EFFICIENCY OF ISLAMIC AND CONVENTIONAL BANKS DURING FINANCIAL CRISIS: EMPIRICAL EVIDENCE FROM MALAYSIA

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ABSTRACT

The global financial crisis that engulfed the world in the mid of 2007 till the end of 2009 slightly affected the Asian countries such as Malaysia has focused attention on the flaws of the conventional banking system. Islamic banks seem much stronger to recover in financial crisis compared to conventional banks because of the inherent nature of Islamic banks, which prohibits the interest payments in all transactions. Thus, this study examines the efficiency level of Islamic and conventional banks during financial crisis particularly in 2007 to 2012. The efficiency of Islamic and conventional banks is measured utilizing Data Envelopment Analysis by adopting the intermediation approach. The data are extracted by Bankscope and Annual Report from 2007 to 2012. The samples consisted of Islamic and conventional banks in Malaysia. The results indicate that pure technical efficiency contributed more to the overall technical efficiency of Islamic banks. In conventional banks, the scale efficiency dominates the overall technical efficiency. In overall, the finding shows that Islamic banks are exhibited higher technical efficiency compared to the conventional banks attributed to the higher pure technical efficiency. Hence, the findings of this study have policy implications, and make a contribution to policy-making by providing empirical evidence on the performance of the Islamic and conventional banks and their efficiency level.

Keywords: Efficiency, Financial Crisis, Data Envelopment Analysis

ABSTRAK

Krisis kewangan global yang melanda dunia pada pertengahan tahun 2007 hingga akhir tahun 2009 sedikit menjejaskan negara-negara Asia seperti Malaysia telah menunjukkan kelemahan sistem perbankan konvensional. Bank-bank Islam kelihatan lebih kukuh untuk pulih dalam krisis kewangan berbanding dengan bank-bank konvensional kerana sifat semulajadinya yang melarang bayaran faedah dalam semua transaksi. Oleh itu, kajian ini meneliti tahap kecekapan bank-bank Islam dan konvensional semasa krisis kewangan terutamanya pada tahun 2007 hingga 2012. Kecekapan bank-bank Islam dan konvensional diukur dengan menggunakan DEA dengan menggunakan pendekatan pengantaraan. Data diperolehi dari Bankscope dan Laporan Tahunan Bank dari tahun 2007 sehingga 2012 . Sampel terdiri daripada bank-bank Islam dan konvensional di Malaysia. Keputusan menunjukkan bahawa PTE menyumbang lebih kepada kecekapan teknikal secara keseluruhan bank Islam. Dalam bank konvensional pula, kecekapan skala menguasai kecekapan teknikal secara keseluruhan. Secara keseluruhannya, dapatan kajian menunjukkan bahawa bank-bank Islam menunjukkan kecekapan teknikal yang lebih tinggi berbanding dengan bank-bank konvensional. Oleh itu, hasil kajian ini mempunyai implikasi dasar, dan membuat sumbangan kepada penggubalan dasar dengan menyediakan bukti empirikal mengenai prestasi bank-bank Islam dan konvensional serta tahap kecekapan mereka.

Kata Kunci: Kecekapan, Krisis Kewangan, DEA

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DMU	Decision making unit
BIMB	Bank Islam Malaysia Berhad
SPI	Skim Perbankan Islam
SPTF	Skim Perbankan Tanpa Faedah
BAFIA	Banking and Finance Institutions Act 1989
BNM	Bank Negara Malaysia
GDP	Gross Domestic Product
DEA	Data Envelopment Analysis
SFA	Stochastic Frontier Analysis
TFA	Thick Frontier Analysis
SFH	Special Finance House
MENA	Middle Eastern and North African
OIC	Organizations of Islamic Conference
VRS	Variable Returns to Scale
VAR	Vector auto-regression
CRS	Constant Returns to Scale
OTE	Overall technical efficiency
PTE	Pure technical efficiency
SE	Scale efficiency
TE	Technical efficiency
NIRS	Non-increasing returns to scale
OLS	Ordinary Least Squares

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

Efficiency can be defined as the good usage of resources to maximize the production of the goods and services of the firms where it concerns with the relationship between the input resources such as labour costs, capital and equipment and the output produced using the inputs (Farrell, 1957). It means the organizations can use or manage their resources to produce goods and services very well.

The efficiency issues remain a predominant focal point on the subject of economics, whether it pertains to firm, organization or countries. In conditions of banking sector, the efficiency evaluation is an essential instrument to evaluate the success of the banking industry. This is supported by Bashir (2001) when he stated that the rating of efficiency is important due the structure of economic todays is tremendous increase. As stated by Berger & Humphrey (1997), studies that concentrated on the efficiency of financial institutions have become a crucial component of banking literature over 24 years ago. They come out with two reasons. The first one is efficiency is the best measurement to evaluate a bank's success. The second reason is, efficiency can be employed to

investigate the potential impact of government policies on a bank's efficiency and can give the information to the bank management as well as policy maker. There are three ways to measure the efficiency which are maximization of output, minimization of cost, and maximization of profits.

According to Kumbhakar and Lovell (2003), there are two components in measuring efficiency consisted of technical efficiency and allocative efficiency. Technical efficiency is achieved when a decision making unit (DMU) obtains maximization outputs from the given input or minimize inputs utilized for the given output. The main reason why the firm's management really wants to know how efficient they are in terms of technical efficiency is to avoid waste.

Differently, the allocative efficiency is closely related to the optimum usage of inputs and outputs in a production. It aims to utilize the inputs given to the minimal costs to produce the optimum outputs so that maximize revenues and profits could be achieved. This practice of production known as the economic efficiency where the aims of the producers happened to be a high degree of economic efficiency from the aspects of cost, revenue or profit efficiency (Koopmans, 1951).

Therefore, efficiency is the key dominant factor in order to increase the bank performance, which is significantly important to all parties, especially bank

management, policy makers and depositors. Through the information on the efficiency of the bank, it provides direction to bank managers in deciding which strategies to adopt, such as improving their resources in term of deposits and asset portfolios in order to generate income, increase the profitability, increase the other earning assets as well. Besides, the policy makers like the Ministry of Finance, Bank Negara Malaysia and other regulatory bodies are also interested in the development or the banking industry for their regulation purposes. Last but not least, the efficiency of the bank can give the information to depositors and investors whether to invest or withdraw their investment from the bank.

1.1 Background of the Study

The word of bank is derived from the Italian word which is “banco.” The word means shelf or bench or money changer utilized to display the coins. Therefore, a bank is an authorized institution to take deposits for the purpose of extending long and short-term financial facilities (Ayub, 2007). He also stated that in the modern form, a bank is an establishment for the keeping of money received from, or on behalf of, its customers, whose drafts it has to honor and pay. Then, the pooled money is utilized by it for the purpose of making advances to others to get a return in the form of interest, dividends or others.

In Malaysia, the Islamic banking system has been practices over 30 years ago and prior to that, conventional banking system has been established to support the banking activities among people until now to meet the demand of the customer. Both banking systems have been operating simultaneously.

According to Santos (2000), he stated that theories of conventional banking are when banks make profits by provide the lowest interest rate in purchasing transactions deposits from the depositors and then reselling those funds to the borrowers at a higher interest rate. It means conventional banks earn profits from the spread between the interest rate received from borrowers and the interest rate paid to depositors (Mohamad, S. et al., na). Here, we can understand that the main principle of conventional banking is time has value. It means that time affects the value of financial transactions. Most conventional loan contracts allow the borrower to spread out the payments over time. For instance, if we take a loan for a car, the bank will allow us to make a monthly installment over seven or nine years and the total payments exceed the amount of the loan. The reason why total repayment is more than the loan is that we have to pay the interest to compensate the lender for the time during we use the funds. Abd Rahman (2007) specified that conventional banking is based on the relationship between debtor and creditor particularly in the bank situation is referred to depositors and the bank on one hand, and between the borrowers and the bank on the other. He also stated that the interest in the conventional banking is considered to be the price of credit, which reflect the opportunity cost of money.

In contrast, Islamic law stated that the time value of money is permitted only in the business and trade of goods and strictly not in the exchange of monetary values and loans or debts (Ayub, 2007). It is because Islamic law prohibits any additional charge to the price due to any delay in the payment because it will involve the *riba.* This statement associated with Malaysian Islamic Banking Act 1983 (276) that stated Islamic banking business is any business that do not mix the forbidden elements in Islam in its operation. To date, Islamic Financial Services Act 2013 defines the Islamic banking business as receiving Islamic deposits on current account, deposit account, savings account or other related accounts, with or without the business of paying or collecting cheques drawn by or paid in by customers; or accepting money under an investment account; and provision of finance.

Hence, Islamic banking refers to a banking organization that complies with *shariah*. The underlying rules that govern Islamic banking are profit sharing and mutual risk between the parties and the transactions are founded on an underlying asset. Any actions that involve for gambling (*maisir*) and interest (*riba*) are strictly forbidden. The Islamic banking principle is the sharing profit and loss and the prohibition of *riba* (Ayub, 2007).

Through the explanation regarding Islamic and conventional banking above, there are many dissimilarities between Islamic and conventional banking. Thus, the differences between both of them has been summarized in Table 1.1 below.

Table 1.1: *Summary of differences between Islamic and conventional banks*

Islamic banks	Conventional banks
Islamic banks are based *shariah* principles.	Conventional banks are based on the principles of man-made.
It subjected to *shariah* restriction to generate profit.	It aims to maximize the profit without any restrictions.
Islamic banks utilized real asset as a product not money as a medium of exchange.	Money is considered as a product besides medium of exchange and store of value.
Islamic banks are exchange of goods and services for the purpose of obtaining profit.	The time value is considered as a basis for charging interest on capital.
The loss is shared in the event of institutions suffers loss.	Although in the event of institutions suffer loss, the interest is charged.

Source: (Ayub, 2007)

Table 1.1 above shows the different philosophy and implementation between Islamic and conventional banks. The basis of Islamic bank is based on the Islamic faith and it has to comply with Islamic law. The concept of money in Islam is a medium of exchange, whereas in conventional, money is a store of value or commodity. Since business has risk and return, Islamic banks implement the profit and loss sharing while conventional banks charge the interest even in case, the institution suffers loss. In short, we can understand that Islamic banks deal in *shariah* compliant products and services only and there is no reward can be earned by capital without exposing to business risk. Meanwhile, there is no limitation to the conventional banks to deal in *shariah*, or non-compliant *shariah* products and services as long as it can generate income for the bank.

Regarding on the different features of Islamic and conventional banking as stated above, Malaysia established Islamic banking system that complies with the Islamic law principles to meet the demands of customers. Therefore, Bank Islam Malaysia Berhad (BIMB) founded in 1983. It was the first Islamic bank in Malaysia, which implement *shariah*-based in Malaysian banking industry (BIMB website).

Then, after that "*Skim Perbankan Islam* (SPI)" or formerly known as "*Skim Perbankan Tanpa Faedah* (SPTF)" was introduced. It has been introduced in March 1993 by Bank Negara Malaysia (BNM) in order to promote the Islamic banking on a wider scope and it was subjected under the Banking and Financial Institutions Act 1989 (BAFIA). The objective of this guideline is to assist the participation of licensed institutions in SPI, through an inclusive guidelines in order to facilitate the licensed institutions in carrying out their SPI operations in a systematic way (Sufian, 2007). To date, Malaysia has been successful in implementing a dual banking system with both Islamic and conventional banks system operating on a parallel basis (Obiyathulla I, 2004). The Islamic banking market has been developed throughout the world at varying paces due to different reasons, such as the size of each nation's Muslim population, government initiatives, and the availability of new products and services. As stated by Cook (2008), Malaysia has perhaps the most developed market in the world for Islamic financial products, partly because of the presence of a significant number of players and partly because of strong government support.

Recently, there are 16 Islamic banks and 27 Conventional banks operating in Malaysia which were registered and given license shown in Table 1.2 and Table 1.3 as follows.

Table 1.2: *List of Islamic Banks in Malaysia*

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

(Source: BNM, 2009 retrieved on 1 February 2014)

Based on the table 1.2 above, there are 10 local Islamic banks and 6 foreign banks are operating in Malaysia. As stated earlier, Bank Islam Malaysia Berhad (BIMB) is the first Islamic bank in Malaysia which established in 1983. The local Islamic banks consisted of Affin Islamic Bank Berhad, Alliance Islamic Bank Berhad, Am Islamic Bank Berhad, Bank Islam Malaysia Berhad, Bank Muamalat Malaysia Berhad, CIMB Islamic Bank Berhad, Hong Leong Islamic Bank Berhad, Maybank Islamic Bank Berhad, Public Islamic Bank Berhad and RHB Islamic Bank Berhad. In addition, the foreign Islamic banks that operating in Malaysia which are Al-Rajhi Banking & Investment Corporation (Malaysia) Berhad, Asian Finance Bank Berhad, HSBC Amanah Malaysia Berhad,

Kuwait Finance House (Malaysia) Berhad, OCBC Al-Amin Bank Berhad and Standard Chartered Saadiq Berhad.

Table 1.3: *List of Conventional Banks in Malaysia*

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

(Source: Bank Negara Malaysia, 2013)

The table 1.3 above indicates that there are 9 local conventional banks and 18 foreign banks are operating in Malaysia. The local conventional banks, including Affin Bank Berhad, Alliance Bank Malaysia Berhad, AmBank (M) Berhad, CIMB Bank Berhad, Hong Leong Bank Berhad, Malayan Banking Berhad, RHB Bank Berhad, OCBC Bank

(M) Berhad and Public Bank Berhad. The foreign banks includes BNP Paribas Malaysia Berhad, Bangkok Bank Berhad, Bank of America Malaysia Berhad, Bank of China (M) Berhad, Bank of Tokyo-Mitsubishi UFJ (Malaysia) Berhad, Citibank Berhad, Deutsche Bank (Malaysia) Berhad, India International Bank (Malaysia) Berhad, Industrial and Commercial Bank of China (Malaysia) Berhad, J.P Morgan Chase Bank Berhad, Mizuho Bank (Malaysia) Berhad, National Bank of Abu Dhabi Malaysia Berhad, Standard Chartered Bank Malaysia Berhad, Sumitomo Mitsui Banking Corporation Malaysia Berhad, The Bank of Nova Scotia Berhad, The Royal Bank of Scotland Berhad and United Overseas Bank (Malaysia) Berhad.

Although there has been progress in the Islamic and conventional banking, the global financial crisis that engulfed the world slightly affected the Asian countries such as Malaysia since the mid-2007 till the end of 2009 has focused attention on the flaws of the conventional banking system subsequently lead to the immediate establishment of Islamic banks as an alternative (Rosman, Wahab, & Zainol, 2013). It is because, the inherent nature of Islamic banks, which prohibits the interest payments in all transactions, and prohibition of undertaking or financing anti-social and unethical behavior such as gambling (*maisir*), pornography and alcohol (Abdul-Majid, S.Saal, & Battisti, 2008). However, people argued this statement because Islamic banks' history is too young to authentically conclude. Thus, this study tries to disclose the efficiency of both Islamic and conventional banks during the financial crisis.

1.2 Problem Statements

Based on Khoon & Mah-Hui (2010) the world was jolted by the global financial crisis and Malaysian suffered capital slight since the second quarter of 2008. They also stated that the global financial crisis affect the Banks and financial institutions in the United States. In the period of crisis, many financial institutions have to face the hardship situation for business survival (Pramuka, 2011). As stated by Ng & Rusticus (2012), the financial crisis has led to a large increase in the number of bank failures. Thus, many scholars realized this crucial issue and play their role to give views and opinions regarding this matter in order to find the best solution to overcome this problem.

Related to the global financial crisis, Chapra (2008), he stated that Islamic banks are slightly affected during the financial crisis compared to conventional banks. Siddiqi (2008) also stated that the greater alternative to this current scenario is an implementation of banking and finance without usury (*riba*) and gambling (*maisir*). It same goes to the recommendation by the Prime Minister of Britain, Gordon Brown when he suggested that greater accountability and transparency, and stricter oversight, for banking and other financial institution are the best idea to end the recession (The New York Times, 2009).

According to Khoon & Mah-Hui (2010), the global financial crisis affected financial and economic environment in the second half of 2008 and the first quarter of 2009. They

also stated that gross domestic product (GDP) is 4.7% year on year growth in the third quarter of 2008 but then sharply dropped to 0.1% year on year in the fourth quarter of the same year. It same goes to the domestic economy, which declined to 6.2% year on year in the first quarter of 2009. Based on the impact of the financial crisis on the GDP, perhaps financial crisis also affects the efficiency of financial institutions particularly in the banking industry.

Barr, Seiford & Siems (1994) stated that the efficiency is continuing to be leading cause of bank failure because it is one of the many factors that had made the economic changes unavoidable. In this case, banks should be capable to function efficiently to ensure it contributes to the nation's overall economic growth. However, in the study conducted by Amba & Almukharreq (2013) shows that financial crisis had a negative impact on profitability of both Islamic and conventional banks but the Islamic banks were more profitable than conventional banks during the financial crisis. On the other hand, Kuran (2004) stated that there is no advantage of Islamic banks in term of efficiency as compared to conventional banks.

Based on Kassim & Majid (2010), the Islamic financial system is stronger to survive during the financial crisis due to inherent nature which is all financial transactions must be trade based and asset linked. For instance, in the context of US sub-prime crisis, the interest based transactions with no clear linkage to the real assets have led to the multiple debt creation, consequently inflating the asset bubble. Aside that, in the Islamic

financial system, the involvement of interest based transactions is really prohibited and it requires a trade-based arrangement where a particular object of sale must be exchanged. Intrinsically, the efficiency level of financial institutions in Malaysia need to reviewed (Mat Nor et al., 2006) and the scope of study could be extended to the comparison of efficiency of Islamic and conventional banks (Rosman, Wahab, & Zainol, 2013).

Hence, this study aims to know to what extent the efficiency of Islamic and conventional banks in Malaysia during the financial crisis. The purpose of this study is to fill demanding gap in the literature by providing the efficiency of Islamic banks during financial crisis and how far the Islamic banks performed compared to conventional banks. Besides, this study can contribute the current information to the bank management, regulators and the investors about the efficiency of the banks because it covers from 2007-2012 which means before, during and after the financial crisis subsequently lead to the decision and action to the related parties. Moreover, there is limited study regarding the efficiency of Islamic and conventional banks during financial crisis which provide the latest data. Thus, several research questions were identified based on discussion of problems and issues described above.

1.3 Research Questions

Based on the problem statement above, the key research questions to be addressed are as follows:

a) To what extent the efficiency of Islamic banks during the financial crisis?

b) To what extent the efficiency of conventional banks during the financial crisis?

c) To what extent Islamic and conventional banks are technical efficient or scale efficient?

1.4 Research Objectives

Based on the research questions above, the objectives of this research are:

a) To analyze the efficiency of Islamic banks during the financial crisis.

b) To analyze the efficiency of the conventional banks during the financial crisis.

c) To examine sources of overall technical efficiency of Islamic and conventional banks during the financial crisis.

1.5 Significance of Study

This study is important to investigate the efficiency of Islamic and conventional banks during the financial crisis.

a) To the bank management

   The results regarding the efficiency of Islamic and conventional banks will be beneficial for banks to improvise their performance. Thus, the outcome of this study will help the banks to maximize the outputs, minimize the cost and last but not least is maximize the profits.

b) To the depositors and investors

   This study is beneficial for the depositors and investors know the performance of the bank during the financial crisis so that it can help them in terms of decision making and subsequently lead them to perform the action.

c) To the research area

   This study attempts to identify how the banking industry survives during the financial crisis. As there is no latest evidence shows that the studies on the particular topic which is an efficiency of banks in Malaysia during the financial crisis have been carried out, this study makes the efforts to disclose how efficient the Islamic and conventional banks performed during the financial crisis.

1.6 Scope of the Study

This study is about the efficiency of Islamic and conventional banks during financial crisis. In addition, it will use the data of 13 Islamic banks and 10 Conventional banks in Malaysia due to the availability of data. Prior to that, this study will explore about two inputs which are fixed assets and total deposits and two outputs which is other earning assets and total loans. The data is from 2007 to 2012.

1.7 Limitation of the Study

There are some limitations discovered in this study. The sample of banks used in this study is based on the availability of sufficient data to satisfy the period coverage requirement. A more extensive study along the same procedures will be necessary if any definite conclusions are to be made. However, due to the time constraint, it is not possible to carry out such an extensive research.

1.8 Organization of the Study

This research report consisted of 5 chapters. In chapter 1, this study begins with an introduction which consists of the background of the study, problem statement, research question and research objectives, significance of study, scope and limitation faced during research. Chapter 2 provides the literature review, which explained the works has been done and related studies by other researchers in this field. The collection is from 2007 until 2013. Chapter 3 measures the efficiency of Islamic and conventional banks in Malaysia. It also provides the research methodology which consists of research design,

data collection, and a method using in this study. Last but not least, in chapter 4 is about the results and findings. In this chapter, Data Envelopment Analysis (DEA) will be used to analyze the data. Finally, chapter 5 is the conclusion and recommendation regarding the efficiency of Islamic and Conventional banks during financial crisis in Malaysia.

1.9 Conclusion

This chapter presented a general view about the outline and direction of the research execution. The focus of this chapter is to discuss several questions about the research regarding the efficiency of Islamic and conventional banks during the financial crisis in Malaysia. This chapter contained background of the study, problem statement, research question and research objectives. Moreover, the significance of this study, scope, limitation and organization of the study was also described in this chapter. The next chapter will be discussed about the literature review of the efficiency of Islamic and conventional banks during the financial crisis.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In this chapter, some of the literatures relevant to this study are explored. Sekaran (2003) stated that a literature review is a documentation of the inclusive reviews of the published work and is obtained from the secondary sources of data in specific areas of the researcher. Hence, this section will discuss the reviews on the efficiency of Islamic and conventional banking during financial crisis. Although a number of studies have been explored the efficiencies in the banking industry (Sufian, 2007; Mokhtar, Abdullah, & Alhabshi, 2008) only few recent studies focus on efficiency of Islamic and conventional banking industry (Beck, Demirguc-Kunt, & Merrouche, 2010; Wasiuzzaman & Gunasegavan, 2013). There is still lack of comparison between Islamic and conventional during the financial crisis subsequently need exploration in-depth.

2.1 Overview of efficiency

Efficiency refers to the weighted sum of outputs divided by a weighted sum of inputs. It is also the good usage of resources to maximize the production of the goods and services

of the firms where it concerns with the relationship between the input resources and the output produced using the inputs. The concept of efficiency is determined of ups and downs of firms. Firms will be considered as high level of efficiency if the firms are capable to produce outputs with a minimal level of inputs relative to other firms in the same industry. Based on Leibenstein (1966) quoted in Yahya, Muhammad, & Hadi, (2012) firms are failing optimally function due to lack of allocation efficiency and failure to utilize resources optimally.

Various types of efficiency studies are performed to know how efficient of an institution used their inputs in producing outputs such as human resource management (Clark, 1992), the education system (Coco & Lagravinese, 2012) and public community hospitals (Kirigia & Asbu, 2013).

In terms of banking efficiency, Berger and Humphrey (1997) stated that it is very important to measure the efficiency of the banking sector in order to get the information and this information can be contributed to the government policy regarding the effects of deregulation, mergers or market structure on efficiency. This information also can improve managerial performance by identifying “best practices” and “worst practices”. Banks management and policy maker also utilized the information of efficiency studies in order to investigate the efficiency of banking industry subsequently leads to the economic growth of the country.

2.2 Measurement of efficiency

Mohamad Noor (2011) stated that there are several measurements can be utilized to examine the efficiency of the bank. The measurement of bank efficiency mostly focuses on two different approaches, namely the parametric and non-parametric methods. The most commonly used parametric approaches are the Stochastic Frontier Approach (SFA), Distribution Free Approach (DFA) and the Thick Frontier Approach (TFA). Whereas, the most commonly used non-parametric approach is the Data Envelopment Analysis (DEA) and Free Disposable Hull (FDH). (Berger & Humphrey, 1997).

The Stochastic Frontier Approach (SFA) refers to the econometric frontier approach specifies a functional form for cost, profit or production relationship between inputs, outputs and environmental factors while allowing for random error. Likewise, the Distribution Free Approach (DFA) specifies a functional form, but the random error of inefficiencies is separately in a different way. Meanwhile, the Thick Frontier Approach (TFA) also prescribes a functional form and assumes that deviations from predicted performance values within the highest and lowest quartiles of observations represents a random error.

In terms of non-parametric approach, the Data Envelopment Analysis or the mathematical programming approach constructs the frontier of the observed input-output ratios by linear programming techniques. It can be measured based on the assumption of

constant returns to scale (CRS) or variable returns to scale (VRS). The Free Disposable Hull is a special case of a DEA model where it assumes that there is no substitution and the isoquant looks like a step function formed by the intersection of lines drawn from observed input combinations.

By using Stochastic Frontier Analysis (SFA), Hussein (2003) conducted a study to analyze the cost efficiency of Islamic banks in Sudan. The period of his study is from 1990 to 2000. The study utilized 17 banks as samples to estimate the cost efficiency within the study period. The finding of this study is large variations in the cost efficiency of Sudanese banks with the foreign owned banks being the most efficient. On the other hand, the state owned banks are the most cost inefficient. The analysis is extended to examine the determinants of bank efficiency. From this analysis, it shows that smaller banks are more efficient than their larger banks. Furthermore, banks that have a higher proportion of *musharakah* and *mudharabah* finance relative to total assets also have efficiency advantages.

Another study conducted by El-Gamal and Inanoglu (2004) also used the SFA to assess the cost efficiency of Turkish banks from 1990-2000. In their study, they make a comparison about the cost efficiencies of 49 conventional banks with four Islamic special finance houses (SFHs). The Islamic firms comprised around 3% of the Turkish banking market. The result indicates that Islamic financial institutions to be the most efficient and this was enlightened by their emphasis on Islamic asset-based financing

which led to lower non-performing loan ratios. In addition, they mentioned that SFH achieved high levels of efficiency in spite of being subjected to branching and other self-imposed constraints, for example, the inability to hold government bonds.

After that, El-Gamal and Inanoglu (2005) extend their previous study to evaluate the scores of bank efficiency. They also utilized SFA in this study. For a second time, they examine the cost efficiency of Turkish banks throughout the 1990s. They were distinguished the groups of banks that have different production technologies. The result shows that Islamic financial firms have different production technologies. The other finding is Islamic financial firms have the same production technology as conventional banks, particularly domestic banks and Islamic firms are among the most efficient.

Last but not least, the SFA analysis also utilized by Rozzani & Rahman (2013) in order to study the area of bank efficiency and identify the determinants that affect the efficiency of Islamic and conventional in Malaysia. The samples of 19 conventional banks and 16 Islamic banks in Malaysia have been utilized. The data is from year-end financial data within 2008 to 2011. As a result, the level of profit efficiency for both conventional and Islamic banks in Malaysia was highly similar. The results indicate that the efficiency of conventional banks would be better with the increment of bank size and decrement of operational cost and credit risk. Meanwhile, the decrement of operational cost will increase the level of efficiency in Islamic banks.

Apart from using the SFA, Data Envelopment Analysis (DEA) is utilized by many researchers in their study of efficiency such as Berger and Humphrey (1997) stated that here are 130 studies regarding the efficiency of the banking industry in 21 countries; 116 of them were published between 1992 and 1997. Another study conducted by Bhattacharya et al., (1997) to study about the impact of liberalization on the efficiency of the Indian banking industry. He utilized a two-stage DEA approach in his study. Alirezaee et al., (1998) conducted numerical experiments relating to DEA results to sample size. The data are from 1282 branches of the bank in Canada. Seiford and Zhu (1999) study about the performance level of the top 55 US banks. All of them utilized Data Envelopment Analysis (DEA) in their study.

By utilizing the DEA method, Darrat et al., (2002) conducted a study to determine inefficiency sources in Kuwaiti banks. The aim of this study is to evaluate banking institutions during the late 1980s, particularly in the 1990s. The finding is inefficiency in those banks was related to both allocative and technical efficiency. He also found that small banks appeared to be more allocative and technically efficient compared to larger banks, which in turn made small banks more profit efficient. Based on Charnes, Coopers & Rodes (1978), Data Envelopment Analysis (DEA) is non-parametric analysis. It does not require the specification of any particular functional form to describe the efficient frontier or envelopment surface.

In addition, Yildirim (2002) utilized DEA method to evaluate the efficiency of Turkish commercial banks between 1988 and 1999. From the analysis, the finding recommends that over the sample period, both pure technical and scale efficiency measures presented a great variety and the sector did not achieve sustained efficiency gains.

Yudistira (2004) analyzed the technical and scale efficiencies of 18 Islamic banks from 1997-2000 in 12 countries. The result indicates that there are diseconomies of scales for small to medium Islamic banks, so that merger and acquisition should be suggested. The finding was supported by Sufian (2004) when he examines the effects of mergers and acquisitions on the efficiency of Malaysian banks during the merger year, pre and post-merger event. The finding shows that the merger program was successful, particularly for small and medium size banks, which have benefited from expansion via economies of scale. Thus, it was recommended that larger banks should shrink to benefit from scale advantages. Both studies conducted by Yudistira (2004) and Sufian (2004) utilize DEA method.

A study by Sufian (2007) utilized DEA to evaluate the efficiency of Islamic banks in Malaysia. The finding shows that domestic Islamic banks were more efficient rather than foreign Islamic banks operating in Malaysia. The result shows that Malaysian Islamic bank efficiency declined in the year 2002 to recover slightly in the years 2003 and 2004.

Another study carried out by Sufian (2006) aimed to examine levels of efficiency in the Malaysian Islamic banking sector from 2001-2004. Non-parametric Data Envelopment Analysis method has been used in this study. The result of this study indicates that scale efficiency, dominated over the pure technical efficiency effects when the number of Malaysian Islamic banks facing the scale raised up dramatically from 28.6% in year 2001 to 60.0% in year 2004, ratifying the fact that during the period of study, the majority of Malaysian Islamic banks were operating at non-optimal of operations. Furthermore, the study confirms that the dominant effect of scale efficiency over pure technical efficiency in determining overall efficiency during the period of study. Thus, he recommends that foreign Islamic Banking Scheme bank have shown a lower technical efficiency compared to domestic Islamic Banking Scheme bank peers. Another finding is scale inefficiency leads to the inefficiency of foreign Islamic Banking Scheme Banks.

2.3 Efficiency of Islamic banks

There are various studies regarding Islamic banks such as Sufian (2007) examined the level of performance of the Malaysian Islamic banking sector for the period 2001 to 2005. Several efficiencies of individual banks were evaluated by utilizing non-parametric Data Envelopment Analysis (DEA). Two different approaches have been used in order to differentiate how efficiency scores differ with changes in inputs and outputs. He has combined problem loans as a non-discretionary input variable in the analysis to examine the impact of risk factor in Islamic bank efficiency. The result

indicates that the scale inefficiency leads to the inefficiency of the Malaysian Islamic banking sector compared to pure technical inefficiency. The finding indicates that foreign banks have presented higher technical efficiency compared to their domestic peers. The efficiency of Malaysian Islamic banks influenced by the inclusion of risk factors. Thus, he recommends that while potential economies of scale, maybe overestimated when risk factors are excluded, pure technical efficiency estimates on the other hand, tend to be much more sensitive to the exclusion of risk factors. The empirical results from the Spearman and Pearson tests reinforce these findings.

Moreover, Sufian, Mohamad, & Muhamed-Zulkhibri (2008) also conducted a study regarding Islamic banks in order to examine the efficiency of Islamic banking sectors from 2001 to 2006. The samples are 16 Islamic banks in Middle Eastern and North African (MENA) countries and Asian countries. They utilized Data Envelopment Analysis (DEA) method to assess of individual banks. The finding indicates that banks from the MENA region were the most efficient banks by leading the top part of the efficiency frontier within the period.

Noor et al., (2010) explored the efficiency of the Islamic banking sectors in 4 Asian countries which are Bangladesh, Indonesia, Malaysia and Pakistan during the period of 2001 to 2006. In this study, the authors utilized non-parametric Data Envelopment Analysis (DEA) method to estimate the efficiency of individual banks. The results show that during the study period, Asian Islamic banking sectors have been operating at a

relatively optimal scale of operations, however, they were relatively managerial inefficiency in controlling their operating costs and utilizing their resources optimally.

Another study conducted by M.Mostafa (2011) to investigate the efficiency of the top 100 Islamic banks. In this study, the DEA was utilized to estimate the relative efficiency of Islamic banks. The finding in this study is the performance of several banks are sub-optimal, means that the potential for significant enhancements. Separate benchmarks were resulting for possible minimization in resources used, and significant savings are possible on this account.

Furthermore, a new empirical evidence on the revenue, efficiency in the Malaysian Islamic banking sector during the period 2006 to 2010 has been provided by Sufian, Kamarudin, & Noor (2012). In the study, the authors examine the internal and external factors which give impact to the revenue efficiency of the Islamic banks. They utilized Data Envelopment Analysis method to compute the level of efficiency in revenue, which comprised 17 domestic and foreign Islamic banks. The finding shows that the domestic Islamic banks have presented lower revenue, efficiency levels compared to their foreign bank peers. They found that capitalization, market power, and liquidity have positive and significant relationships with Malaysian Islamic banks' revenue efficiency.

By using DEA method, Ab-Rahim, Kadri, & Ismail (2013) examined the efficiency performance of the full-fledged Islamic banks in Malaysia for the period of 2006 to 2011. During the period of study, the Malaysian Islamic banking industry has grown in terms of assets, deposits and total financing. DEA employed in this study to measure the cost efficiency as well as the technical efficiency and its decompositions. The results show that, on average the main contributor of cost efficiency for Islamic domestic and foreign banks in Malaysia is allocative efficiency. In addition, from this study, Islamic foreign banks are more efficient than domestic banks with respect to pure technical efficiency and allocative efficiency.

2.4 Efficiency of Islamic and Conventional banks

Aside of study the efficiency of Islamic banks, various comparative studies were conducted such as Abdul-Majid, S.Saal, & Battisti (2008) investigate the efficiency in Islamic and conventional banks. The study used the sample of 10 countries which comprised 23 Islamic and 88 conventional banks from 1996 to 2002. The findings from this study are Sudan and Yemen has relatively higher inefficiency while Iran and Malaysia have lower estimated inefficiency.

In order to enhance the literature regarding the efficiency topic, Mokhtar, Abdullah, & Alhabshi (2008) organized a study to assess the efficiency of the fully fledged Islamic banks as well as Islamic windows in Malaysia. The study used Data Envelopment

Analysis (DEA). Within the period of study, the results indicate that on average, the efficiency for overall Islamic banking industry has increased. The study discovered that full-fledged Islamic banks were more efficient than the Islamic windows, however, it is still less efficient than the conventional banks. In addition, Islamic windows of the foreign banks indicates more efficient than Islamic windows of the domestic banks.

Kamaruddin, Safa, & Mohd (2008) also conducted a study regarding full-fledged Islamic banks and Islamic window operations of domestic and foreign banks, but he focused his study to investigate the cost and profit efficiency part. The study used the annual reports of the banks, Bank Negara Malaysia (BNM) books and serial publications, and other relevant published literature. The samples are 14 commercial banks, which comprised 2 Islamic banks and 12 Islamic window divisions of commercial banks. The study utilized Data Envelopment Analysis (DEA) method. The results indicate that Islamic banking operators are relatively more efficient at controlling costs than at generating profits.

Another study by I.Bader, Mohamad, Ariff, & Hassan (2008) aims to evaluate and compare the cost, revenue and profit efficiency of Islamic and conventional banks from 1990 to 2005 in 21 countries. This study utilized Data Envelopment Analysis. The evaluation is based on the size, age and region on those banks. From this analysis, they found that there are no significant differences between the overall efficiency results of conventional versus Islamic banks.

Comparative studies between Islamic and conventional banking has been conducted by Hassan, Mohamad, & I.Bader (2009) to examine the differences in mean cost, revenue and profit efficiency scores of both banks. The purpose of this study is to investigate the effect of size, and age on cost, revenue and profit efficiency of the 40 banks in 11 organizations of Islamic Conference (OIC) countries. A cross-country level data compiled from the financial statements of the banks from 1990 to 2005. DEA non-parametric efficiency approach has been utilized in this study. As result, no significant differences between the overall efficiency of conventional and Islamic banks. Aside that, on average, banks are more efficient in utilizing their resources compared to their capability to generate revenues and profits.

Al-Khasawneh, Bassedat, Aktan, & Thapa (2012) examined the efficiency of Islamic banks relative to conventional banks operating in North African Arab countries, in terms of cost and revenue efficiency. The aim of this study is to assess more evidence regarding the banking system efficiency trend and dynamics in each single country, and to compare such trends among countries included in this study. Non-parametric Data Envelopment Analysis (DEA) has been utilized to estimate cost and revenue, efficiency scores, assuming variable returns to scale (VRS). The sample consists of 9 Islamic banks and 11 conventional banks. In this study, the finding is Islamic banks achieved higher average revenue efficiency scores over conventional banks in this region, while the growth rate of revenue efficiency score of Islamic bank was less than conventional banks. For the cost efficiency, the result varied from country to another. The finding also indicates that both groups of banks were close to each other, with an advantage to

conventional banks, which suffer less cost efficiency loss over time compared to Islamic banks.

Ahmad & Rahman (2012), examined the efficiency of the Islamic commercial banks and conventional commercial banks in Malaysia for the year 2003 to 2007. The samples are 10 local commercial banks selected in Malaysia, which comprise of 8 conventional commercial banks and 2 Islamic commercial banks. This study used Data Envelopment Analysis and Mann-Whitney U-test in order to know the difference in the average efficiency score of the Islamic commercial banks and conventional commercial banks. The finding in this study is conventional commercial banks outperformed Islamic commercial banks in all efficiency measures. The result indicates that the conventional commercial banks may be more efficient than the Islamic commercial banks in line of managerial efficiency and technological advancement.

Yahya, Muhammad, & Hadi (2012) conducted a comparative study on the level of efficiency between Islamic and conventional banking in Malaysia. The authors utilized DEA to measure the efficiency levels of banks in both sectors. The finding of this study is there is no significant difference in the level of efficiency between Islamic and conventional banks.

2.5 Impacts of financial crisis

Chazi & Syed (2010) investigated how Islamic financial institutions performed in recent financial problems and only focused on risk management. Totally, there are 27 Islamic banks and 27 conventional banks selected from a wide range of countries around the world was analyzed. The study indicates that Islamic banks are preserved better capital ratios compared to conventional counterparts. The study reveals a new approach to the comparative performance of Islamic and conventional banks in terms of risk management. The research design as well as the findings can be very beneficial to academicians and banking professional alike.

Kassim & Majid (2010) also conducted a study on the impact of financial shocks on the Islamic banks in relation to the conventional banks. The study focused on the Malaysian experience over two major financial crisis, namely 1997 Asian financial crisis period from July 1997 to September 1999, the 2007 global financial crisis period from July 2007 to September 2009. The study employs the impulse response functions and variance decomposition analysis based on the vector auto-regression (VAR) method. The data for this study covers three sub-periods, namely the 1997 Asian financial crisis period (July 1997-September 1999), the non-crisis period (October 1999-June 2007), and the 2007 global financial crisis period (July 2007-September 2009). The results indicate that both the Islamic and conventional banking systems are vulnerable to financial shocks. This is contrary to the popular belief that the Islamic financial system is protected from the financial shocks due to its interest-free nature. The result of this

study is important implications for the risk management practices of both the Islamic and conventional banks.

Rosman, Wahab, & Zainol (2013) provided an empirical evidence on the efficiency of Islamic banks in 12 Middle-Eastern countries and 7 Asian countries during the period of 2007 to 2010. This study employed DEA to estimate the efficiency of each Islamic bank. As a result, Islamic bank was able to sustain operations through the crisis. The other finding indicates that most of Islamic banks were scale inefficient.

This study is an extension of the previous literature by providing recent empirical evidence on the performance of the banks particularly during the financial crisis period. In addition, this study explores the differences in the efficiency scores between the Islamic and conventional banks in Malaysia during the financial crisis since there are limited studies on the efficiency of the banking industry during the financial crisis. The summary of past studies related to efficiency in the banking industry and the financial crisis will be explained in the table 2.1 below.

Table 2. 1: *Summary of past studies*

	Authors	Year	Method	Input	Output	Findings
1	Khalid Shahooth, K & Ahmed H.batt et al	2006	DEA	1) Capital, 2) Reserves 3) Deposits	1) Investment 2) Assets	Most Islamic banking institutions which are the sample of the paper are efficient and the rest is on the way of improving their efficiencies.
2	Fadzlan Sufian	2006	DEA	1) Total deposits 2) Labor 3) Fixed assets	1) Total loans 2) Income	The domestic Islamic banks were more efficient compared to the foreign Islamic banks.
3	Ramakrishnan Ramanathan	2007	DEA	1) Fixed Assets 2) Deposits 3) Short term funding 4) Equity 5) Personnel expenses	1) Loans 2) Other earning assets	Only 15 of the 55 banks are rated as efficient under a constant return to scale (CRS) assumption, and all the GCC countries have at least one efficient bank.
4	Hamim S. Ahmad Mokhtar, Naziruddin Abdullah and Syed M. Alhabshi	2008	DEA	1) Total deposits 2) Total Overhead Expenses	1) Total Earning Assets	Full-fledged Islamic banks more efficient than the Islamic windows, but they were still less efficient than the conventional banks. Islamic windows of the foreign banks are more efficient than Islamic windows of the domestic banks.
5	Fadzlan Sufian, A.M Noor Mohamad and Abdul MajidMuhamed-Zulkhibri	2008	DEA	1) Total deposits 2) Assets	1) Total loans 2) Income 3) Investment	The empirical findings also indicate that banks from the MENA region were the most efficient banks by dominating the top part of the efficiency frontier over the period.

6	Mariani Abdul Majid, David S.Saal, GiulianaBattisti	2008		1) Total operating expense, 2) Deposits 3) Equity	1) Loans 2) Total earning assets	The banks in each of the 10 sample countries exhibit moderate returns to scale. The average estimated returns to scale for conventional banks are lower than those for Islamic banks, with the exception of Malaysia and Jordan.
7	Mohamed KhaledI.Bader, ShamsherMohamad, Mohamed Ariff, Taufiq Hassan	2008	DEA	1) Labor 2) Fixed Assets 3) Total Funds	1) Total loans 2) Other earning assets 3) Off balance sheet items	Banks are more efficient in using their resources compared to their ability to generate revenues and profits.
8	BadrulHishamKamaruddin, Mohammad SamaunSafa, RohaniMohd	2008	DEA	Cost and Profit efficiency model: 1) Personnel expenses 2) Total deposits 3) Premises 4) Fixed assets	Cost efficiency model: 1) Earning assets (loans, advances & financing, securities & investments) 2) Liquid assets 3) Other income. The output of both models is profit before taxation and zakat	Islamic banking operators are relatively more efficient at controlling costs than at generating profits. The main contributor for cost efficiency of domestic and foreign banks comes from resource management and economies of scale respectively.
9	Taufiq Hassan, ShamserMohamad, Mohammed KhaledI.Bader	2009	DEA	1) Labor 2) Fixed Assets 3) Total Funds (total deposits plus total borrowed funds)	1) Total loans, 2) Other earning assets 3) Off-balance sheet items	No significant differences between the overall efficiency of conventional and Islamic banks. However, on average, banks are more efficient in using their resources compared to their ability to generate profits and revenues. The size and age factor did not significantly influence the efficiency scores in both banking streams.

10	Fatimah SalwaAbd. Hadi and Norma Md. Saad	2010	DEA	1) Total deposits, 2) Labor 3) Fixed asset	1) Total loan 2) Income	The scale efficiency dominates the pure technical efficiency effects in determining Malaysian Islamic banks' overall or technical efficiency. Malaysian-owned Islamic banks' performance is better compared to their foreign-owned counterparts.
11	Mohamad Akbar Noor Mohamad Noor and Nor Hayati Ahmad and FadzlanSufian	2010	DEA	1) Total deposits 2) Assets	1) Total loans 2) Income 3) Investment	During the period of study, the finding indicates that although the Asian Islamic banking sectors have been operating at a relatively optimal scale of operations, they were relatively managerially inefficient in controlling their operating costs and utilizing their resources to the fullest.
12	Mohamed M. Mostafa	2011	DEA	1) Assets 2) Equity	1) Net income 2) ROA 3) ROE	The results indicate that the performance of several banks is sub-optimal suggesting the potential for significant improvements. Separate benchmarks were derived for possible reductions in resources used, and significant savings are possible on this account.
13	Jamal Ali Al-Khasawneh, KarimaBassedat, Bora Aktan, PriyaDarshini Pun Thapa	2012	DEA	1) Personnel expenses 2) Fixed Assets 3) Loanable Funds	1) Net loans 2) Other earning assets	The result indicated that Islamic banks achieved higher average revenue, efficiency scores over conventional banks in this region, while the growth rate of revenue efficiency scores of Islamic banks was less than conventional banks. In terms of cost efficiency, the result varied from country to another.

						The results also showed that both groups of banks were close to each other, with an advantage to conventional bank, which suffer less cost efficiency loss over time compared to Islamic banks.
14	Mohamed HishamYahya and Junaina Muhammad	2012	DEA	1) Deposits (this includes current, savings and term deposits plus short-term borrowings) 2) Fixed assets 3) Other earning assets (among these assets are loans and advances to banks, securities, derivatives, investment in property and insurance assets) 4) Overheads.	1) Loan amount (inclusive of residential mortgage loans, consumer or retail loans, and commercial loans less non-performing loans) 2) Interest revenue 3) Net income.	There is no significant difference in the level of efficiency between Islamic and conventional banks.
15	Suraya Ahmad, Abdul Rahim Abdul Rahman	2012	DEA, Mann-Whitney U-test	1) Labor 2) Capital 3) Total deposits	1) Loans and advances 2) Total income	The commercial banks in Malaysia are facing the scale inefficiency. The banks are unable to fully utilize their capabilities and capacities in generating the outputs from their resources. The scale inefficiency is the main factor that leads to the low technical efficiency in the Islamic commercial banks as their size is relatively smaller than the conventional commercial banks.

16	Fadzlan Sufian, FakarudinKamarudin, Nor HalidaHaziatonMohd Noor	2012	DEA	1) Deposits 2) Labor	1) Loans 2) Income	The result shows that the domestic Islamic banks have exhibited lower revenue efficiency levels compared to their foreign bank peers. Capitalization, market power and liquidity have positive and significant relationships with Malaysian Islamic banks' revenue efficiency.
17	NabilahRozzani, Rashidah Abdul Rahman	2013	SFA	1) Price of labour 2) Price of Fund 3) Price of Physical Capital	1) Total loans 2) Total of other earnings assets	The levels of profit efficiency for both conventional and Islamic banks in Malaysia were highly similar. It could be observed that efficiency would be better for conventional banks with the increment of bank size, and also the decrement of both operating cost and credit risk, while the efficiency of Islamic banks would be better with only the decrement of operational cost.
18	Farhana Ismail, M. Shabri Abd. Majid, Rossazana Ab. Rahim	2013	DEA	1) Labour (measured by personnel expenses) 2) Capital (measured by fixed assets), 3) Total deposits	1) Total loans, 2) Other earning assets 3) Off balance sheet items	Technical efficiency as the main contributor of cost efficiency for conventional commercial banks and allocative efficiency as the main contributor for cost efficiency of Islamic commercial banks. Conventional commercial banks have been efficient in utilizing information technology and electronics.

19	Fadzlan Sufian	2007	DEA	1) Total deposits 2) Non-performing loans	1) Total loans 2) Investments	Scale inefficiency dominates pure technical inefficiency in the Malaysian banking sector. Foreign banks have exhibited higher technical efficiency compared to their domestic peers.
20	Salina H. Kassim and M. Shabri Abd Majid	2010				Both the Islamic and conventional banking systems are vulnerable to financial shocks.
21	AbdelazizChazi, Lateef A.M Syed	2010				Islamic banks are maintaining better capital ratios than to their conventional counterparts.
22	Romzie Rosman, NorazlinaAbdWahab, ZairyZainol	2013	DEA	1) Deposit and short term funding 2) Fixed Assets 3) Personnel expenses	1) Loans 2) Other earning assets	Islamic banks were able to sustain operations through the crisis. The majority of these Islamic banks were scale inefficient. Most of the scale inefficient banks were operating at decreasing returns to scale.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

In this chapter, the researcher will explain about the sample selection and methodology employed to analyze efficiency of Islamic and conventional banks in Malaysia during the financial crisis and to examine sources of technical efficiency of Islamic and conventional banks during the financial crisis. The structure of this chapter is such that it firstly re-addresses the research design for this study. Besides, the selection of the sample in this study will be discussed where several institutions which represent the banking industry in Malaysia will be selected based on the availability of data for a sample period of 6 years from 2007 until 2012. Last but not least, the research methodology will be discussed. Finally, this chapter will also describe the sources of data and the data analysis method which is Data Envelopment Analysis will be employed to clarify the data collection.

3.1 Research Design

3.1.1 Data Collection

In measuring the efficiency of Islamic and conventional banks during the financial crisis, this study will utilize the output-input data which consists of 13 Islamic banks and 10 conventional banks in Malaysia from 2007 to 2012. As stated in the first chapter, there are 16 Islamic banks and 27 conventional banks in Malaysia. However, based on the availability of data, only 13 Islamic banks and 10 conventional banks operate in Malaysia will be examined.

3.1.2 Source of data

The data for this study will be collected from the Bank Scope and Annual Report of the bank from 2007 to 2012. The calculation of efficiency will take into consideration the assumptions of variable returns to scale (VRS). To identify the efficiency measure, this study will apply the DEAP version 2.1, developed by Coelli (1996). Two inputs and two outputs were chosen to examine the efficiency using DEA. The inputs are total deposits and fixed assets and the outputs are total loans and other earning assets and these are used to investigate the efficiency of 13 Islamic banks and 10 conventional banks in Malaysia.

3.1.3 Data Analysis

3.1.3.1 Data Envelopment Analysis

There are two main approaches have been used to estimate banks' efficiency, which are parametric and non-parametric approaches (Berger and Humphrey, 1997). The difference between both approaches is a parametric approach requires a specification of the functional form of production, cost and profit in addition to the assumption about the error, whereas non-parametric approach doesn't require a prior assumption about errors or specification of functional form for production. Data Envelopment Analysis (DEA) has been used extensively to evaluate the efficiency of banking institutions.

As we know, Farrell (1957) was introduced the Data Envelopment Analysis (DEA) and then extended by Charnes et al., (1978) and subsequently modified by Banker et al., (1984), and Byrnes et al., (1984) and was drawn upon the efficiency concept discussed in Farrell (1957) as mentioned by Banker et al., (1984).

Farrell (1957) stated that DEA is a linear programming for frontier analysis of multiple inputs and multiple outputs. DEA compares each producer unit with the optimal producer unit to find out the inefficiency level of each producer. This producer unit known as Decision Making Unit (DMU). Here, each of DMU has a function of converting a set of inputs into a set of outputs.

The core objective of DEA is to determine which banks are operating on their efficient frontier and which banks are not. If the bank's input-output combination lies on the DEA frontier, the bank is considered efficient and the bank is considered inefficient if the bank's input-output combination lies inside the frontier.

DEA can estimate efficiency under the assumption of constant returns to scale (CRS) and variable returns to scale (VRS). The CCR model proposed by Charnes, Cooper and Rhodes (1978) is assumed CRS and only appropriate when all DMUs are operating at optimal scale. However, factors like imperfect competition and constraints in finance may cause banks not to operate at optimal scale. The efficiency measures attained from the CCR model are known as overall technical efficiency (OTE) scores and are confounded by scale efficiencies.

Therefore, the established bank literature that uses linear programming techniques to estimate efficiency tend to use the VRS assumption as suggested by Banker, Charnes and Cooper (1984). The BCC model extended the CCR model with the purpose of resolving problems with VRS. The efficiency measures acquired from the BCC model are identified as pure technical efficiency (PTE) scores and without of scale efficiency (SE) effects. If there appears to be a difference between the TE and PTE scores of a particular DMU, then it indicates the existence of scale inefficiency.

The linear programming problem is stated in order to represent the input oriented in the DEA model with VRS technologies as below:

$$
\begin{aligned}
& \min \varphi, \lambda, \varphi \\
\text{subject to } & -\varphi y_i + Y\lambda \geq 0 \\
& x_i - X\lambda \geq 0 \\
& N1' \lambda = 1 \\
\text{and } & \lambda \geq 0 \qquad (1)
\end{aligned}
$$

where λ is an N× 1 intensity vector of constants and φ is a scalar ($1 \geq \varphi \leq \infty$). $N1$ is an $N \times 1$ vector of ones. For N number of firms, yi and xi are the $M \times N$ and $K \times N$ output and input vectors, respectively. Y comprises the data for all N firms. Given a fixed level of inputs for the ith firm. Note that without the convexity constraint $N1' \lambda = 1$, equation (1) becomes a DEA model with CRS technology. The convexity constraint implies that an inefficient firm is benchmarked against firms of a similar size and therefore the projected point of that firm on the DEA frontier will be a convex combination of observed firms. In other words, each firm would produce on or to the right of the convex production possibility frontier. If TE scores for a particular firm with or without the convexity constraint imposed are the same, then the firm is operating under CRS. If these scores are different, the firm operate under VRS technology. However, in such a case, it would be necessary to identify whether the firm or the DMU operates with IRS or DRS. To do this, assumption of non-increasing returns to scale (NIRS) is imposed in (1) and

the convexity constraint $N1' \lambda = 1$ is substituted with $N1' \leq 1$. This is given as follows:

$$\begin{aligned} & \min \varphi, \lambda, \varphi \\ \text{subject to} \quad & -y\,i, + Y\lambda, \geq 0 \\ & \varphi\, xi - X\lambda \geq 0 \\ & N1'\, \lambda \leq 1 \\ & \text{and} \quad \lambda \geq 0 \end{aligned} \tag{2}$$

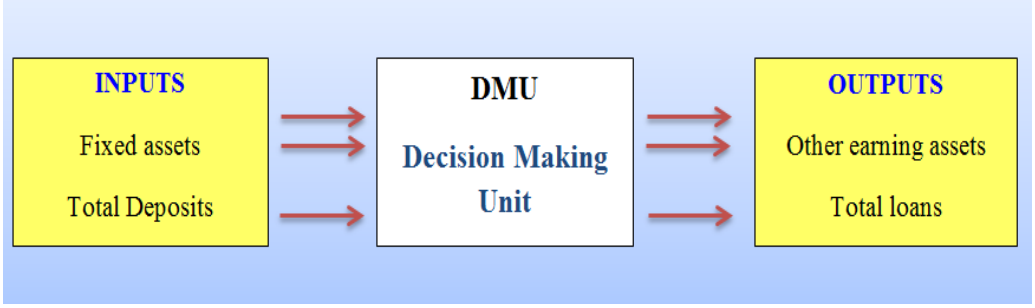
Solution of the equation (2) reveals the nature of scale efficiencies. IRS exists if TE score obtained with NIRS technology differs from the TE estimates with VRS technology. If both of these efficiency scores are equal, then the corresponding firm operates with DRS.

The advantages of using DEA to measure efficiency is that DEA permits calculating parameters such as overall technical efficiency. It also assists in understanding and computing the pure technical and scale efficiencies. According to Farrell (1957), technical efficiency (TE) can be defined as the firm's ability to obtain as large as possible an output from a combination of inputs. Scale efficiency (SE) denotes to the firm's ability to work at its optimal scale while pure technical efficiency (PTE) refers to the firm's ability to avoid waste by producing as much output as input usage allows or by using as little input as output production allows.

The weakness of DEA is that it assumes data are free from measurement errors. In addition, since efficiency is measured in a relative way, its analysis is confined to the sample set used. This means that an efficient DMU found in the analysis cannot be compared with other DMUs outside of the sample.

In short, the DEA process is explained in figure 3.1 below.

Figure 3. 1: *DEA process*



As we can see the figure 3.1 above shows that DEA is a linear programming technique to assess how making a particular decision for a unit which means decision making unit (DMU). Besides, the figure shows that the output obtained in relation to the resources employed. Production process refers a process that can turn a set of resources into desirable outcomes of production units. In the processing period, efficiency is utilized to measure how well a production unit is performing by using its resources to generate the derived outcomes. Each of the various DEA models seeks to determine which of the decision making unit (DMUs) define an envelopment surface that represents the best practice, referred to as the empirical production function or the efficient frontier. Units that lie on the surface are considered efficient in DEA while those units that do not, are called inefficient. For example, the bank's operation is considered to be efficient if the

value of efficiency equals 1 or near 1. In contrast, the bank's operation is deemed inefficient if the value of efficiency equals 0 or near 0.

There are two main objectives in this measurement of efficiency section which is the first one is to illustrate the concept of economic efficiency measurements as suggested by Farrell (1957) seminal paper using an input-orientation, and the other one is to discuss how it may be calculated relative to a given technology, which is normally represented by some form of frontier function and the other objective is to review the various methods used in estimating the frontier.

Rogers (1988) mentioned that is principally for a single firm that produces one output using a single input, the ratio of output to input is a measure of the productivity level. In this case, it is easy to measure productivity. This idea also supported by Diewert (1992) when he stated that the measurement of an output-input ratio is difficult in the case of many outputs and many inputs in a production process. Thus, there are various approaches have been applied by many researchers in order to measure the changes of productivity and efficiency in many types of institutions, and levels of decision making units (DMUs) as well.

In terms of technical efficiency, a producer will be considered as technical efficiency if the output increase, which require a reduction in at least one other output or an increase in at least one input, and if a reduction in any input requires

an increase in at least one other input or a reduction in at least one output (Koopmans, 1951).

Generally, technical efficiency is effective if one set of inputs given is utilized to produce an output. It means a firm is considered as technically efficient if a firm is able to produce maximum output from the minimum quantity of inputs such as labor and capital. In the case of a firm employed many workers over than necessary or a firm utilized outdated capital, the firm would be considered as technically inefficient. In this study, banks are considered inefficient if it unable to give more loans from the deposits that the banks have. Hence, a producer must produce the same outputs with less of at least one input, or could use the same inputs to produce more at least one output to achieve the technical efficient.

The measurement of input-output oriented is the equivalent measure of technical efficiency when constant returns to scale exist. As proposed by Farrell (1957), the efficiency of a firm comprises of two components which is technical efficiency and allocative efficiency. Technical efficiency refers to a firm that capable to achieve maximum output from a given set of inputs whereas allocative efficiency is referred to the capability of firm to utilize the input in optimal proportions, given their respective prices and the production technology. These two measures are combined in order to provide a measure of total economic efficiency.

3.1.3.2 Inputs and Outputs Specification

There are three approaches in defining input and output, which are intimidation approach, the production approach and the value added approach. In the intermediation approach, bank is considered as the intermediary between the supplier and the consumer of funds. In the production approach, the bank is defined as a financial institution that produces some services for its customers such as depositors and account holders. Meanwhile, value added approach or operating approach in which the bank is assumed as a business unit that its main target is generating revenue from the total cost for running the business.

There is no general consensus on how to define inputs and outputs as variables in analyzing efficiency. Based on Sealey and Lindley (1977), in terms of literatures cited on banking theories, two distinct theories are seen to be producing rivaling concepts such as the production and intermediation approaches. Then, Mester (1997) also stated that the literature on bank efficiency has two prominent approaches which are production and intermediation approach.

This study employs the intermediation approach. Based on Kwan (2002), the intermediation approach is the most widely used technique to measure efficiency. The intermediation approach assumes that financial firms act as intermediary between savers and borrowers, and it posits total loans and securities as outputs, while deposits along with labor and physical capital are defined as inputs. This

approach was mostly used in the earlier banking efficiency studies such as (Mokhtar, Abdullah, & Alhabshi, 2008; Hassan, Mohamad, & I.Bader, 2009; M.Mostafa, 2011).

Table 3.1 shows the input and output used in previous studies in measuring efficiency of Islamic and conventional banks.

Table 3. 1: *Summary of input and outputs used in the previous studies*

Authors (Year)	Approach	Inputs	Outputs
Khalid Shahooth & Ahmed H.Batt et al (2006)	Intermediation	Capital, Reserves, Deposits	Investments, Assets
Fadzlan Sufian (2007)	Intermediation	Total deposits, Labor, Fixed Assets	Total loans, Income
Ramakrishnan Ramanathan (2007)	Intermediation	Fixed Assets, Deposits, Short term funding, equity, personnel expenses	Loans, other earning assets
Hamim S. Ahmad Mokhtar, Naziruddin Abdullah and Syed M. Alhabshi (2008)	Intermediation	Total deposits, total overhead expenses	Total earning assets
Fadzlan Sufian (2008)	Intermediation	Deposits, Labor, Capital	Loans, Investments
	Value added	Labor, Capital, Interest expenses	Deposits, Loans, Investments
	Operating	Interest expenses, labor, non-interest expense	Interest income, non-interest income
Mariani Abdul Majid, David S.Saal, Giuliana Battisti (2008)	Intermediation	Total operating expense, deposits and equity	Loans, total earning assets
Taufiq Hassan et al (2009)	Intermediation	Labor, fixed assets, total funds	Total loans, other earning assets, off-balance sheet items
Suraya Ahmad, Abdul Rahim Abdul Rahman (2012)	Intermediation	Labour, capital, total deposits	Loans and advances, total income
Mohamed M. Mostafa (2011)	Operating	Asset equity	Net income, rate on assets, rate on equity
Mohammad Hanif Akhtar (2013)	Operating	Interest, non-interest expenses	Net interest income, non-interest income

In this study, the selection of the outputs and inputs for this study is replicated from Sufian (2007) and Ramanathan (2007). The outputs and inputs that are utilized in this study is shown in table 3.2.

Table 3. 2: *The outputs and inputs used in this study*

Outputs	**Inputs**
Other earning assets Total loans	Fixed assets Total deposits

From the Table 3.2 above, the outputs in this study are other earning assets and total loans whereas the inputs are fixed assets and total deposits. The definition of each term is described below.

a) Outputs

i. Other earning assets

Other earning assets are known as an income-producing investment that is owned by a business, institution or individual. It includes stocks, bonds, income from rental property and other interest or dividend earning accounts or instruments.

ii. Total loan

Loan is an agreement in written or oral form for a temporary transfer property from the lender to a borrower who promises to pay back in a stipulated time and usually with interest for its use.

b) Inputs

i. Total deposits

Total deposits are money placed into a banking institution for safekeeping. The depositor has the right to withdraw any deposited funds, as set forth in the terms and conditions of the account.

ii. Fixed assets

In general, fixed assets are a long-term tangible piece of property that a firm owns and uses in the production of its income and is not expected to be consumed or converted into cash any sooner than at least one year's time.

3.2 Independent Sample T-tests

Having the results of the different groups, the study utilized both parametric and non-parametric to test the significance difference between the Islamic and conventional banks' efficiency. T-test is normally used to test or to compare the

differences between two means of two related groups in order to detect whether there is any statistically significant differences between the means. In this study, t-test is used to analyze the differences between types of bank which is Islamic and conventional banks' efficiency. In addition, Mann-Whitney U-test is a non-parametric test of the null hypothesis that two populations are the same against an alternative hypothesis, particularly in population tends to have larger values than the other.

3.3 Conclusion

This chapter represents the details of the approaches adopted in this study. The choices of outputs and inputs and the measurement of approach were developed from the past literature and research. The sample selection and the process of data collection are based on the availability of data. A detailed data analysis will be described in the next chapter.

CHAPTER FOUR

EMPIRICAL RESULTS AND ANALYSIS

4.0 Introduction

In this chapter, the result of efficiency will be explained. The researcher utilized Data Envelopment Analysis (DEA) in measuring efficiency of Islamic and conventional banks during financial crisis in Malaysia. This study utilized the output-input data which consists of 13 Islamic banks and 10 conventional banks in Malaysia. Two outputs (other earning assets and total loans) and two inputs (fixed assets and total deposits) were utilized to measure efficiency of Islamic and conventional banks in Malaysia. The detail on the analysis as follows.

4.1 Descriptive Statistics of Inputs and Outputs for Islamic banks

Data as stated in this descriptive statistic is sourced from the Bankscope and statement of financial position (known as balance sheet). All variables are measured in millions of Malaysian Ringgit (RM). Two inputs and two outputs were considered for this study in order to investigate the efficiency of Islamic banks for the period of 2007 to 2012. Accordingly, Fixed Assets (x1) and Total Deposits (x2) consisted of deposits from customers and other banks were used in this study. Other earning assets (y1) and Total Loan (y2) which includes loans to

the customers and other banks utilized as outputs for this study. Table 4.1 below shows the descriptive statistics of inputs and outputs for Islamic banks.

Table 4. 1: *Descriptive Statistics of Inputs and Outputs for Islamic banks*

(in millions of Ringgit Malaysia)

	Mean	Min	Max	Std. Dev
Outputs				
2007				
Other earning assets (y1)	416624.72	143.74	1356796	585013.39
Total loan (y2)	1421824.79	98.44	4514812	1989307.81
2008				
Other earning assets (y1)	790999.06	82.12	2927031	1027970.37
Total loan (y2)	2726541.09	259.13	11877409	3687295.89
2009				
Other earning assets (y1)	2255149.93	487.30	16093818	4680382.75
Total loan (y2)	5037871.38	2456.69	16093818	5962577.90
2010				
Other earning assets (y1)	846818.19	348.11	3164671	1287019.36
Total loan (y2)	3328793.08	739.58	16339975	5094189.49
2011				
Other earning assets(y1)	798178.06	443.29	3505352	1112814.61
Total loan (y2)	4101319.13	960.90	19224468	6028245.72
2012				
Other earning assets (y1)	1255035.30	1761.76	3533711	1216659.11
Total loan (y2)	7367551.59	4678.69	20168110	7396294.36
Inputs				
2007				
Fixed Assets (x1)	4579.08	0.32595	22482	8395.63
Total Deposits (x2)	2213812.55	971.66	7227727	3105185.25
2008				
Fixed Assets (x1)	1174446.84	0.32595	43340	13023.75
Total Deposits(x2)	3687072.36	1547.94	14487150	4695630.82
2009				
Fixed Assets (x1)	7149.09	0.32595	35874	12361.54
Total Deposits(x2)	7422205.31	2863.80	25718929	8783682.24
2010				
Fixed Assets (x1)	1667260.37	0.32595	26915	9867.93
Total Deposits(x2)	4688778.12	1884.97	21686716	6898731.58
2011				
Fixed Assets (x1)	5204.80	0.32595	23624	8187.77
Total Deposits(x2)	6242597.54	2001.01	27209468	8935873.58
2012				
Fixed Assets (x1)	10967.11	0.32595	36491	13239.27
Total Deposits(x2)	10099256.85	6203.81	26348169	10145255.93

From the Table 4.1 above, it presents descriptive statistics of the output and input variables utilized in the DEA method. It is measured in millions of Malaysian Ringgit. It shows from 2007 to 2012, the awareness among Malaysian about Islamic banking and finance products has been increased due to the growth in total loan in 2008, 2009 and 2012. Similarly, total deposits increased in 2008, 2009, 2011 and 2012.

4.2 Descriptive Statistics of Inputs and Outputs for Conventional Banks

In this section, we stated the data from the statement of financial position (known as balance sheet). All variables are measured in millions of Malaysian Ringgit (RM). In view of that, Fixed Assets (x1) and Total Deposits (x2) consisted of deposits from customers and other banks were used in this study. Other earning assets (y1) and Total loans (y2) which includes loans to the customers and other banks utilized as outputs for this study. Table 4.2 below shows the descriptive statistics of inputs and outputs for conventional banks.

Table 4. 2: *Descriptive Statistics of Inputs and Outputs for Conventional Banks*

(in millions of Ringgit Malaysia)

	Mean	Min	Max	Std. Dev
Outputs				
2007				
Other earning assets (y1)	13167849	3884253	28543026	11103333.16
Total loan (y2)	38374956	13019480	118557035	37142017.47
2008				
Other earning assets (y1)	13171990	3961475	36126384	10991265.29
Total loan (y2)	42967947	15318769	138855474	44120419.36
2009				
Other earning assets (y1)	22208943	5386095	144431798	18587171.95
Total loan (y2)	57002581	16277911	1531816	54976635.07
2010				
Other earning assets(y1)	22093746	3509925	60568705	20114551
Total loan (y2)	62979673	17132000	159181385	59497460.29
2011				
Other earning assets (y1)	22281565	282512	68556823	21984659.35
Total loan (y2)	66264342	3976766	194174085	72769121.61
2012				
Other earning assets(y1)	24758724	482375	65487259	24571591.45
Total loan (y2)	76418819	3975909	214852046	79836583.35
Inputs				
2007				
Fixed Assets (x1)	328990	72227	987194	310257.41
Total Deposits (x2)	56858257	18190472	165026349	51297142.61
2008				
Fixed Assets (x1)	341342	54834	1062383	340926.20
Total Deposits(x2)	62323924	21271712	180752634	55071276.29
2009				
Fixed Assets (x1)	506386	62664	1531816	531646.09
Total Deposits(x2)	81049529	23901610	193574846	70450350.42
2010				
Fixed Assets (x1)	509062	108781	1442948	493489.39
Total Deposits(x2)	87512779	22246954	212809973	75942430.08
2011				
Fixed Assets(x1)	506531	18210	1458400	521144.89
Total Deposits(x2)	89500828	5617271	235025299	86440708.30
2012				
Fixed Assets(x1)	509138	21157	1534341	544789.08
Total Deposits(x2)	106087316	6013807	266600855	98126090.61

Table 4.2 above indicates the descriptive analysis of the output and input variables utilized in the DEA method, which is measured in millions of Malaysian Ringgit. Despite the increase of total loans in each year from 2007 to 2012, but it's still less stimulating growth. It same goes to the total deposits that increased in each year.

4.3 Efficiency of Islamic banks

This section presents the efficiency of Islamic banks from year 2007 until 2012 respectively. All the availability of data has been measured by DEA to identify the level of efficiency each bank.

4.3.1 Efficiency of Islamic banks in 2007

In 2007, there are 8 Islamic banks were evaluated. The value of overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) were explained in the table 4.3 below.

Table 4. 3: *Efficiency of Islamic banks in 2007*

BANKS	OTE	PTE	SE
Affin Islamic Bank Berhad	1.000	1.000	1.000
Am Islamic Bank Berhad	1.000	1.000	1.000
Asian Finance Bank Berhad	0.112	0.691	0.0162
Bank Islam Malaysia Berhad	0.371	1.000	0.371
Bank Muamalat Malaysia Berhad	0.371	0.890	0.417
Hong Leong Islamic Bank Berhad	1.000	1.000	1.000
Kuwait Finance House (Malaysia) Berhad	0.475	1.000	0.475
RHB Islamic Bank Berhad	1.000	1.000	1.000
MEAN	**0.666**	**0.948**	**0.678**

Notes: OTE – (Overall technical efficiency); PTE – (Pure technical efficiency); SE- (Scale efficiency)

Based on the table 4.3 above, the mean of OTE of Islamic banks in 2007 is 0.666. This means that 33.4% of input used was wasted in producing the same outputs. In

terms of PTE, it indicates that the efficiency of Islamic banks is 94.8%, while the scale efficiency score is 67.8%. The results show that the source of inefficiency of Malaysian Islamic banks in 2007 have been scale inefficiency, suggesting that Malaysian Islamic banks have been operating on the wrong scale of operations. In 2007, there are 4 Islamic banks are efficient, which are Affin Islamic Bank Berhad, Am Islamic Bank Berhad, Hong Leong Islamic Bank Berhad and RHB Islamic Bank Berhad. The least efficient is Asian Finance Bank Berhad which is a waste of 88.8% inputs in OTE, 30.9% inputs in PTE and 98.38% inputs in SE.

4.3.2 Efficiency of Islamic banks in 2008

In 2008, there are 12 Islamic banks were evaluated by utilizing Data Envelopment Analysis (DEA). The value of OTE, PTE and SE were explained in the table 4.4 below.

Table 4. 4: *Efficiency of Islamic banks in 2008*

BANKS	OTE	PTE	SE
Affin Islamic Bank Berhad	0.560	1.000	0.560
Alliance Islamic Bank Berhad	1.000	1.000	1.000
Am Islamic Bank Berhad	1.000	1.000	1.000
Asian Finance Bank Berhad	0.124	0.305	0.405
Bank Islam Malaysia Berhad	0.275	1.000	0.275
Bank Muamalat Malaysia Berhad	0.354	1.000	0.354
Hong Leong Islamic Bank Berhad	0.450	0.500	0.901
HSBC Amanah Malaysia Berhad	1.000	1.000	1.000
Kuwait Finance House (Malaysia) Berhad	1.000	1.000	1.000
OCBC Al-Amin Bank Berhad	1.000	1.000	1.000
Public Islamic Bank Berhad	0.444	0.450	0.988
RHB Islamic Bank Berhad	0.165	0.400	0.413
MEAN	**0.614**	**0.805**	**0.741**

Table 4.4 shows the OTE, PTE and SE level of the banks for the year 2008. On average, the OTE is 61.4%, PTE is 80.5% and SE is 74.1%. Hence, it means

Islamic banks in 2008 exhibited mean overall technical efficiency of 61.4%. This result recommends that the Islamic banks could have saved 38.6% of the inputs to produce the same amount of outputs that they produced. In other words, the Islamic banks in 2008 could have produced the same amount of outputs by using only 38.6% of the amount of inputs utilized. Based on the result, on average the overall technical inefficiency of the Islamic banks in 2008 is due to the scale inefficiency. Alliance Islamic Bank Berhad, Am Islamic Bank Berhad, HSBC Amanah Malaysia Berhad, Kuwait Finance House (Malaysia) Berhad and OCBC Al-Amin Bank Berhad is efficient. On the other hand, Asian Finance Bank Berhad scores the lowest efficiency level under OTE, PTE and SE.

4.3.3 Efficiency of Islamic banks in 2009

There are 11 of Islamic banks were measured in the year 2008 by utilizing the DEA. The value of OTE, PTE and SE as stated in table 4.5 below.

Table 4. 5: *Efficiency of Islamic banks in 2009*

BANKS	**OTE**	**PTE**	**SE**
Affin Islamic Bank Berhad	1.000	1.000	1.000
Alliance Islamic Bank Berhad	1.000	1.000	1.000
Am Islamic Bank Berhad	1.000	1.000	1.000
Bank Islam Malaysia Berhad	0.430	1.000	0.430
CIMB Islamic Bank Berhad	0.446	0.611	0.729
Hong Leong Islamic Bank Berhad	1.000	1.000	1.000
HSBC Amanah Malaysia Berhad	1.000	1.000	1.000
Kuwait Finance House (Malaysia) Berhad	0.125	1.000	0.125
OCBC Al-Amin Bank Berhad	0.461	1.000	0.461
Public Islamic Bank Berhad	0.540	0.939	0.575
RHB Islamic Bank Berhad	0.451	0.955	0.472
MEAN	**0.678**	**0.955**	**0.708**

Table 4.5 above shows the efficiency level for the year 2009. The mean of Islamic banks in 2009 is 67.8% in OTE, 95.5% in PTE and 70.8% in SE. It shows that scale inefficiency lead in overall technical inefficiency. Affin Islamic Bank Berhad, Alliance Islamic Bank Berhad, Am Islamic Bank Berhad, Hong Leong Islamic Bank Berhad and HSBC Amanah Malaysia Berhad are efficient. The least efficient is Kuwait Finance House (Malaysia) Berhad which is a waste of 87.5% inputs in OTE, and 87.5% inputs in SE. However, Kuwait Finance House (Malaysia) Berhad is efficient in PTE.

4.3.4 Efficiency of Islamic banks in 2010

In 2010, 12 of Islamic banks were evaluated and the result as stated in the table 4.6 below.

Table 4. 6: *Efficiency of Islamic banks in 2010*

BANKS	**OTE**	**PTE**	**SE**
Affin Islamic Bank Berhad	1.000	1.000	1.000
Alliance Islamic Bank Berhad	1.000	1.000	1.000
Al-Rajhi Banking & Investment Corporation (M) Berhad	0.755	0.969	0.779
Am Islamic Bank Berhad	1.000	1.000	1.000
Asian Finance Bank Berhad	0.600	0.738	0.814
Bank Islam Malaysia Berhad	1.000	1.000	1.000
Bank Muamalat Malaysia Berhad	0.549	0.736	0.746
Hong Leong Islamic Bank Berhad	1.000	1.000	1.000
HSBC Amanah Malaysia Berhad	1.000	1.000	1.000
Kuwait Finance House (Malaysia) Berhad	0.619	0.938	0.660
Public Islamic Bank Berhad	1.000	1.000	1.000
RHB Islamic Bank Berhad	0.720	1.000	0.720
MEAN	**0.854**	**0.948**	**0.893**

Regarding the table 4.6 above, the mean of OTE is 85.4%, PTE is 94.8% and SE is 89.3%. Thus, the scale inefficiency contributed to the overall technical inefficiency. There are 7 Islamic banks are efficient in 2010 which are Affin Islamic Bank Berhad, Alliance Islamic Bank Berhad, Am Islamic Bank Berhad, Bank Islam Malaysia Berhad, Hong Leong Islamic Bank Berhad, HSBC Amanah Malaysia Berhad and Public Islamic Bank Berhad. The least efficient is Bank Muamalat Malaysia Berhad which is 54.9% in OTE, 73.6% in PTE and 74.6% in SE. Hence, it shows that Bank Muamalat Malaysia Berhad is wasted of 45.1% of inputs in OTE, 26.4% of inputs in PTE and 25.4% of inputs in SE.

4.3.5 Efficiency of Islamic banks in 2011

By using DEA, the efficiency of Islamic banks in 2011 were measured. The result of the analysis as shown in table 4.7 below.

Table 4. 7: *Efficiency of Islamic banks in 2011*

BANKS	**OTE**	**PTE**	**SE**
Affin Islamic Bank Berhad	0.781	1.000	0.781
Alliance Islamic Bank Berhad	1.000	1.000	1.000
Al-Rajhi Banking & Investment Corporation (M) Berhad	0.785	0.885	0.887
Am Islamic Bank Berhad	1.000	1.000	1.000
Asian Finance Bank Berhad	0.628	0.885	0.710
Bank Islam Malaysia Berhad	0.907	1.000	0.907
Bank Muamalat Malaysia Berhad	0.647	0.736	0.880
Hong Leong Islamic Bank Berhad	0.707	0.768	0.921
HSBC Amanah Malaysia Berhad	1.000	1.000	1.000
Kuwait Finance House (Malaysia) Berhad	1.000	1.000	1.000
OCBC Al-Amin Bank Berhad	1.000	1.000	1.000
Public Islamic Bank Berhad	0.614	0.872	0.703
RHB Islamic Bank Berhad	0.748	0.941	0.794
MEAN	**0.832**	**0.930**	**0.891**

From the table 4.7, on average, the OTE is 83.2%, PTE is 93% and 89.1%. It must be highlighted the scale inefficiency of Islamic banks in 2011 is contributed to the overall technical inefficiency. Furthermore, we found that there are 5 Islamic banks are efficient such as Alliance Islamic Bank Berhad, Am Islamic Bank Berhad, HSBC Amanah Malaysia Berhad, Kuwait Finance House (Malaysia) Berhad and OCBC Al-Amin Bank Berhad. On the other hand, Public Islamic Bank Berhad scores the lowest efficiency level under OTE and SE, and Bank Muamalat Malaysia Berhad scores the lowest efficiency level under PTE.

4.3.6 Efficiency of Islamic banks in 2012

There are 9 of Islamic banks were evaluated in 2012. The value of the efficiency of Islamic banks will be explained in table 4.8 below according to OTE, PTE and SE of each bank respectively.

Table 4. 8: *Efficiency of Islamic banks in 2012*

BANKS	**OTE**	**PTE**	**SE**
Alliance Islamic Bank Berhad	1.000	1.000	1.000
Am Islamic Bank Berhad	1.000	1.000	1.000
Bank Muamalat Malaysia Berhad	1.000	1.000	1.000
Hong Leong Islamic Bank Berhad	0.599	1.000	0.599
HSBC Amanah Malaysia Berhad	0.815	0.871	0.936
Kuwait Finance House (Malaysia) Berhad	0.400	0.800	0.500
OCBC Al-Amin Bank Berhad	1.000	1.000	1.000
Public Islamic Bank Berhad	0.111	0.275	0.405
RHB Islamic Bank Berhad	0.655	1.000	0.655
MEAN	**0.731**	**0.883**	**0.788**

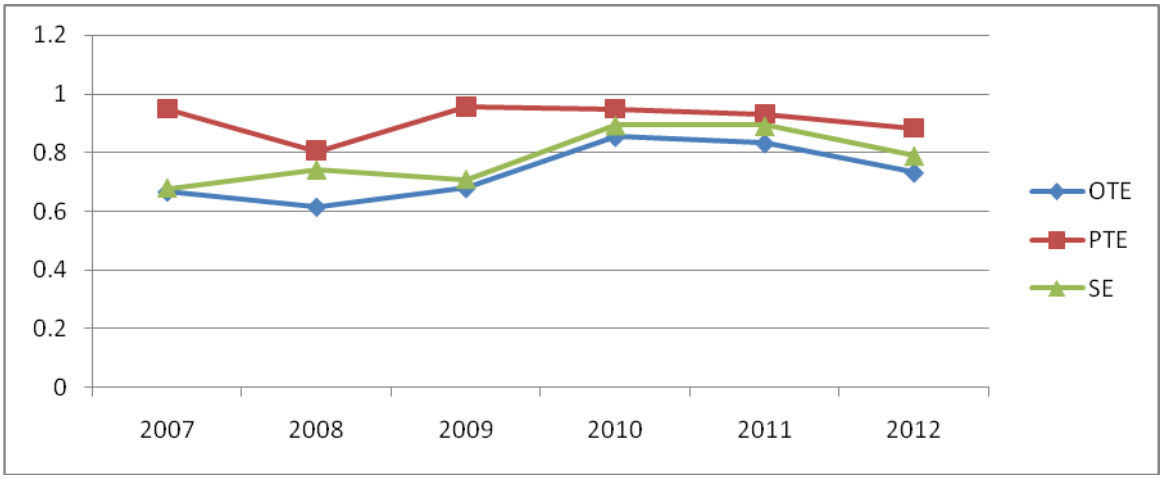
As shown in the table 4.8 above, the mean of OTE is 73.1%, PTE is 88.3% and SE 78.8%. Thus, the scale inefficiency contributed to the overall technical inefficiency. There are 4 Islamic banks such as Alliance Islamic Bank Berhad, Am

Islamic Bank Berhad, Bank Muamalat Malaysia Berhad and OCBC Al-Amin Bank Berhad is fully efficient. The least efficient is Public Islamic Bank Berhad which is 11.1% in OTE, 27.5% in PTE and 40.5% in SE. Therefore, it shows that Public Islamic Bank Berhad is wasted of 88.9% of the OTE, 72.5% in PTE and 59.5% in SE.

4.4 Efficiency of Islamic banks from 2007-2012

In this section, the efficiency estimates each Islamic banks from 2007 to 2012 is computed by using the non-parametric Data Envelopment Analysis (DEA). Through this method, we can distinguish three different types of efficiency measures which are overall technical efficiency (OTE), pure technical efficiency (PTE), and scale efficiency (SE) as shown in the line chart below.

Figure 4. 1: *DEA Result Movement 2007 to 2012 for Islamic Banks*



Source: author's own elaboration

It is clear from the result in Figure 4.1 above shows the efficiency of Islamic banks in Malaysia. In terms of OTE, it declined in 2008, increased in 2009 and 2010, before declining again during the years 2011 and 2012. In short, we can see that it

reaches a peak in the years 2010 and the lowest score of overall technical efficiency is in the years 2008. In terms of PTE, it declined in 2008, increased in 2009 and slightly declined in the years 2010, 2011 and 2012. The highest score of PTE is in 2009 and the lowest score of PTE is in 2008. In terms of SE, it increased in 2008 and slightly declined in 2009, before increasing again in 2010. The highest score of SE is at 2010 and the lowest score of SE is at 2007.

During the period of study, we encounter that there is a global financial crisis in 2008. While during the global financial crisis period, the figure 4.1 shows that the efficiency scores in OTE decreased 5.2% from 0.666 in 2007 to 0.614 in 2008. Besides, in PTE, the efficiency scores declined 14.3% from 0.948 in 2007 to 0.805 in 2008. In terms of SE, it increased 6.3% from 0.678 in 2007 to 0.741 in 2008.

Aside that, the OTE was increased 6.4%, which is from 0.614 in 2008 to 0.678 in 2009. PTE also increased 15%, which is from 0.805 in 2008 to 0.955 in 2009. However, the SE dropped 3.3%, which is 0.741 in 2008 to 0.708 in 2009.

From this result, we can see that Islamic banks are speedy recover during the financial crisis in terms of its overall technical efficiency and pure technical efficiency. There is also the possibility of the migration of customer's confidence from the conventional banking system changed to the Islamic banking system

within the period of global financial crisis subsequently lead to the positive result of the Islamic bank's efficiency.

4.5 Efficiency of conventional banks

This section discusses on the efficiency of conventional banks from year 2007 till 2012. All the availability of data has been measured by DEA to identify the level of efficiency each bank.

4.5.1 Efficiency of conventional banks in 2007

In 2007, there are 7 conventional banks were evaluated. The value of overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) were explained in the table 4.9 below.

Table 4. 9: *Efficiency of conventional banks in 2007*

BANKS	**OTE**	**PTE**	**SE**
Affin Bank Berhad	1.000	1.000	1.000
Alliance Bank Malaysia Berhad	0.311	1.000	0.311
Citibank Berhad	0.651	0.747	0.871
HSBC Bank Malaysia Berhad	0.390	0.594	0.656
Hong Leong Bank Berhad	1.000	1.000	1.000
Malayan Banking Berhad	0.229	0.229	1.000
RHB Bank Berhad	0.356	0.423	0.840
MEAN	**0.562**	**0.713**	**0.811**

Notes: OTE – (Overall technical efficiency); PTE – (Pure technical efficiency); SE- (Scale efficiency)

As shown in the table 4.9 above, the mean of OTE is 56.2%, PTE is 71.3% and SE 81.1%. Thus, the managerial inefficiency contributed to the overall technical inefficiency. There are 2 conventional banks are efficient in 2007 such as Affin Bank Berhad and Hong Leong Bank Berhad. The lowest score in efficiency is

Malayan Banking Berhad which is 22.9% in OTE and 22.9% in PTE. It means Malayan Banking Berhad is wasted 77.1% of inputs in OTE and PTE.

4.5.2 Efficiency of conventional banks in 2008

In 2008, there are 7 conventional banks were evaluated by utilizing Data Envelopment Analysis (DEA). The value of OTE, PTE and SE were explained in the table 4.10 below.

Table 4. 10: *Efficiency of conventional banks in 2008*

BANKS	**OTE**	**PTE**	**SE**
Affin Bank Berhad	0.745	1.000	0.745
Alliance Bank Malaysia Berhad	1.000	1.000	1.000
Citibank Berhad	1.000	1.000	1.000
HSBC Bank Malaysia Berhad	0.987	1.000	0.987
Hong Leong Bank Berhad	1.000	1.000	1.000
Malayan Banking Berhad	1.000	1.000	1.000
RHB Bank Berhad	0.829	0.834	0.993
MEAN	**0.937**	**0.976**	**0.961**

Based on the table 4.10 above, on average, OTE is 93.7%, PTE is 97.6% and SE is 96.1%. There are 4 conventional banks are efficient in 2008 which are Alliance Bank Malaysia Berhad, Citibank Berhad, Hong Leong Bank Berhad and Malayan Banking Berhad. Affin Bank Berhad indicates the lowest score of efficiency. As we can see that Affin Bank Berhad is wasted 25.5% of inputs in OTE and SE.

4.5.3 Efficiency of conventional banks in 2009

There are 8 of conventional banks were measured in the year 2009. Their value of OTE, PTE and SE as mention in the table 4.11 below.

Table 4. 11: *Efficiency of conventional banks in 2009*

BANKS	OTE	PTE	SE
Affin Bank Berhad	1.000	1.000	1.000
Alliance Bank Malaysia Berhad	1.000	1.000	1.000
CIMB Bank Berhad	0.289	1.000	0.289
Citibank Berhad	1.000	1.000	1.000
HSBC Bank Malaysia Berhad	1.000	1.000	1.000
Hong Leong Bank Berhad	0.590	0.616	0.957
Malayan Banking Berhad	0.410	1.000	0.410
RHB Bank Berhad	0.369	0.470	0.784
MEAN	**0.707**	**0.886**	**0.805**

The table 4.11 above shows that the mean is 70.7% in OTE, 88.6% in PTE and 80.5% in SE. From this result, we can see that the scale inefficiency is contributing to the overall technical inefficiency. There are 4 conventional banks are efficient in 2009 which are Affin Bank Berhad, Alliance Bank Malaysia Berhad, Citibank Berhad and HSBC Bank Malaysia Berhad. The least efficient is CIMB Bank Berhad which is wasted 71.1% of their inputs.

4.5.4 Efficiency of conventional banks in 2010

In 2010, 8 of conventional banks were evaluated and the result as stated in the table 4.12 below.

Table 4. 12: *Efficiency of conventional banks in 2010*

BANKS	OTE	PTE	SE
Affin Bank Berhad	1.000	1.000	1.000
Alliance Bank Malaysia Berhad	1.000	1.000	1.000
CIMB Bank Berhad	1.000	1.000	1.000
Citibank Berhad	0.632	0.895	0.706
HSBC Bank Malaysia Berhad	0.633	0.813	0.778
Hong Leong Bank Berhad	0.880	0.904	0.973
Malayan Banking Berhad	1.000	1.000	1.000
RHB Bank Berhad	0.473	1.000	0.473
MEAN	**0.827**	**0.952**	**0.866**

As stated in the table 4.12 above, on average, 82.7% in OTE, 95.2% in PTE and 86.6% in SE. It means 17.3% of inputs in OTE, 4.8% of inputs in PTE and 13.4% of inputs in SE have been wasted. The result shows that the source of inefficiency of Malaysian conventional banks in 2010 have been scale, suggesting that Malaysian conventional banks have been operating on the wrong scale of operations. Affin Bank Berhad, Alliance Bank Malaysia Berhad, CIMB Bank Berhad and Malayan Banking Berhad are efficient. The least efficient is RHB Bank Berhad. The scale inefficiency of RHB Bank Berhad contributed to the overall technical inefficiency of the bank.

4.5.5 Efficiency of conventional banks in 2011

By using Data Envelopment Analysis, the efficiency of conventional banks in 2011 were measured. The result of the analysis as shown in table 4.13 below.

Table 4. 13: *Efficiency of conventional banks in 2011*

BANKS	**OTE**	**PTE**	**SE**
Affin Bank Berhad	1.000	1.000	1.000
Alliance Bank Malaysia Berhad	1.000	1.000	1.000
Bank of Tokyo-Mitsubishi UFJ (Malaysia) Bhd	1.000	1.000	1.000
CIMB Bank Berhad	0.797	1.000	0.797
Citibank Berhad	0.539	0.850	0.634
HSBC Bank Malaysia Berhad	0.568	0.652	0.870
Hong Leong Bank Berhad	0.558	0.639	0.872
Malayan Banking Berhad	0.768	0.949	0.809
RHB Bank Berhad	0.717	0.942	0.762
MEAN	**0.772**	**0.893**	**0.860**

The efficiency level for the year 2011 as presented in table 4.13. On average, the OTE was 77.2%, PTE was 89.3% and the SE was 86%. In 2011, the overall technical inefficiency is due to the scale inefficiency. There are 3 conventional banks such as Affin Bank Berhad, Alliance Bank Malaysia Berhad, Bank of Tokyo-Mitsubishi UFJ (Malaysia) Berhad is efficient. Apart from that, Citibank Berhad scores the lowest efficiency. It wasted 46.1% of inputs in OTE, 15% of inputs in PTE and 36.6% of inputs in SE.

4.5.6 Efficiency of conventional banks in 2012

There are 9 of conventional banks were evaluated in 2012. The value of the efficiency of conventional banks will be explained below according to OTE, PTE and SE of each bank respectively.

Table 4. 14: *Efficiency of conventional banks in 2012*

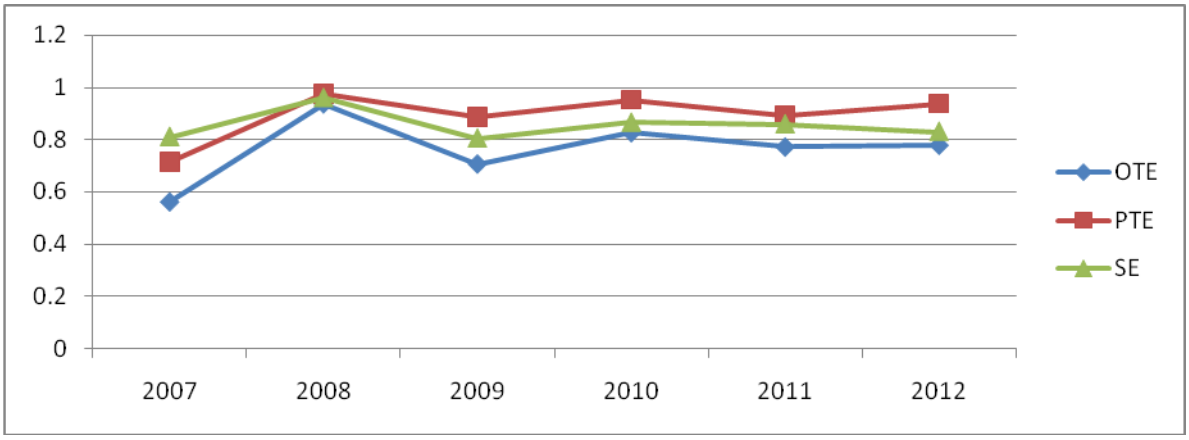
BANKS	OTE	PTE	SE
Affin Bank Berhad	1.000	1.000	1.000
Alliance Bank Malaysia Berhad	1.000	1.000	1.000
Bank of Tokyo-Mitsubishi UFJ (Malaysia) Bhd	1.000	1.000	1.000
CIMB Bank Berhad	1.000	1.000	1.000
Citibank Berhad	0.338	1.000	0.338
HSBC Bank Malaysia Berhad	0.787	0.976	0.807
Hong Leong Bank Berhad	0.866	1.000	0.866
Malayan Banking Berhad	0.520	0.569	0.914
RHB Bank Berhad	0.499	0.898	0.555
MEAN	**0.779**	**0.938**	**0.831**

Regarding the table 4.14 above, on average, OTE is 77.9%, PTE is 93.8% and SE is 83.1%. Thus, the overall technical inefficiency is due to the scale inefficiency. There are 4 banks are efficient, which are Affin Bank Berhad, Alliance Bank Malaysia Berhad, Bank of Tokyo-Mitsubishi UFJ (Malaysia) Berhad and CIMB Bank Berhad. The least efficient is Citibank Berhad which is wasted of 66.2% of inputs in OTE and SE. From this result, it indicates that Citibank Berhad have been operating on the wrong scale of operations in 2012.

4.6 Efficiency of Conventional banks from 2007-2012

After we go through the efficiency of conventional banks, according to the year, respectively, we want to see the overall of efficiency estimation for each conventional bank from 2007 to 2012. Through DEA method, we can distinguish three different types of efficiency measures, namely OTE), PTE), and SE as shown in the line chart below.

Figure 4. 2: *DEA Result Movement 2007 to 2012 for Conventional Banks*



From the figure 4.2 above, in terms of OTE, it reaches in peak in 2008 but declined in 2009. The highest level of OTE is in 2008 and the lowest level of OTE is in 2007. In terms of PTE, it increased in 2008 and declined in 2009.the highest level of PTE is in 2008 and the lowest level of PTE is in 2007. It same goes to the SE, it increased on 2008 and declining again in 2009. All three types of efficiency measures in conventional banking show the increasing of efficiency level in 2008 but declined in 2009.

As we realized, there is a global financial crisis in 2008 which is involved within the study period. The figure 4.2 indicates that the efficiency scores in OTE increased 37.5% from 0.562 in 2007 to 0.937 in 2008. Besides, in PTE, the efficiency scores increased 26.3% from 0.713 in 2007 to 0.976 in 2008. In terms of SE, it increased 15% from 0.811 in 2007 to 0.961 in 2008.

Meanwhile, the OTE was decreased 23%, which is from 0.937 in 2008 to 0.707 in 2009. PTE also declined 9%, which is from 0.976 in 2008 to 0.886 in 2009. The SE was dropped 15.6%, which is 0.961 in 2008 to 0.805 in 2009. From this result, we can see that conventional banks are affected during the financial crisis. The possibility related to this case subsequently due to the lack of confidence level among customer towards conventional banking system within the period of global financial crisis leads to the negative result of the conventional bank's efficiency.

4.7 Return to Scale for Islamic banks

In this section, we can see the Constant Return to Scale (CRS), Increasing Return to Scale (IRS) or Decreasing Return to Scale (DRS) of the Islamic banks. CRS means the increasing in the input results in a proportionate increase in outputs. In addition, IRS means an increase in inputs result in a higher increase in outputs, whereas DRS indicates the increase in inputs result in a lesser output increase.

Table 4.15 below summarizes the details of each year score for Islamic banks either CRS, IRS or DRS.

Table 4. 15: *Returns to Scale for Islamic banks*

YEAR	CRS	%	IRS	%	DRS	%	TOTAL
2007	4	50	2	25	2	25	8
2008	5	41.67	3	25	4	33.33	12
2009	5	45.45	5	45.45	1	9.09	11
2010	7	58.33	3	25	2	16.67	12
2011	5	38.46	3	23.08	5	38.46	13
2012	4	44.44	4	44.44	1	11.11	9
OVERALL	**30**	**46.15**	**20**	**30.77**	**15**	**23.08**	**65**

Notes: CRS – (Constant Returns to Scale); DRS – (Decreasing Returns to Scale); IRS – (Increasing Returns to Scale)

From data reported in table 4.15 above, in terms of CRS, there are 50% of Islamic banks in 2007, 41.67% of Islamic banks in 2008, 45.45% of Islamic banks in 2009, 58.33% of Islamic banks in 2010, 38.46% in 2011 and 44.44% in 2012 are appearing on the efficiency frontier. Based on this result, in 2010 shows the highest percentage of Islamic banks that appear on the frontier. In overall, 46.15% of the Islamic banks are CRS, which is appearing on the efficiency frontier, 30.77% of the Islamic banks are IRS and 23.08% of the Islamic banks are DRS. Thus, it means the majority of the Islamic banks during the study period were operating at CRS.

4.8 Return to scale for conventional banks

In this section, we can see the CRS, IRS or DRS of the conventional banks from 2007 to 2012. Table 4.16 below summarizes the details of each year score for conventional banks either CRS, IRS or DRS.

Table 4. 16: *Returns to Scale for conventional banks*

YEAR	CRS	%	IRS	%	DRS	%	TOTAL
2007	3	42.86	4	57.14	0	0	7
2008	4	57.14	3	42.86	0	0	7
2009	4	50	1	12.5	3	37.5	8
2010	4	50	3	37.5	1	12.5	8
2011	3	33.33	3	33.33	3	33.33	9
2012	4	44.44	4	44.44	1	11.11	9
OVERALL	**22**	**45.83**	**18**	**37.5**	**8**	**16.67**	**48**

From the table 4.16 above, in terms of CRS, there are 42.86% of Islamic banks in 2007, 57.14% of Islamic banks in 2008, 50% of Islamic banks in 2009, 50% of Islamic banks in 2010, 33.33% in 2011 and 44.44% in 2012 are appearing on the efficiency frontier. Based on this result, in 2008 shows the highest percentage of conventional banks that appear on the frontier. In overall, there are 45.83% of the conventional banks are CRS, which is appearing on the efficiency frontier, 37.5% of the conventional banks are IRS and 16.67% of the conventional banks are DRS. Hence, it indicates that the majority of the conventional banks was operating at CRS.

4.9 Return to scale for Islamic and conventional banks

While the result in Table 4.15 and Table 4.16 above shows the percentage of Islamic and conventional banks that appear on the efficiency frontier respectively, we next turn to discuss about the Return to Scale for both Islamic and conventional banks in Malaysia during the study period. The Table 4.17 below summarizes the observation of the details of each year score either CRS, IRS or DRS by Islamic and conventional banks availability from 2007 to 2012.

Table 4. 17: *Returns to Scale for Islamic and conventional banks*

Bank	Types	2007	2008	2009	2010	2011	2012	Count
Affin Islamic Bank Berhad	Islamic	CRS	DRS	CRS	CRS	IRS	-	**3**
Alliance Islamic Bank Berhad	Islamic	-	CRS	CRS	CRS	CRS	CRS	**5**
Al-Rajhi Banking & Investment Corporation (M) Berhad	Islamic	-	-	-	DRS	DRS	-	**0**
Am Islamic Bank Berhad	Islamic	CRS	CRS	CRS	CRS	CRS	CRS	**6**
Asian Finance Bank Berhad	Islamic	IRS	IRS	-	IRS	IRS	-	**0**
Bank Islam Malaysia Berhad	Islamic	DRS	DRS	DRS	CRS	DRS	-	**1**
Bank Muamalat Malaysia Berhad	Islamic	DRS	DRS	-	DRS	DRS	CRS	**1**
CIMB Islamic Bank Berhad	Islamic	-	-	IRS	-	-	-	**0**
Hong Leong Islamic Bank Berhad	Islamic	CRS	IRS	CRS	CRS	IRS	IRS	**3**
HSBC Amanah Malaysia Berhad	Islamic	-	CRS	CRS	CRS	CRS	IRS	**4**
Kuwait Finance House (Malaysia) Berhad	Islamic	IRS	CRS	IRS	IRS	CRS	IRS	**2**
OCBC Al-Amin Bank Berhad	Islamic	-	CRS	IRS	-	CRS	CRS	**3**

Public Islamic Bank Berhad	Islamic	-	DRS	IRS	CRS	DRS	IRS	**1**
RHB Islamic Bank Berhad	Islamic	CRS	IRS	IRS	IRS	DRS	DRS	**1**
Affin Bank Berhad	Conventional	CRS	IRS	CRS	CRS	CRS	CRS	**5**
Alliance Bank Malaysia Berhad	Conventional	IRS	CRS	CRS	CRS	CRS	CRS	**5**
Bank of Tokyo-Mitsubishi UFJ (M) Berhad	Conventional	-	-	-	-	CRS	CRS	**2**
CIMB Bank Berhad	Conventional	-	-	DRS	CRS	DRS	CRS	**2**
Citibank Berhad	Conventional	IRS	CRS	CRS	IRS	IRS	IRS	**2**
HSBC Bank Malaysia Berhad	Conventional	IRS	IRS	CRS	IRS	DRS	IRS	**1**
Hong Leong Bank Berhad	Conventional	CRS	CRS	IRS	IRS	IRS	DRS	**2**
Malayan Banking Berhad	Conventional	CRS	CRS	DRS	CRS	DRS	IRS	**3**
RHB Bank Berhad	Conventional	IRS	IRS	DRS	DRS	IRS	IRS	**0**
Number of banks		**7**	**9**	**9**	**11**	**8**	**8**	**52**

As we can see in the table 4.17 above, during the period of study, Am Islamic Bank Berhad seems to have dominated the efficiency frontier for DEA. It is clear when Am Islamic Bank Berhad have appeared the most times on the efficiency frontier from 2007 to 2012. Then, it followed by Alliance Islamic Bank Berhad was appeared 5 times during the period of study. Meanwhile, HSBC Amanah Malaysia Berhad appeared 4 times on the efficiency frontier. Affin Islamic Bank Berhad, Hong Leong Islamic Bank Berhad and OCBC Al-Amin Bank Berhad were 3 times appeared on the efficiency frontier during the study period. Last but not least, from 2007 to 2012, Kuwait Finance House (Malaysia) Berhad was 2 times appeared on the efficiency frontier whereas Public Islamic Bank Berhad and RHB Islamic Bank Berhad were at least once on the frontier.

In terms of conventional banks, Affin Bank Berhad and Alliance Bank are 5 times appeared on the efficiency frontier from 2007 to 2012. Then, it followed by Malayan Banking Berhad was 3 times appeared on the efficiency frontier within the time period of study. Bank of Tokyo-Mitsubishi UFJ (M) Berhad, CIMB Bank Berhad, Citibank Berhad and Hong Leong Bank Berhad were 2 times appeared on the efficiency frontier. Meanwhile, the HSBC Bank Malaysia Berhad was appeared once during the period of study.

4.10 Independent Sample T-tests

From the results derived from the DEA method, the issue of interest now is whether the difference in the Islamic and conventional banks' efficiency during a financial crisis is statistically significant. Hence, we utilized Mann-Whitney [Wilcoxon Rank Sum] which is suggested by Coakes and Steed (2003), when they stated that it is a relevant test for two independent samples coming from populations having the same distribution. The relevant reason is that the data violate the stringent assumptions of the independent group's t-test. Thus, we perform the non-parametric Mann-Whitney [Wilcoxon] test along with a series of other parametric (t-test) to obtain the results.

The findings reported in Table 4.18 below. The result seems to suggest that Islamic banks are relatively more technically efficient compared to conventional bank counterparts.

Table 4. 18: *Summary of Parametric and Non-Parametric Test*

Test Groups				
	Parametric Test		**Non-Parametric Test**	
Individual tests	T-test		Mann-Whitney [Wilcoxon Rank-Sum] test	
Test Statistics	t(Prb> t)		z(Prb> z)	
	Mean	t	Mean Rank	z
Technical Efficiency (TE)				
Islamic banks	0.4391	6.866***	72.04	-5.680***
Conventional banks	0.1262		36.64	
Pure Technical Efficiency (PTE)				
Islamic banks	0.6157	9.670***	76.59	-7.410***
Conventional banks	0.1762		30.47	
Scale Efficiency (SE)				
Islamic banks	0.6426	-2.754***	52.41	-1.734***
Conventional banks	0.7716		63.22	

Note: ***indicates significant at the 1 % level

Table 4.18 above indicates that the results from the parametric t-test and non-parametric Mann-Whitney [Wilcoxon] test recommends that the Malaysian Islamic banks have exhibited a higher mean technical efficiency level compared to Malaysian conventional banks (0.4391 > 0.1262). Likewise, the Malaysian Islamic banks have also exhibited a higher mean pure technical efficiency level than Malaysian conventional banks (0.6157 > 0.1762). The results from the parametric t-test are further confirmed by the non-parametric Mann-Whitney [Wilcoxon] test. On the other hand, the parametric t-test and non-parametric Mann-Whitney [Wilcoxon] results show that the Malaysian Islamic banks have exhibited a lower scale efficiency level compared to the Malaysian conventional banks (0.6426 < 0.7716).

Based on the results, we can see that Malaysian Islamic banks are efficient, particularly technical efficiency and the same goes to the management when the pure technical efficiency is higher than Malaysian conventional banks during the study period. Besides, we can see that Malaysian conventional banks are efficient in terms of scale efficiency. Perhaps the main factor that leads the conventional banks are efficient in scale efficiency because it already established for the hundred years rather than Islamic banks which still in the infancy stage.

4.11 Conclusion

This chapter provides the analysis in order to examine the efficiency of Islamic and conventional banks during the financial crisis over the period of 2007 to 2012. We found that Islamic banks have presented higher technical efficiency compared to their conventional banks which attributed to higher scale efficiency. In addition, we can see that Islamic banks are higher in technical efficiency and pure technical efficiency during the study period compared to conventional banks during the financial crisis. The results are validated by a parametric and non-parametric test. This result is in line with a number of previous studies as Chapra (2008) and Rosman, Wahab, & Zainol (2013).

CHAPTER FIVE

CONCLUSION

5.0 Introduction

The objective of this study is to analyze the efficiency of Islamic and conventional banks during the financial crisis and to examine the source of overall technical efficiency of Islamic and conventional banks during the financial crisis.

In order to examine the efficiency of Islamic and conventional banks, Data Envelopment Analysis (DEA) was utilized 16 Islamic banks and 10 conventional banks involved in this study.

5.1 Summary of findings

Based on the empirical finding of this study, Islamic banks score around 0.614 to 0.854 of OTE during the study period. In terms of PTE, Islamic banks score around 0.805 to 0.955 while for the SE, Islamic banks score around 0.678 to 0.893 from 2007 to 2012. In overall, we can see that pure technical efficiency contributed more to the overall technical efficiency. In other words, the scale inefficiency leads to the overall technical inefficiency. Hence, we can suggest that Malaysian Islamic banks have been operating in the wrong scale operations. This result is consistent with the RTS results of the Islamic banks whereby 53.85% of the samples were operating at non-CRS.

The resulting analysis shows that conventional banks score around 0.562 to 0.937 of OTE during the study period. In terms of PTE, conventional banks score around 0.713 to 0.976 while for the SE, Islamic banks score around 0.805 to 0.961 within the period of study. In overall, we can see that scale efficiency, dominated more to the overall technical efficiency. This result is consistent with the RTS results of the conventional banks whereby 54.17% of the samples were operating at non-CRS.

The general findings that we can provide is that in the year of 2007 to 2012, the Islamic banking has presented higher technical efficiency compared to the conventional banks attributed to the higher pure technical efficiency. The findings are validated by parametric and non-parametric tests.

The findings explain that Islamic banks were able to sustain operations through the crisis is consistent with the study conducted by Rosman, Wahab, & Zainol (2013). Nevertheless, the study also shows that most of Islamic banks were scale inefficient, which dominates the pure technical inefficiency consistent with a similar DEA study by Sufian (2007).

5.2 Policy implications

From the analysis, we know that Islamic banks are more efficient during the financial crisis. However, in terms of scale efficiency, Islamic banks still not good enough compared to conventional banks. Perhaps because of the conventional banking system

has been around longer in Malaysia and is more established compared to Islamic banking.

This study could be an initial effort to analyze the efficiency of Islamic and conventional banks during financial crisis. In addition, more significantly, is the use of DEA to examine the efficiency of the banking industry in Malaysia in which the Islamic banks are comparatively analyzed with the conventional banks. The result of this study have significant contributions to several interested parties, such as in informing the policy makers such as Bank Negara Malaysia (BNM) in Malaysia as well as related ministries on the relative efficiency of Islamic and conventional banks during the financial crisis and whether the source of growth in overall technical efficiency is due to the pure technical efficiency or scale efficiency.

Such information also gives significant benefits to the management of both Islamic and conventional banks in facilitating them to develop strategies in terms of operations and management as well as scale in order to improve the efficiency of both Islamic and conventional banks in using their inputs to generate more outputs, therefore, improving their competitive edge and strengthening their positions in the industry further.

5.3 Limitation of the study

This study was carried out with the main objective to analyze the efficiency of Islamic and conventional banks during the financial crisis. Therefore, it only covers the period of

2007 to 2012 and only involve 13 Islamic banks and 10 conventional banks that operate in Malaysia because the limitation of data. Perhaps in the future, we can extend our study with the longer period to view the impact of financial crisis to the efficiency of both Islamic and conventional banks, for instance from 1997 (Asian Financial Crisis) to the current year and also we can use other samples to analyze the efficiency of the samples.

Moreover, the scope of study could be further extended using the other inputs and outputs. Besides, it is recommended for further analysis by utilizing the other approach such as Stochastic Frontier Analysis or extended to the second stage such as Multivariate Regression Analysis, Tobit or Ordinary Least Squares (OLS). Last but not least, future research about the efficiency of the banking industry, particularly in Islamic banking could also consider the operating and value added function instead of using intermediation function.

Notwithstanding these limitations, the findings of this study are projected to contribute significantly to the existing knowledge on the operating performance of the banking industry in Asian countries. Nevertheless, the study also provide the way to generate the idea of the bank management as well as policy makers in order to improve the managerial side, gaining an optimal utilization of resources and most productive scale of operation of the banks in the industry. It is the best way to show the directions for sustainable competitiveness of future Islamic banking operations.

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APPENDIX A

DATA ENVELOPMENT ANALYSIS TEST

APPENDIX A: DATA ENVELOPMENT ANALYSIS TEST

a) Efficiency of Islamic banks in 2007

```
Instruction file = 2007-ins.txt
Data file        = 2007-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  0.112  0.691  0.162 irs
    4  0.371  1.000  0.371 drs
    5  0.371  0.890  0.417 drs
    6  1.000  1.000  1.000  -
    7  0.475  1.000  0.475 irs
    8  1.000  1.000  1.000  -

 mean  0.666  0.948  0.678

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

b) Efficiency of Islamic banks in 2008

```
Instruction file = 08-ins.txt
Data file        = 08-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  0.560  1.000  0.560 drs
    2  1.000  1.000  1.000  -
    3  1.000  1.000  1.000  -
    4  0.124  0.305  0.405 irs
    5  0.275  1.000  0.275 drs
    6  0.354  1.000  0.354 drs
    7  0.450  0.500  0.901 irs
    8  1.000  1.000  1.000  -
    9  1.000  1.000  1.000  -
   10  1.000  1.000  1.000  -
   11  0.444  0.450  0.988 drs
   12  0.165  0.400  0.413 irs

 mean  0.614  0.805  0.741

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

c) Efficiency of Islamic banks in 2009

```
Instruction file = 09-ins.txt
Data file        = 09-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  1.000  1.000  1.000  -
    4  0.430  1.000  0.430 drs
    5  0.446  0.611  0.729 irs
    6  1.000  1.000  1.000  -
    7  1.000  1.000  1.000  -
    8  0.125  1.000  0.125 irs
    9  0.461  1.000  0.461 irs
   10  0.540  0.939  0.575 irs
   11  0.451  0.955  0.472 irs

 mean  0.678  0.955  0.708

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

d) Efficiency of Islamic banks in 2010

```
Instruction file = 10-ins.txt
Data file        = 10-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  0.755  0.969  0.779 drs
    4  1.000  1.000  1.000  -
    5  0.600  0.738  0.814 irs
    6  1.000  1.000  1.000  -
    7  0.549  0.736  0.746 drs
    8  1.000  1.000  1.000  -
    9  1.000  1.000  1.000  -
   10  0.619  0.938  0.660 irs
   11  1.000  1.000  1.000  -
   12  0.720  1.000  0.720 irs

 mean  0.854  0.948  0.893

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

e) Efficiency of Islamic banks in 2011

```
Instruction file = 11-ins.txt
Data file        = 11-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  0.781  1.000  0.781 irs
    2  1.000  1.000  1.000  -
    3  0.785  0.885  0.887 drs
    4  1.000  1.000  1.000  -
    5  0.628  0.885  0.710 irs
    6  0.907  1.000  0.907 drs
    7  0.647  0.736  0.880 drs
    8  0.707  0.768  0.921 irs
    9  1.000  1.000  1.000  -
   10  1.000  1.000  1.000  -
   11  1.000  1.000  1.000  -
   12  0.614  0.872  0.703 drs
   13  0.748  0.941  0.794 drs

 mean  0.832  0.930  0.891

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

f) Efficiency of Islamic banks in 2012

```
Instruction file = 12-ins.txt
Data file        = 12-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  1.000  1.000  1.000  -
    4  0.599  1.000  0.599 irs
    5  0.815  0.871  0.936 irs
    6  0.400  0.800  0.500 irs
    7  1.000  1.000  1.000  -
    8  0.111  0.275  0.405 irs
    9  0.655  1.000  0.655 drs

 mean  0.731  0.883  0.788

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

g) Efficiency of conventional banks in 2007

```
Instruction file = 07-ins.txt
Data file        = 07-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  0.311  1.000  0.311 irs
    3  0.651  0.747  0.871 irs
    4  0.390  0.594  0.656 irs
    5  1.000  1.000  1.000  -
    6  0.229  0.229  1.000  -
    7  0.356  0.423  0.840 irs

 mean  0.562  0.713  0.811

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

h) Efficiency of conventional banks in 2008

```
Instruction file = 08-ins.txt
Data file        = 08-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  0.745  1.000  0.745 irs
    2  1.000  1.000  1.000  -
    3  1.000  1.000  1.000  -
    4  0.987  1.000  0.987 irs
    5  1.000  1.000  1.000  -
    6  1.000  1.000  1.000  -
    7  0.829  0.834  0.993 irs

 mean  0.937  0.976  0.961

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

i) Efficiency of conventional banks in 2009

```
Instruction file = 09-ins.txt
Data file        = 09-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  0.289  1.000  0.289 drs
    4  1.000  1.000  1.000  -
    5  1.000  1.000  1.000  -
    6  0.590  0.616  0.957 irs
    7  0.410  1.000  0.410 drs
    8  0.369  0.470  0.784 drs

 mean  0.707  0.886  0.805

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

j) Efficiency of conventional banks in 2010

```
Instruction file = 10-ins.txt
Data file        = 10-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  1.000  1.000  1.000  -
    4  0.632  0.895  0.706 irs
    5  0.633  0.813  0.778 irs
    6  0.880  0.904  0.973 irs
    7  1.000  1.000  1.000  -
    8  0.473  1.000  0.473 drs

 mean  0.827  0.952  0.866

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

k) Efficiency of conventional banks in 2011

```
Instruction file = 11-ins.txt
Data file        = 11-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  1.000  1.000  1.000  -
    4  0.797  1.000  0.797 drs
    5  0.539  0.850  0.634 irs
    6  0.568  0.652  0.870 drs
    7  0.558  0.639  0.872 irs
    8  0.768  0.949  0.809 drs
    9  0.717  0.942  0.762 irs

 mean  0.772  0.893  0.860

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

l) Efficiency of conventional banks in 2012

```
Instruction file = 12-ins.txt
Data file        = 12-dta.txt

 Input orientated DEA

 Scale assumption: VRS

 Slacks calculated using multi-stage method


 EFFICIENCY SUMMARY:

  firm  crste  vrste  scale

    1  1.000  1.000  1.000  -
    2  1.000  1.000  1.000  -
    3  1.000  1.000  1.000  -
    4  1.000  1.000  1.000  -
    5  0.338  1.000  0.338 irs
    6  0.787  0.976  0.807 irs
    7  0.866  1.000  0.866 drs
    8  0.520  0.569  0.914 irs
    9  0.499  0.898  0.555 irs

 mean  0.779  0.938  0.831

Note: crste = technical efficiency from CRS DEA
      vrste = technical efficiency from VRS DEA
      scale = scale efficiency = crste/vrste
```

APPENDIX B

T-TEST

APPENDIX B : T-TEST

a) Overall technical efficiency

i. Parametric Test

Group Statistics

	TYPES	N	Mean	Std. Deviation	Std. Error Mean
OTE	1	65	.4391	.33802	.04193
	0	48	.1262	.12381	.01787

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
OTE	Equal variances assumed	55.326	.000	6.112	111	.000	.31291	.05120	.21146	.41436
	Equal variances not assumed			6.866	85.523	.000	.31291	.04558	.22230	.40352

ii. Non-Parametric Test

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
OTE	113	.3062	.30962	.01	1.00
TYPES	113	.5752	.49651	.00	1.00

iii. Mann-Whitney Test

Ranks

	TYPES	N	Mean Rank	Sum of Ranks
OTE	0	48	36.64	1758.50
	1	65	72.04	4682.50
	Total	113		

Test Statistics[a]

	OTE
Mann-Whitney U	582.500
Wilcoxon W	1758.500
Z	-5.680
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: TYPES

b) Pure technical efficiency

i. Parametric Test

Group Statistics

	TYPES	N	Mean	Std. Deviation	Std. Error Mean
PTE	1	65	.6157	.29646	.03677
	0	48	.1762	.18507	.02671

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PTE	Equal variances assumed	24.541	.000	9.046	111	.000	.43951	.04859	.34323	.53578
	Equal variances not assumed			9.670	108.302	.000	.43951	.04545	.34942	.52959

ii. Non-Parametric Test

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
PTE	113	.4290	.33498	.05	1.00
TYPES	113	.5752	.49651	.00	1.00

iii. Mann-Whitney Test

Ranks

	TYPES	N	Mean Rank	Sum of Ranks
PTE	0	48	30.47	1462.50
	1	65	76.59	4978.50
	Total	113		

Test Statistics[a]

	PTE
Mann-Whitney U	286.500
Wilcoxon W	1462.500
Z	-7.410
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: TYPES

c) Scale efficiency

i. Parametric Test

Group Statistics

	TYPES	N	Mean	Std. Deviation	Std. Error Mean
SE	1	65	.6426	.29660	.03679
	0	48	.7716	.20115	.02903

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SE	Equal variances assumed	18.725	.000	-2.603	111	.010	-.12906	.04957	-.22729	-.03083
	Equal variances not assumed			-2.754	110.290	.007	-.12906	.04687	-.22193	-.03619

ii. Non-parametric Test

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
SE	113	.6974	.26712	.09	1.00
TYPES	113	.5752	.49651	.00	1.00

iii. Mann-Whitney Test

iv. **Ranks**

	TYPES	N	Mean Rank	Sum of Ranks
SE	0	48	63.22	3034.50
	1	65	52.41	3406.50
	Total	113		

Test Statistics[a]

	SE
Mann-Whitney U	1261.500
Wilcoxon W	3406.500
Z	-1.734
Asymp. Sig. (2-tailed)	.083

a. Grouping Variable: TYPES