0.0025	-0.0214
	(0.0069)*	(0.0090)	(0.0093)**
LOANS/TA	0.3236	0.3396	0.2122
	(0.0650)*	(0.0848)*	(0.0885)**
LOANS/DEP	0.2671	0.2107	0.1164
	(0.0343)*	(0.0448)*	(0.0467)**
ROA	3.7945	3.3736	1.4866
	(0.8499)*	(1.1083)*	(1.1562)
ROE	0.0416	0.0335	0.0073
	(0.0286)	(0.0373)	(0.0390)
Economic Conditions Variables:			
GDP	0.0027	0.0038	0.0003
	(0.0025)	(0.0032)	(0.0034)
CPI	0.0022	0.0018	-0.0017
	(0.0061)	(0.0079)	(0.0082)
Main Variables:			
POST_CRISIS	0.0396	0.0376	-0.0021
	(0.0161)**	(0.0210)***	(0.0219)
OWN	-0.0710	-0.1489	0.0484
	(0.0174)*	(0.0227)*	(0.0236)**

Table 4.3 (Continued)

Variables	(1) Technical Efficiency	(2) Pure Technical Efficiency	(3) Scale Efficiency
TYPE	0.1261	-0.0461	0.2100
	(0.0180)*	(0.0235)**	(0.0245)*
No. of observations	404	404	404
Log likehood	255.6868	148.4347	131.3171

Note: *significant at 1% level, **significant at 5% level, ***significant at 10% level. Value of standard errors are denotes in the parentheses ( ). Bank-specific variables are measured by SIZE (log transformation of total assets of the banks), LOANS/TA (ratio of total loans to total asset), LOANS/DEP (ratio of total loans to deposits), ROA (return on assets), and ROE (return on equity). The economic variables are measured by GDP (GDP growth), and CPI (consumer price index). The main-variables are measured using dummy variables: POST_CRISIS (1 for post-crisis period, 0 for pre and during the crisis period), OWN (1 for foreign banks, 0 for domestic banks) and TYPE (1 for Islamic banks, 0 for conventional banks).

(a)   Bank size (SIZE)

This variable is included in the regression model to evaluate the relationship between the size and bank efficiency. Larger banks are expected to perform better due to having high capability in using their capital and technology. Hence, it is predicted that the bank size would have a positive relationship with the bank efficiency. From the results, the Malaysian banks are found to have a negative and statistically significant relationship with the bank efficiency in model 1 (technical efficiency) and model 3 (scale efficiency). These results indicate that smaller bank is more efficient than the larger bank. Since smaller banks are usually having less complex structure, this could give them greater flexibility in the minimizing input and maximizing the outputs in the banks' production. Similar findings are also found by Isik and Hassan (2002), Rosman et al. (2014), Sufian (2009a; 2011).

(b)   Credit risk (LOANS/TA)

Failure in managing credit risk is the major concern of the banks because it might dampens the banks' stability and performance (Gup & Kolari, 2005; and Mukherjee et al. (2001). Thus, the relationship between credit risk and bank efficiency is expected to be negative. However, the results presented in Table 4.3 prove otherwise. The result reveals a positive and significant link between credits risk and bank efficiency in all models (technical efficiency, pure technical efficiency, and scale efficiency). This results is also consistent with Rosman et al. (2014). One possible reason for this positive relationship is when the credit risk is higher; it will put more pressure for the management to perform better to ensure the survivorship of the banks (Mukherjee et al., 2001).

(c)   Intermediation role (LOANS/DEP)

Banks act as financial intermediaries between the surplus units (depositors) and the deficit units (borrower). They provide funds to the deficit unit by converting the deposits into loans. Higher intermediation role allows the bank to penetrate wider customer base and this could force them to operate more efficiently. Hence, it is expected that the intermediation role will have a positive influence on bank efficiency. As suggested earlier, the results reveal a positive and significant relationship between the intermediation role and bank efficiency in all models (technical efficiency, pure technical efficiency, and scale efficiency). The results suggest that higher ability to convert deposits into loans will enhance the banks' performance. This results is consistent with findings by Ariff and Can (2009) and Berger et al. (2000). They suggest that banks with higher intermediation role would

operate in wider market segments and thus becoming more efficient and competitive in the market.

(d)   Profitability (ROA and ROE)

Bank efficiency is influenced by the ability of banks in generating high earnings because profitable banks are likely to gain more confidence and trust from customers. Thus, they are able to attract more customers, depositors and borrowers with high creditworthiness (Sufian, 2009b). Therefore, this variable is expected to have a positive relationship with bank efficiency. As suggested by previous studies (Ferreira 2012; Isik & Hassan, 2002; Košak and Zajc, 2011; Pasiouras, 2008; Rosman et al., 2014; Sufian & Abdul-Majid, 2008), two profitability variables are used which are ROA and ROE. In general, both variables measure profitability but ROE provides information on the shareholders wealth.

The results in Table 4.3 show that there is a positive and significant relationship between the ROA and bank efficiency in model 1 (technical efficiency) and model 2 (pure technical efficiency). This finding indicates that banks with high return are able to minimize the input's usage in their productions. This result is in line with the previous studies (Isik & Hassan, 2002; Košak, and Zajc, 2011; Rosman et al., 2014; Sufian & Abdul-Majid, 2008).

The next profitability variable is ROE. As suggested by Ferreira (2012), bank's management is forced to increase the earnings from the funds invested by shareholder. With this, it is expected that the relationship between ROE and bank efficiency is positive. Apparently, results show an insignificant relationship between

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ROE and bank efficiency in all efficiency measures. However, this result failed to provide evidence that shareholders maximization influence the bank efficiency.

(e)   Economic growth (GDP)

The GDP variable enters into the regression model to measure the relationship between the economic growth and bank efficiency. It is predicted that bank efficiency would increase in the favorable economic environment. Due to that, the relationship between the economic growth and bank efficiency is expected to be positive. However, the findings fail to prove a positive relationship between economic growth and bank efficiency in all models (technical efficiency, pure technical efficiency and scale efficiency). This result is consistent with (Ariff & Can, 2009; Gardener, Molyneux and Nguyen-Linh, 2011; Sufian, 2009b; Sufian & Habibullah, 2012). This finding could be explained by the ability of Malaysian banks to withstand the turbulances of 2007/2008 U.S. financial crisis (Sufian and Habibullah, 2012). In addition, BNM reported that Malaysia economic condition remain stable during the crisis period (BNM 2007; BNM 2008). Therefore, it could cause less variability in the level of economic and lead to insignificant result of GDP and bank efficiency.

(f)   Inflation (CPI)

Another macroeconomic variable that would affect the bank efficiency is inflation. According to Kasman and Yildrim (2006), higher inflation could have a negative influence on bank efficiency because it will create variability in the banks' interest margin. Hence, this variable is expected to have a negative relationship with bank efficiency. However, results in Table 4.3 provide insignificant findings. This result is in line with Sufian and Habibullah (2012). This finding suggests that for the period of

the study, the levels of inflation rate have been predicted by the Malaysian bank. Hence, this allows them to adjust their interest rate in accordance to the predicted inflation rate. Therefore, the negative link between inflation and bank efficiency is not found in the study.

(g)   Post-crisis (POST_CRISIS)

Post-crisis is the main variable used to examine the impact of financial crisis on bank efficiency. According to previous studies Matkovskyy (2016), Mohamad and Wahab (2016) and San et al. (2011), banks show an improvement following the crisis. On the other hand, studies by lzubaidi and Bougheas (2012) and Anayiotos et al.(2010) revealed that bank are not efficient after the crisis.   Hence, based on the different arguments, this present study hypothesizes a mixed relationship between post-crisis period and bank efficiency.

As predicted, bank efficiency increases following the 2007/2008 U.S. financial crisis which are presented in model 1 (technical efficiency) and model 2 (pure technical efficiency). The results suggest that Malaysian banks perform better in the post-crisis period which is consistent with Matkovskyy (2016), Mohamad and Wahab (2016) and San et al. (2011). The significant reformations conducted in Malaysian banking industry after the 1997/1998 Asian financial crisis proved to strengthen the foundations of Malaysian banks during the 2007/2008 U.S. financial crisis. Among the reformations are strengthening of the liquidity management, capitalization and managerial practices. According to BNM (1999; 2007; 2008; 2009), as at the end of 2007 to 2009, the risk-weighted capital ratio for Malaysian bank is above the benchmark level which is 12.5%. It shows higher capability of the banks in absorbing the operational risks. In addition, it is also noted that the process of financial

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intermediation process remain stable and strong during that particular time. With this, the performance of Malaysian banks is intact by the global financial crisis.

However, there is an insignificant relationship between the post-crisis and bank efficiency in model 3 (scale efficiency). Thus, this study fails to find evidence on the relationship between these two variables.

(h)   Origins of bank ownership (OWN)

In line with the objective to investigate the relationship between origins of bank ownership and bank efficiency, origins of bank ownership (OWN) enters into the regression model. Results on this variable are expected to be mixed, consistent with the suggestion made by Berger et al. (2000) under the home field advantage and the global advantage hypothesis. For this present study, the results indicate a positive link between the origins of bank ownership and bank efficiency as indicated in model 3 (scale efficiency). Supporting the global advantage hypothesis, this results highlight that Malaysian foreign banks outperform their domestic counterparts by producing at optimum scale of production. As noted by Berger et al. (2000), foreign banks perform better than domestic banks because they managed to achieve economies of scale from the cross-border banking operations. This result is also consistent with Abdul-Majid (2008) and Sufian and Habibullah (2012).

In contrast, as highlighted in model 1 (technical efficiency) and model 2 (pure technical efficiency), domestic banks outperform their foreign counterparts and thus, supporting the home field advantage hypothesis. These finding are consistent with (Burki & Niazi, 2009; Matthews & Mahadzir, 2006; Rezvanian et al., 2008; Sufian & Habibullah, 2012). According to Berger et al. (2000), domestic banks are found to

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have competitive advantages than foreign banks in terms of better knowledge and experience, regulations, language and culture practices in the local market (Jensen & Szulanski, 2004; Naarborg, 2007; Rezvanian, Ariss, & Mehdian, 2011)

(i)   Types of bank (TYPE)

This variable is included in the regression model to assess the relationship between types of bank (Islamic banks versus conventional banks) and bank efficiency. According to suggestion made by Johnes et al. (2014), Abdul-Majid et al. (2008) and Abdul-Majid et al. (2011), relationship between these variables is expected to be mixed. This study reveals that there is a positive and significant relationship between the types of bank and bank efficiency in model 1 (technical efficiency) and model 3 (scale efficiency). These result highlight that Islamic banks are more efficient than conventional banks in minimizing input wastage and thus, producing at optimum production scale. This results is consistent with Abdul-Majid et al. (2008) and Abdul-Majid et al. (2011).

In contrast, it is found that conventional banks are more efficient than Islamic counterparts in model 2 (pure technical efficiency). It is noted that conventional banks have are better management capability in producing at highest level of efficiency. These result are in line with Johnes et al. (2014). Since Islamic banks have to handle various Islamic compliance contracts which are costly and time-consuming, this could dampen banks' management ability to produce at efficient level.

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4.5   Conclusion

In summary, this chapter provides the results on the bank efficiency and its relationship with financial crisis, origins of bank ownership and types of bank in Malaysia. The results reveal that technical and pure technical efficiencies improve following the 2007/2008 U.S. financial crisis. In addition, the domestic banks outperform foreign banks in technical and pure technical efficiencies. However, for scale efficiency, foreign banks have better performance than their domestic counterparts. Lastly, Islamic banks are found to have better efficiency performance in technical and scale efficiencies. Nonetheless, conventional banks are more efficient in producing at optimum level.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1   Introduction

This chapter is organized into four parts. Section 5.2 presents the summary of the findings which consists of the analysis on the efficiency results and followed by the findings on the relationships between financial crisis, origins of bank ownership, the types of bank and bank efficiency. Subsequently, Section 5.3 provides the policy implications. Next, Section 5.4 discusses on the limitations and recommendations for the future research. Lastly, Section 5.5 concludes this present study.

5.2   Summary of Findings

This section is divided into two parts. The first part will discuss the results on efficiency performance based on scores provided by DEA approach. Meanwhile, the second part elaborates on the findings of the relationships between financial crisis, origins of bank ownership, types of bank and bank efficiency regressed using the Tobit regression model.

5.2.1   Analysis of Efficiency Performance

This section summarizes the findings on the efficiency performance of all banks used in the study. The discussion is divided into two groups based on the results for (1) the overall analysis of efficiency performance and sources of inefficiency and (2) the changes of efficiency performance for origins of bank ownership (foreign banks versus domestic banks) and the types of banks (Islamic banks versus conventional

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banks) in full period (2004-2015), pre and during the crisis period (2004-2008); and post-crisis period (2009-2015).

Firstly, the analysis for overall efficiency performance was analyzed using DEA approach. Results from the efficiency performance and sources of inefficiency for the origins of bank ownership show that domestic banks outperformed foreign banks in all three periods (full period, pre and during the crisis and the post crisis period) between 2004 and 2015. Results also reveal that domestic banks and foreign banks have made an improvement in their efficiency performance following the crisis. However, domestic banks have made a larger efficiency improvement as compared to foreign banks.

In addition, the overall results on efficiency performance for the types of banks indicate that Islamic banks perform better than conventional banks in all efficiency scores (technical efficiency, pure technical efficiency and scale efficiency) during the three periods between 2004 and 2015.One possible explanation is because the Islamic banks are operating under Islamic principles that would reduce the overall business risks and could positively influence their efficiency performance. Amongst the principles are risk sharing, real assets transactions and prohibitions of gharar, maisir and riba.

Secondly, the analysis is made on the changes in efficiency scores by comparing between the pre and during crisis period (2004-2008); and post-crisis period (2009-2015). For the origins of bank ownership, domestic banks have found to have a positive change in efficiency performance in all efficiency measures. Conversely, foreign banks only show little improvements in two efficiency scores (technical efficiency and scale efficiency) as compared to their domestic counterparts.

On top of that, it is also discovered that foreign banks have a negative pure technical efficiency performance following the crisis.

With regards to the types of bank, it is evident that Islamic banks outperformed conventional banks in all efficiency scores. This results show that Islamic banks performed better after the 2007/2008 financial crisis as compared to the conventional banks. Thus, it can be said that the practices of Shariah guidelines which are based on Al-Quran and As-Sunnah have a significant positive influence on the Islamic banks performance in Malaysia.

In summary, the analysis of efficiency performance shows that for the origins of bank ownership, domestic banks perform better than foreign banks following the crisis. Meanwhile, for the types of banks, Islamic banks appear to outperform the conventional banks.

5.2.2 Financial Crisis and Bank Efficiency

The first objective of this study is to examine the impact of financial crisis on bank efficiency. This study finds that financial crisis have a significant and positive impact on bank efficiency (technical efficiency and pure technical efficiency). This finding is consistent with Matkovskyy (2016), Mohamad and Wahab (2016) and San et al. (2011). The financial reforms conducted by the BNM in Malaysian banking industry after the 1997/1998 Asian financial crisis could be the key factor that prevent its negative impacts on the domestic banking system.

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5.2.3 Origins of Bank Ownership and Bank Efficiency

The second objective of this study is to investigate the impact of origins of bank ownership (foreign banks versus domestic banks) on bank efficiency. Supported by global advantage hypothesis developed by Berger et al. (2000), foreign banks with better skills, expertise and technology, outperformed the domestic banks in scale efficiency (Sturm & Williams, 2004: Sufian, 2009a). In contrast, domestic banks have higher technical and pure technical efficiencies performance than their foreign counterparts. This findings is consistent with the home field advantage hypothesis by Berger et al. (2000). The competitive advantages in terms of the knowledge, experiences, language, regulatory and cultural practices in the local market could explain the superior performance of domestic banks (Jensen & Szulanski, 2004; Naarborg, 2007; Rezvanian et al., 2011).

5.2.4 Types of Bank on Bank Efficiency

The final objective of this study is to assess the impact of types of bank (Islamic banks versus conventional banks) on bank efficiency. The results show that Islamic banks outperform the conventional banks in technical and scale efficiencies. These findings are also in line with Abdul-Majid et al. (2008) and Abdul-Majid et al. (2011).

On the contrary, consistent with Johnes et al. (2014), conventional banks are performed better than the Islamic banks in pure technical efficiency. This indicates a stronger management capability of conventional banks in the banking operations. The handling of various Islamic Shariah compliance contracts could increase the costs and time in the Islamic banks' management which could lead to the pure technical inefficiency performance.

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5.3 Policy Implication

This study provides a few policy implications that would help the policy maker. From the findings of the study, it can be concluded that the efficiency performance of the banks in Malaysia is not affected by the 2007/2008 U.S. financial crisis. It shows that the current regulations imposed by the BNM help the domestic banking system to withstand against the global financial crisis. Besides that, BNM can continuously assess the performance of Malaysian banks in order to constantly preserve the higher efficiency performance that could finally help the economic growth.

In addition, the information provided by this study could contribute to the effective bank management. For example, as suggested by the findings, foreign banks need to revise their operations strategies so that they could improve in the technical and pure technical efficiencies. Thus, the continuous evaluation by the bank management could encourage healthy competition and improve the banking services among the banks operating in Malaysia.

5.4 Limitations and Recommendation of the Study

The present study also highlights several limitations. Firstly, this study only focuses on all commercial banks in Malaysia from the year 2004 to 2015. Thus, other banking institutions such as investment banks are not included in the dataset. Secondly, due to the time constraints, the study only covers banks in Malaysia. Hence, it is recommended for other researchers to conduct a similar study using cross-country settings.

In addition, since this study only employed DEA approach, future studies could utilize other methods such as stochastic frontier analysis (SFA) approach to

extend the analysis of the bank efficiency performance in the pre, during and post financial crises.

5.5   Conclusion

In conclusion, this present study provides empirical evidences on the relationships between the financial crisis, origins of bank ownership, types of bank and bank efficiency. Although with a few limitations, this study has succeeded in providing evidences on the improvement of bank efficiency following the financial crisis. Besides that, the findings also provide the comparisons of efficiency performances based on the origins of bank ownership and the types of bank. Finally, towards the end of this chapter, few policy implications, limitations of the study and recommendations are highlighted.

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APPENDIX A

NUMBER OF COMMERCIAL BANKS IN MALAYSIA (2004-2015)

Origins of bank ownership	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Domestic banks	11	12	13	15	15	17	17	17	17	17	17	17
Foreign banks	14	14	14	15	17	18	18	18	22	23	23	23
Total	25	26	27	30	32	35	35	35	39	40	40	40

Types of bank	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Conventional banks	23	23	22	22	22	22	22	21	25	26	26	26
Islamic banks	2	3	5	8	10	13	13	14	14	14	14	14
Total	25	26	27	30	32	35	35	35	39	40	40	40

Sources: BNM Statistical Bulletin (2004-2015)

APPENDIX B

LIST OF COMMERCIAL BANKS IN MALAYSIA (2004-2015)

No	Conventional Banks	Origins of Bank Ownership
1	Affin Bank Bhd.	Domestic bank
2	Alliance Bank Bhd.	Domestic bank
3	AmBank Bhd.	Domestic bank
4	BNP Paribas Malaysia Bhd.	Foreign bank
5	Bangkok Bank (M) Bhd.	Foreign bank
6	Bank of America (M) Bhd.	Foreign bank
7	Bank of China (M) Bhd.	Foreign bank
8	Bank of Tokyo-Mitsubishi UFJ (M) Bhd.	Foreign bank
9	CIMB Bank Bhd.	Domestic bank
10	Citibank (M) Bhd.	Foreign bank
11	Deutsche Bank (M) Bhd.	Foreign bank
12	Hong Leong Bank Bhd.	Domestic bank
13	HSBC Bank (M) Bhd.	Foreign bank
14	India International Bank (M) Bhd.	Foreign bank
15	Industrial and Commercial Bank of China (M) Bhd.	Foreign bank
16	J.P. Morgan Chase Bank (M) Bhd.	Foreign bank
17	Malayan Banking Bhd.	Domestic bank
18	Mizuho Corporate Bank (M) Bhd.	Foreign bank
19	National Bank of Abu Dhabi (M) Bhd.	Foreign bank
20	OCBC Bank (M) Bhd.	Foreign bank
21	Public Bank Bhd.	Domestic bank
22	RHB Bank Bhd.	Domestic bank
23	Standard Chartered Bank (M) Bhd.	Foreign bank
24	Sumitomo Mitsui Banking Corporation (M) Bhd.	Foreign bank
25	The Bank of Nova Scotia (M) Bhd.	Foreign bank
26	The Royal Bank of Scotland (M) Bhd.	Foreign bank
27	United Overseas Bank (M) Bhd.	Foreign bank

(Source: BNM, 2015 retrieved on 1 Mac 2016)

No	Islamic Banks	Origins of Bank Ownership
1	Affin Islamic Bank Bhd.	Domestic bank
2	Al-Rajhi Banking & Investment Corporation (M) Bhd.	Foreign bank
3	Alliance Islamic Bank Bhd.	Domestic bank
4	AmIslamic Bank Bhd.	Domestic bank
5	Asian Finance Bank Bhd.	Foreign bank
6	Bank Islam Malaysia Bhd.	Domestic bank
7	Bank Muamamalat Malaysia Bhd.	Domestic bank
8	CIMB Islamic Bank Bhd.	Domestic bank
9	Hong Leong Islamic Bank Bhd.	Domestic bank
10	HSBC Amanah (M) Bhd.	Foreign bank
11	Kuwait Finance House (M) Bhd.	Foreign bank
12	Maybank Islamic Bhd.	Domestic bank
13	OCBC Al-Amin Bank Bhd.	Foreign bank
14	Public Islamic Bank Bhd.	Domestic bank
15	RHB Islamic Bank Bhd.	Domestic bank
16	Standard Chartered Saadiq Bhd.	Foreign bank

(Source: BNM, 2015 retrieved on 1 Mac 2016)
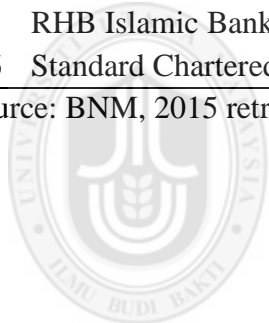
EFFFIENCY SCORES FROM YEAR 2004 TO 2015

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
Conventional Banks:					
2004	ABNAMRO	0.4158	0.4524	0.9190	F
2005	ABNAMRO	0.3962	0.4119	0.9619	F
2006	ABNAMRO	0.2343	0.2967	0.7895	F
2007	ABNAMRO	0.1198	0.1245	0.9623	F
2004	AFFIN	0.4197	0.6820	0.6153	D
2005	AFFIN	0.4676	0.7956	0.5877	D
2006	AFFIN	0.3784	0.6125	0.6178	D
2007	AFFIN	0.3539	0.5836	0.6064	D
2008	AFFIN	0.3958	0.6253	0.6329	D
2009	AFFIN	0.4571	0.6786	0.6736	D
2010	AFFIN	0.4413	0.6478	0.6812	D
2011	AFFIN	0.4821	0.6913	0.6974	D
2012	AFFIN	0.5127	0.7819	0.6558	D
2013	AFFIN	0.5134	0.7575	0.6778	D
2014	AFFIN	0.5642	0.8254	0.6836	D
2015	AFFIN	0.5832	0.8952	0.6515	D
2004	ALLIANCE	0.4755	0.7820	0.6080	D
2005	ALLIANCE	0.4852	0.8099	0.5991	D
2006	ALLIANCE	0.4209	0.7080	0.5946	D
2007	ALLIANCE	0.3683	0.6224	0.5917	D
2008	ALLIANCE	0.3677	0.6019	0.6109	D
2009	ALLIANCE	0.3645	0.6009	0.6067	D
2010	ALLIANCE	0.4150	0.6993	0.5934	D
2011	ALLIANCE	0.4921	0.8340	0.5901	D
2012	ALLIANCE	0.4797	0.8200	0.5849	D
2013	ALLIANCE	0.4922	0.8712	0.5649	D
2014	ALLIANCE	0.5023	0.8283	0.6064	D
2015	ALLIANCE	0.5291	0.8477	0.6242	D
2004	AMBANK	0.4444	0.5935	0.7488	D
2005	AMBANK	0.5982	0.8940	0.6690	D
2006	AMBANK	0.5399	0.8295	0.6509	D
2007	AMBANK	0.4675	0.7303	0.6402	D
2008	AMBANK	0.4648	0.7972	0.5830	D
2009	AMBANK	0.4353	0.7180	0.6063	D
2010	AMBANK	0.4642	0.8627	0.5381	D

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2011	AMBANK	0.4679	0.8644	0.5413	D
2012	AMBANK	0.5069	0.9586	0.5289	D
2013	AMBANK	0.4918	0.9826	0.5005	D
2014	AMBANK	0.4915	0.9951	0.4940	D
2015	AMBANK	0.4858	0.9805	0.4955	D
2004	BANGKOK	0.5432	0.6667	0.8148	F
2005	BANGKOK	0.5004	0.6453	0.7754	F
2006	BANGKOK	0.6535	0.8072	0.8095	F
2007	BANGKOK	0.3604	0.4471	0.8061	F
2008	BANGKOK	0.5421	0.6178	0.8774	F
2009	BANGKOK	0.5020	0.5664	0.8862	F
2010	BANGKOK	0.4504	0.4972	0.9057	F
2011	BANGKOK	0.4540	0.4998	0.9084	F
2012	BANGKOK	0.5321	0.5461	0.9743	F
2013	BANGKOK	0.5400	0.5478	0.9859	F
2014	BANGKOK	0.5369	0.5460	0.9833	F
2015	BANGKOK	0.6148	0.6223	0.9879	F
2004	BOA*	0.1338	0.6899	0.1940	F
2005	BOA	0.1409	0.8525	0.1652	F
2006	BOA	0.1170	1.0000	0.1170	F
2007	BOA	0.1201	0.5619	0.2137	F
2008	BOA	0.1031	0.6394	0.1612	F
2009	BOA	0.1226	0.8170	0.1501	F
2010	BOA	0.1373	0.4076	0.3369	F
2011	BOA	0.0681	0.2929	0.2326	F
2012	BOA	0.2701	0.3893	0.6938	F
2013	BOA	0.1406	0.2315	0.6073	F
2014	BOA	0.1425	0.2544	0.5603	F
2015	BOA	0.0916	0.3153	0.2906	F
2004	BOC*	0.2123	0.7698	0.2758	F
2005	BOC	0.2065	0.9742	0.2120	F
2006	BOC	0.2185	1.0000	0.2185	F
2007	BOC	0.2049	0.7260	0.2823	F
2008	BOC	0.3766	0.6762	0.5569	F
2009	BOC	0.2624	0.4188	0.6267	F
2010	BOC	0.2591	0.3727	0.6953	F
2011	BOC	0.3128	0.3923	0.7973	F
2012	BOC	0.2833	0.3316	0.8543	F

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2013	BOC	0.2135	0.2307	0.9253	F
2014	BOC	0.3661	0.3716	0.9853	F
2015	BOC	0.3798	0.3988	0.9523	F
2004	BOTM*	0.3575	0.3725	0.9597	F
2005	BOTM	0.3628	0.3793	0.9564	F
2006	BOTM	0.3371	0.3519	0.9582	F
2007	BOTM	0.3396	0.3530	0.9622	F
2008	BOTM	0.3561	0.3667	0.9710	F
2009	BOTM	0.3087	0.3159	0.9772	F
2010	BOTM	0.3649	0.3663	0.9962	F
2011	BOTM	0.3376	0.3449	0.9789	F
2012	BOTM	0.2982	0.3057	0.9754	F
2013	BOTM	0.3278	0.3516	0.9324	F
2014	BOTM	0.4827	0.6040	0.7991	F
2015	BOTM	0.8588	1.0000	0.8588	F
2004	CIMB	0.4380	0.7158	0.6120	D
2005	CIMB	0.4638	0.8125	0.5708	D
2006	CIMB	0.4213	0.8068	0.5222	D
2007	CIMB	0.3416	0.6618	0.5162	D
2008	CIMB	0.4196	0.7818	0.5367	D
2009	CIMB	0.3714	0.7434	0.4995	D
2010	CIMB	0.3860	0.7918	0.4875	D
2011	CIMB	0.3772	0.7495	0.5033	D
2012	CIMB	0.4001	0.9304	0.4300	D
2013	CIMB	0.4264	0.9040	0.4717	D
2014	CIMB	0.4475	1.0000	0.4475	D
2015	CIMB	0.4768	1.0000	0.4768	D
2004	CITI	0.4341	0.6847	0.6340	F
2005	CITI	0.3667	0.5802	0.6321	F
2006	CITI	0.3886	0.6867	0.5659	F
2007	CITI	0.2739	0.4141	0.6614	F
2008	CITI	0.3161	0.5166	0.6119	F
2009	CITI	0.3441	0.5377	0.6401	F
2010	CITI	0.3007	0.5040	0.5967	F
2011	CITI	0.2958	0.4729	0.6255	F
2012	CITI	0.3005	0.5134	0.5852	F
2013	CITI	0.2959	0.5077	0.5829	F
2014	CITI	0.3543	0.6473	0.5474	F

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2015	CITI	0.3407	0.6063	0.5619	F
2004	DEUTSCHE	0.2856	0.3079	0.9277	F
2005	DEUTSCHE	0.1469	0.2318	0.6339	F
2006	DEUTSCHE	0.1362	0.1727	0.7889	F
2007	DEUTSCHE	0.2968	0.2990	0.9926	F
2008	DEUTSCHE	0.1429	0.2129	0.6712	F
2009	DEUTSCHE	0.1535	0.2295	0.6688	F
2010	DEUTSCHE	0.1139	0.2166	0.5261	F
2011	DEUTSCHE	0.0975	0.2223	0.4386	F
2012	DEUTSCHE	0.2442	0.2952	0.8273	F
2013	DEUTSCHE	0.3121	0.3600	0.8667	F
2014	DEUTSCHE	0.1298	0.2744	0.4732	F
2015	DEUTSCHE	0.1120	0.2071	0.5406	F
2004	EON	0.5488	0.8127	0.6752	D
2005	EON	0.5006	0.8513	0.5881	D
2006	EON	0.4977	0.8205	0.6066	D
2007	EON	0.4266	0.7304	0.5840	D
2008	EON	0.3871	0.6797	0.5696	D
2009	EON	0.3976	0.7217	0.5509	D
2010	EON	0.3854	0.6737	0.5721	D
2004	HLEONG*	0.3589	0.5112	0.7021	D
2005	HLEONG	0.3833	0.5535	0.6925	D
2006	HLEONG	0.4353	0.6373	0.6831	D
2007	HLEONG	0.3474	0.4777	0.7274	D
2008	HLEONG	0.3475	0.5124	0.6782	D
2009	HLEONG	0.3891	0.7334	0.5305	D
2010	HLEONG	0.4191	0.8698	0.4818	D
2011	HLEONG	0.3965	0.6164	0.6431	D
2012	HLEONG	0.4476	0.8386	0.5337	D
2013	HLEONG	0.4977	0.8349	0.5961	D
2014	HLEONG	0.5512	0.9900	0.5568	D
2015	HLEONG	0.5779	1.0000	0.5779	D
2004	HSBC	0.3716	0.6373	0.5830	F
2005	HSBC	0.3446	0.6020	0.5724	F
2006	HSBC	0.3616	0.6572	0.5502	F
2007	HSBC	0.3077	0.5464	0.5631	F
2008	HSBC	0.3410	0.6111	0.5579	F
2009	HSBC	0.2796	0.4941	0.5659	F

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2010	HSBC	0.3140	0.5428	0.5785	F
2011	HSBC	0.2926	0.4541	0.6443	F
2012	HSBC	0.3441	0.5919	0.5813	F
2013	HSBC	0.3299	0.5623	0.5867	F
2014	HSBC	0.3881	0.7314	0.5307	F
2015	HSBC	0.3167	0.5688	0.5569	F
2013	INDIAINTER*	0.0715	1.0000	0.0715	F
2014	INDIAINTER	0.1090	1.0000	0.1090	F
2015	INDIAINTER	0.1093	1.0000	0.1093	F
2012	ICBC*	0.0682	0.2962	0.2303	F
2013	ICBC	0.2129	0.2571	0.8279	F
2014	ICBC	0.2750	0.3115	0.8829	F
2015	ICBC	0.3181	0.3375	0.9423	F
2004	JPMORGAN	0.0835	0.3982	0.2097	F
2005	JPMORGAN	0.1672	0.4396	0.3803	F
2006	JPMORGAN	0.4496	0.6127	0.7339	F
2007	JPMORGAN	0.4602	0.5219	0.8818	F
2008	JPMORGAN	0.0729	0.3764	0.1936	F
2009	JPMORGAN	0.0591	0.3748	0.1576	F
2010	JPMORGAN	0.1999	0.3804	0.5255	F
2011	JPMORGAN	0.2606	0.3591	0.7257	F
2012	JPMORGAN	0.1754	0.3162	0.5548	F
2013	JPMORGAN	0.0854	0.1389	0.6150	F
2014	JPMORGAN	0.0948	0.1499	0.6321	F
2015	JPMORGAN	0.0335	0.1090	0.3070	F
2004	MAYBANK	0.4676	0.8270	0.5654	D
2005	MAYBANK	0.4814	0.8541	0.5636	D
2006	MAYBANK	0.4663	0.8352	0.5583	D
2007	MAYBANK	0.4310	0.7432	0.5800	D
2008	MAYBANK	0.4701	0.7971	0.5898	D
2009	MAYBANK	0.4494	0.9350	0.4807	D
2010	MAYBANK	0.4499	0.9261	0.4858	D
2011	MAYBANK	0.4472	0.9069	0.4931	D
2012	MAYBANK	0.4555	0.9155	0.4975	D
2013	MAYBANK	0.4602	0.9536	0.4826	D
2014	MAYBANK	0.4872	1.0000	0.4872	D
2015	MAYBANK	0.4639	1.0000	0.4639	D
2012	MIZUHO	0.1188	0.4546	0.2614	F

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2013	MIZUHO	0.1277	0.2889	0.4422	F
2014	MIZUHO	0.1326	0.2807	0.4724	F
2015	MIZUHO	0.1956	0.2918	0.6705	F
2012	NBAD*	1.0000	1.0000	1.0000	F
2013	NBAD	0.2387	0.6208	0.3844	F
2014	NBAD	0.2062	0.4821	0.4276	F
2015	NBAD	0.3921	0.6869	0.5708	F
2004	OCBC	0.6228	0.9879	0.6304	F
2005	OCBC	0.6426	0.9587	0.6703	F
2006	OCBC	0.5750	0.8419	0.6830	F
2007	OCBC	0.5091	0.7544	0.6749	F
2008	OCBC	0.5001	0.7832	0.6386	F
2009	OCBC	0.4525	0.6398	0.7072	F
2010	OCBC	0.4565	0.6485	0.7040	F
2011	OCBC	0.4997	0.7443	0.6714	F
2012	OCBC	0.4620	0.6818	0.6776	F
2013	OCBC	0.5119	0.7594	0.6741	F
2014	OCBC	0.5330	0.7906	0.6742	F
2015	OCBC	0.5786	0.8949	0.6466	F
2004	PUBLICBANK	0.4509	0.6783	0.6647	D
2005	PUBLICBANK	0.4538	0.6993	0.6490	D
2006	PUBLICBANK	0.4582	0.6932	0.6610	D
2007	PUBLICBANK	0.4340	0.7034	0.6170	D
2008	PUBLICBANK	0.4642	0.7021	0.6611	D
2009	PUBLICBANK	0.4629	0.7119	0.6502	D
2010	PUBLICBANK	0.5014	0.7829	0.6405	D
2011	PUBLICBANK	0.5642	0.9110	0.6194	D
2012	PUBLICBANK	0.5789	0.9256	0.6254	D
2013	PUBLICBANK	0.5793	0.9248	0.6264	D
2014	PUBLICBANK	0.6264	1.0000	0.6264	D
2015	PUBLICBANK	0.6202	1.0000	0.6202	D
2004	RHB	0.3784	0.7600	0.4978	D
2005	RHB	0.4454	0.8279	0.5379	D
2006	RHB	0.4983	1.0000	0.4983	D
2007	RHB	0.3920	0.6868	0.5707	D
2008	RHB	0.4242	0.7839	0.5411	D
2009	RHB	0.4564	0.7828	0.5831	D
2010	RHB	0.4973	0.8676	0.5732	D

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2011	RHB	0.4586	0.8448	0.5428	D
2012	RHB	0.4545	0.7985	0.5692	D
2013	RHB	0.5068	0.9923	0.5107	D
2014	RHB	0.4773	0.9089	0.5251	D
2015	RHB	0.4787	0.9852	0.4858	D
2004	SOUTHERN	0.5251	0.9053	0.5800	F
2005	SOUTHERN	0.4778	0.8259	0.5784	F
2004	STDCHARTERED*	0.4594	0.6605	0.6955	F
2005	STDCHARTERED	0.4748	0.6888	0.6893	F
2006	STDCHARTERED	0.4054	0.6123	0.6621	F
2007	STDCHARTERED	0.3015	0.4374	0.6893	F
2008	STDCHARTERED	0.4230	0.8163	0.5181	F
2009	STDCHARTERED	0.3992	0.6179	0.6460	F
2010	STDCHARTERED	0.4896	0.8303	0.5897	F
2011	STDCHARTERED	0.4652	0.8040	0.5786	F
2012	STDCHARTERED	0.4591	0.8055	0.5699	F
2013	STDCHARTERED	0.4175	0.7346	0.5684	F
2014	STDCHARTERED	0.3838	0.7144	0.5372	F
2015	STDCHARTERED	0.3540	0.6160	0.5747	F
2012	SUMITUMOMITSUI	0.1419	0.3278	0.4327	F
2013	SUMITUMOMITSUI	0.2852	0.3815	0.7477	F
2014	SUMITUMOMITSUI	0.2788	0.3614	0.7714	F
2015	SUMITUMOMITSUI	0.2639	0.2830	0.9324	F
2004	NOVASCOTIA	0.6114	0.7018	0.8711	F
2005	NOVASCOTIA	0.5878	0.6825	0.8613	F
2006	NOVASCOTIA	0.6275	0.7913	0.7930	F
2007	NOVASCOTIA	0.5037	0.5431	0.9275	F
2008	NOVASCOTIA	0.7756	0.7843	0.9889	F
2009	NOVASCOTIA	0.8145	0.8199	0.9934	F
2010	NOVASCOTIA	0.8995	0.9164	0.9815	F
2011	NOVASCOTIA	0.9512	0.9650	0.9858	F
2012	NOVASCOTIA	1.0000	1.0000	1.0000	F
2013	NOVASCOTIA	0.8989	1.0000	0.8989	F
2014	NOVASCOTIA	0.6663	0.6966	0.9566	F
2015	NOVASCOTIA	1.0000	1.0000	1.0000	F
2008	ROYALBANK	0.2614	0.2779	0.9404	F
2009	ROYALBANK	0.1388	0.1497	0.9273	F
2010	ROYALBANK	0.1809	0.2018	0.8966	F

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2011	ROYALBANK	0.2717	0.3044	0.8924	F
2012	ROYALBANK	0.2043	0.2788	0.7328	F
2013	ROYALBANK	0.2067	0.3070	0.6734	F
2014	ROYALBANK	0.1973	0.2962	0.6662	F
2015	ROYALBANK	0.1151	0.2994	0.3845	F
2004	UNITEDOVERSEA	0.5648	0.8015	0.7046	F
2005	UNITEDOVERSEA	0.5602	0.8177	0.6851	F
2006	UNITEDOVERSEA	0.5476	0.8912	0.6144	F
2007	UNITEDOVERSEA	0.5358	0.8919	0.6008	F
2008	UNITEDOVERSEA	0.4639	0.6765	0.6858	F
2009	UNITEDOVERSEA	0.4879	0.7486	0.6518	F
2010	UNITEDOVERSEA	0.4757	0.7289	0.6526	F
2011	UNITEDOVERSEA	0.4874	0.7407	0.6581	F
2012	UNITEDOVERSEA	0.5675	0.8870	0.6398	F
2013	UNITEDOVERSEA	0.4923	0.7616	0.6465	F
2014	UNITEDOVERSEA	0.5066	0.8432	0.6007	F
2015	UNITEDOVERSEA	0.5187	0.8811	0.5887	F

Islamic Banks:

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2007	AFFIN-I	0.3536	1.0000	0.3536	D
2008	AFFIN-I	0.3137	0.3543	0.8853	D
2009	AFFIN-I	0.3422	0.3492	0.9802	D
2010	AFFIN-I	0.3611	0.3701	0.9758	D
2011	AFFIN-I	0.3017	0.3117	0.9681	D
2012	AFFIN-I	0.3421	0.3455	0.9902	D
2013	AFFIN-I	0.3691	0.3773	0.9782	D
2014	AFFIN-I	0.4450	0.4887	0.9105	D
2015	AFFIN-I	0.6291	0.7079	0.8887	D
2008	ALRAJHI-I	0.2948	0.2949	0.9999	F
2009	ALRAJHI-I	0.3470	0.4031	0.8608	F
2010	ALRAJHI-I	0.3746	0.4362	0.8588	F
2011	ALRAJHI-I	0.3504	0.3995	0.8773	F
2012	ALRAJHI-I	0.3381	0.3992	0.8469	F
2013	ALRAJHI-I	0.4518	0.5705	0.7920	F
2014	ALRAJHI-I	0.4646	0.5735	0.8101	F
2015	ALRAJHI-I	0.4994	0.6322	0.7899	F
2009	ALLIANCE-I	1.0000	1.0000	1.0000	D
2010	ALLIANCE-I	0.7048	0.7730	0.9117	D

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2011	ALLIANCE-I	0.8536	0.8858	0.9637	D
2012	ALLIANCE-I	0.9192	0.9533	0.9643	D
2013	ALLIANCE-I	0.9821	1.0000	0.9821	D
2014	ALLIANCE-I	1.0000	1.0000	1.0000	D
2015	ALLIANCE-I	0.9265	0.9451	0.9803	D
2007	AMBANK-I	0.8594	0.8853	0.9707	D
2008	AMBANK-I	1.0000	1.0000	1.0000	D
2009	AMBANK-I	0.8288	0.9145	0.9063	D
2010	AMBANK-I	0.8101	1.0000	0.8101	D
2011	AMBANK-I	0.7770	0.7770	1.0000	D
2012	AMBANK-I	0.9570	0.9652	0.9915	D
2013	AMBANK-I	0.9624	0.9666	0.9956	D
2014	AMBANK-I	1.0000	1.0000	1.0000	D
2015	AMBANK-I	1.0000	1.0000	1.0000	D
2007	ASIANFINANCE-I	0.0421	0.3303	0.1274	F
2008	ASIANFINANCE-I	0.0666	0.2672	0.2492	F
2009	ASIANFINANCE-I	0.1621	0.2740	0.5914	F
2010	ASIANFINANCE-I	0.1736	0.3042	0.5706	F
2011	ASIANFINANCE-I	0.2472	0.3421	0.7225	F
2012	ASIANFINANCE-I	0.3418	0.4116	0.8305	F
2013	ASIANFINANCE-I	0.4762	0.5806	0.8202	F
2014	ASIANFINANCE-I	0.6028	0.8079	0.7461	F
2015	ASIANFINANCE-I	0.4931	0.8789	0.5610	F
2004	BANKISLAM-I	0.4664	0.6159	0.7572	D
2005	BANKISLAM-I	0.3941	0.5472	0.7201	D
2006	BANKISLAM-I	0.3188	0.4711	0.6766	D
2007	BANKISLAM-I	0.2843	0.3819	0.7445	D
2008	BANKISLAM-I	0.2374	0.3001	0.7910	D
2009	BANKISLAM-I	0.3176	0.6554	0.4846	D
2010	BANKISLAM-I	0.3887	1.0000	0.3887	D
2011	BANKISLAM-I	0.3834	0.8593	0.4461	D
2012	BANKISLAM-I	0.4479	0.9844	0.4550	D
2013	BANKISLAM-I	0.4181	0.8467	0.4937	D
2014	BANKISLAM-I	0.4443	0.8212	0.5410	D
2015	BANKISLAM-I	0.4685	0.8485	0.5521	D
2004	BANKMUAMALAT-I	0.3041	0.3225	0.9431	D
2005	BANKMUAMALAT-I	0.2857	0.3030	0.9429	D
2006	BANKMUAMALAT-I	0.3159	0.3312	0.9540	D

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2007	BANKMUAMALAT-I	0.3378	0.3647	0.9263	D
2008	BANKMUAMALAT-I	0.3168	0.3483	0.9094	D
2009	BANKMUAMALAT-I	0.3616	0.4093	0.8834	D
2010	BANKMUAMALAT-I	0.2858	0.3371	0.8478	D
2011	BANKMUAMALAT-I	0.2926	0.3411	0.8579	D
2012	BANKMUAMALAT-I	0.3688	0.4800	0.7684	D
2013	BANKMUAMALAT-I	0.3835	0.5590	0.6861	D
2014	BANKMUAMALAT-I	0.4556	0.7248	0.6285	D
2015	BANKMUAMALAT-I	0.4537	0.7357	0.6167	D
2009	CIMB-I	0.6144	0.6904	0.8900	D
2010	CIMB-I	0.6542	0.6937	0.9431	D
2011	CIMB-I	0.6777	0.7824	0.8661	D
2012	CIMB-I	0.7005	1.0000	0.7005	D
2013	CIMB-I	0.7409	1.0000	0.7409	D
2014	CIMB-I	0.8082	0.9518	0.8491	D
2015	CIMB-I	0.8522	1.0000	0.8522	D
2006	HLEONG-I*	0.6903	0.7428	0.9293	D
2007	HLEONG-I	0.6766	0.7473	0.9053	D
2008	HLEONG-I	0.6778	0.7720	0.8779	D
2009	HLEONG-I	0.8555	0.8722	0.9808	D
2010	HLEONG-I	1.0000	1.0000	1.0000	D
2011	HLEONG-I	0.7106	0.7114	0.9988	D
2012	HLEONG-I	0.9172	0.9224	0.9944	D
2013	HLEONG-I	0.9335	0.9340	0.9995	D
2014	HLEONG-I	0.9639	0.9640	0.9999	D
2015	HLEONG-I	0.8926	0.9133	0.9773	D
2009	HSBC-I	0.6164	0.6279	0.9818	F
2010	HSBC-I	0.5761	0.5804	0.9925	F
2011	HSBC-I	0.6876	0.7175	0.9583	F
2012	HSBC-I	0.6684	0.7135	0.9367	F
2013	HSBC-I	0.5898	0.6167	0.9563	F
2014	HSBC-I	0.8151	0.8679	0.9392	F
2015	HSBC-I	0.6401	0.6906	0.9269	F
2006	KUWAITFINANCE-I	0.2170	0.2333	0.9301	F
2007	KUWAITFINANCE-I	0.3021	0.3429	0.8809	F
2008	KUWAITFINANCE-I	0.3772	0.5285	0.7136	F
2009	KUWAITFINANCE-I	0.4138	0.5229	0.7913	F
2010	KUWAITFINANCE-I	0.3570	0.4628	0.7714	F

Year	Banks	Technical Efficiency Score	Pure Technical Efficiency Score	Scale Efficiency Score	Origins of Bank Ownership
2011	KUWAITFINANCE-I	0.3264	0.4147	0.7871	F
2012	KUWAITFINANCE-I	0.3891	0.5201	0.7482	F
2013	KUWAITFINANCE-I	0.4123	0.5738	0.7186	F
2014	KUWAITFINANCE-I	0.4226	0.5753	0.7346	F
2015	KUWAITFINANCE-I	0.4524	0.5744	0.7876	F
2008	OCBC-I*	1.0000	1.0000	1.0000	F
2009	OCBC-I	0.4798	0.5139	0.9336	F
2010	OCBC-I	0.5310	0.5401	0.9830	F
2011	OCBC-I	0.5369	0.5396	0.9950	F
2012	OCBC-I	0.6700	0.6751	0.9923	F
2013	OCBC-I	0.6836	0.7002	0.9763	F
2014	OCBC-I	0.7274	0.7550	0.9634	F
2015	OCBC-I	0.7702	0.7962	0.9674	F
2011	PUBLICBANK-I	0.7092	0.7282	0.9738	D
2012	PUBLICBANK-I	0.8069	0.8237	0.9795	D
2013	PUBLICBANK-I	0.7667	0.7766	0.9872	D
2014	PUBLICBANK-I	1.0000	1.0000	1.0000	D
2015	PUBLICBANK-I	1.0000	1.0000	1.0000	D
2005	RHB-I	0.5268	0.5393	0.9768	D
2006	RHB-I	0.4806	0.4812	0.9988	D
2007	RHB-I	0.4767	0.4813	0.9906	D
2008	RHB-I	0.5364	0.5653	0.9489	D
2009	RHB-I	0.4537	0.4843	0.9368	D
2010	RHB-I	0.6226	0.7031	0.8856	D
2011	RHB-I	0.5183	0.5572	0.9301	D
2012	RHB-I	0.6460	0.7501	0.8611	D
2013	RHB-I	0.6819	0.8093	0.8426	D
2014	RHB-I	0.7834	0.8701	0.9004	D
2015	RHB-I	0.9052	1.0000	0.9052	D

*Note: BOA = Bank of America, BOC = Bank of China, BOTM = Bank of Tokyo-Mitsubishi UFJ, HLEONG = Hong Leong Banks, INDIAINTER = India International Bank, ICBC = Industrial and Commercial Bank of China, NBAD = National Bank of Abu Dhabi, STDCHARTERED = Standard Chartered Bank, HLEONG-I = Hong Leong Islamic Bank, OCBC-I = OCBC Al-Amin Bank.