A Comparative study of Technical Efficiency in GCC Islamic Financial Institutions during the Global financial Crisis using Malmquist-Type Data Envelopment analysis

دراسة مقارنة للكفاءة الفنية للمؤسسات المالية الإسلامية في دول الخليج العربية خلال الأزمة المالية العالمية باستخدام تحليل البيانات التطويقي ومعيار مالمكوست

By

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This dissertation would not have been possible without the help of God the Most Merciful, the Most Compassionate and the blessing of my parents…

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ملخص البحث

اكتسبت المصرفية الإسلامية المزيد من الأهمية وخاصة بعد الأزمة المصرفية العالمية الأخيرة. هذه الأهمية لأن المؤسسات المالية الإسلامية يعتقد أنها لم تكن تأثرت بالانهيار المالي خلال عامي2007-2008.

و قد كان الهدف الرئيسي من هذا البحث هو دراسة تأثير الأزمة المالية في 2007-2008 على كفاءة المؤسسات المالية الإسلامية في دول مجلس التعاون الخليجي. وعلاوة على ذلك، تتناول هذه الدراسة الفرق بين كفاءة المؤسسات المالية الإسلامية في دول مجلس التعاون الخليجي وغيرها من دول العالم، وما إذا كانت كفاءة هذه المؤسسات المالية الإسلامية قد تحسنت أم لا خلال فترة ما بعد الأزمة المالية. والهدف الأخير من هذه الدراسة هو دراسة العلاقة بين حجم المؤسسات المالية الإسلامية (من حيث مجموع الأصول مجموع وعامل تغيير الإنتاجية. و لتلبية هذا الاهداف السابق ذكرها تم تطبيق أسلوب تحليل البيانات التطويقي (DEA) ومؤشر الإنتاجية الإجمالية (Malmquist) على عدد 22 مؤسسة ماليه إسلامية خليجية و 19من المؤسسات الاسلامية غير الخليجية.

وقد خلصت نتائج الدراسة إلى أن المؤسسات المالية الإسلامية بشكل عام لم تتأثر بشكل كبير من جراء الأزمة المالية العالمية. وأظهرت النتائج الفردية أن بعض المؤسسات المالية قد واجهة زيادة أو نقصان في الكفاءة بعد الأزمة. وبالإضافة إلى ذلك، تشير نتائج مؤشر Malmquist أن كلا من المؤسسات المالية الإسلامية الخليجية وغير الخليجية شهدت تقدما في الكفاءة خلال فترة الدراسة. وكان المصدر الرئيسي للكفاءة هو التغير في الكفاءة الفنية وكفاءة التغيير الصافية، بينما كان مقياس الكفاءة (Scale) هو أقل مصدر من مصادر الكفاءة. والنتيجة تشير أيضا إلى أن العلاقة بين الكفاءة وحجم المؤسسة المالية هي علاقة طردية ضعيفة.

واقترحت الدراسة بعض السياسات وآثارها على القرارات الإدارية. كما ألقت الدراسة الضوء على أهمية إدخال الكفاءة الفنية كبديل للمؤشرات الأداء البسيطة الأخرى. أيضا، يقترح هذا البحث أن يعطي المشرع المزيد من الاهتمام لكفاءة المؤسسات المالية عند فرض أي سياسات أو أنظمة جديدة.

الكلمات المفتاحية: تحليل البيانات التطويقي، الكفاءة الفنية، المؤسسات المالية الاسلامية، مجلس التعاون الخليجي

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Abstract

Islamic banking is gaining more importance, especially after the latest global banking crisis. This importance is because Islamic financial Institutions (IFIs) are believed to have not been affected by the year 2007-2008 financial meltdown.

The major aim of this study was to investigate the effect of the 2007-2008 financial crisis on GCC IFIs efficiency. Moreover, this study examined the difference between GCC and non-GCC IFIs efficiency and whether or not IFIs efficiency was improving during the post and pre financial crisis period. The last aim of this study is to examine the relation between IFI size (by total Asset) and Annual Total Factor Productivity Change .To satisfy the previously mentioned aims both Data envelopment analysis (DEA) and Malmquist total productivity Index was applied on a balanced panel of 22 GCC and 19 non-GCC IFIs.

The results suggest that generally GCC and non-GCC IFIs efficiency was not significantly affected by the financial crisis. However, Individual IFIs result showed that some bank has experienced increase or decrease of efficiency after the crisis. In addition, Malmquist index result suggests that both GCC and non-GCC IFIs experienced an efficiency progress during the period tested. The main source of efficiency was technical efficiency change and pure efficiency change, while scale efficiency was the least source of efficiency. The result also suggest that efficiency and IFI size is positively but weakly related.

The study suggested some policy and managerial implications. This study highlights the significance of introducing technical efficiency as an alternative to other simple performance indicators .Also, this research suggests that regulators should give more attention to banks efficiency when imposing any new policies and regulations.

Keywords: Data envelopment analysis, Malmquist index, Technical efficiency, Islamic Financial Institutions, Gulf Cooperation council

Chapter 1: Introduction

Financial institutions are an important part of any developing economy. Gulf Cooperation council (GCC) member countries are considered one of the fastest growing economies over the last decades thank to the huge Oil reserves and production. These huge transactions were supported by a growing of a soled banking sector that is able to connect this region with the rest of the world.

Islamic banking entered GCC in an early stage since Dubai Islamic bank was introduced as the first Islamic bank in the world in 1970s. Since then, GCC Islamic banks are growing and facing all kind of obstacles and challenges such as competing with international banks that exist in this region since the pre-oil era, not to mention the difficulties of the political stability on the Arabian Gulf region.

The last decade has seen extensive changes in (GCC) Islamic banking sector. One of the most important changes is the introduction of Islamic Finance and banking initiative by H.H Sheikh Mohammad bin Rashid Al-Maktoom Ruler of Dubai. This initiative aims to make Emirate of Dubai a regional and international hub of Islamic finance. In the same way, Sultanate of Oman has recently opened doors for Islamic banks to operate in this part of GCC.

In general, the global Islamic banking sector experienced huge expansion and growth and the international awareness of Islamic banking is increasing along with an increasing number of new Islamic banking windows opened all over the world. Also, International booming of Sukuk market increased the importance of having a soled and efficient Islamic financial system to backup all kind of Islamic operation.

The global banking crisis which started after the collapse of Lehman Brothers back in 2008 affected most of the financial sectors all over the world. However, the opposing changes in the global banking system do not seem to have affected the Islamic banking sector growth. The total size of the IFIs sector reached more than 6.6 trillion UAE dirhams in the beginning of year 2013, in comparison to not more than 54 billion dirhams a decade ago. SESRIC (2012).

Islamic banking is based on the prohibition of Usury (interest) and other financial activities with uncertainty. That will include futures, forward and Mortgage contracts. On the top of that, Islamic banking system is built on the concept of risk sharing between different parties, (investors and banks). That has led many analysts to claim that Islamic financial Institutions were less effected by the financial crisis.

Many researches have been applied on Islamic banks to test for the effect of crisis on different attributes of this type of banks. Efficiency is one of the most important attribute of any successful Bank. The basic definition of efficiency is achieving the maximum output from the minimum set of

inputs; this simple concept might be more complicated when applied on financial institutions since input and output of such entities are not simple. In fact, it might differ from one financial Institution to another. The next sections will discuss technical efficiency in more details.

Technical Efficiency

Technical efficiency terminology was started with the seminal work of Farrell (1957) who introduced the two fundamental concepts which decomposed total efficiency into allocative and technical efficiency. Allocative efficiency is defined as the using optimal amounts of inputs given production technology and prices and is usually used at macro level rather than micro or industry specific level. Zamorano (2004) defined technical efficiency as obtaining more than the maximum output possible given a group of inputs, i.e. minimizing inputs to produce a certain number of outputs. Førsund & Hjalmarsson (1974) stated that "efficiency is a relative concept" that is it should be compared with a certain benchmark. For example, an Islamic bank might be technically inefficient by having huge revenue from Murabaha accounts while having a very low net return on Asset.

In the previous example an Islamic bank is considered a producer which produces financial service and products. Hence, Technical efficiency analysis such as frontier analysis is applicable on IFIs if it is treated as a production unit that is supposed to accept certain inputs in order to produce the maximum possible output. Therefore, efficient an IFI is defined as the one that makes the maximum use of sharia complaint profit and equity in order to achieve the maximum output in the form of net income and revenue. An Islamic financial Institution will be considered inefficient if it produce less output than what is expected for the level of input by using poor financial operation mix. The methodology section will discuss different methods that are used to obtain Technical efficiency. The next section discusses the effect of financial crisis on the GCC banking Sector.

The GCC Islamic banking Sector and financial crisis

GCC refers Gulf cooperation council countries which consist of six member countries which are Saudi Arabia, United Arab Emirates, Oman, Qatar, Bahrain and Kuwait. GCC was formed back in 1981 for various political and economical goals.

In recent years, Islamic banks have become an important part of GCC economy and financial system. GCC Islamic bank assets reached more than 441 billion dollars in 2012. Grewal (2012). This increase is due to advance in knowledge and technology that is achieved by GCC's Islamic banks.

The increase and growth was not only in GCC Islamic banks but also in Global Islamic banks. Global Islamic banks have grown between year 2010 and 2012 by more than 304 billion dollars. GCC share in this growth was more than 41 percent which 127 billion US dollars. Ernst and Young (2012).

This increase draws attention to significance of improving efficiency for such important sector in a critical part of the world. In addition, this increase and growth might not necessarily reflect high efficiency since the whole GCC banking sector experience growth. Moreover, risk should be put into consideration Islamic banks is known of being risky due to the concept of *Musharkah* (a risk sharing contract). For instance, the liability side of Islamic banks includes profit and loss sharing contracts which impose higher risk on Islamic banks.

GCC Islamic banks are highly challenged by competitive environment. The restrictions imposed by Sharia principle might affect its profitability and efficiency. For instance, Islamic banks require backing of assets for most of its financial transaction and it might share huge risks. The effect of such risk may worsen if any disturbance happened in asset or real-estate market.

GCC economies like any other international economy have been hit by 2007-2008 financial crisis either directly or indirectly. Consequently, GCC banks are exposed to international investments which were affected by the crisis. Moreover, GCC IFIs are expected to have a high concentration of real-estate Investments which was one of the most affected sectors in this crisis. UAE banking sector experienced an Asset bubble during the financial crisis and was therefore directly affected by the crisis. However, given all of these factors GCC banking sector seem to be sold and expected to have a potential future growth.

The present study will examine the effect of the 2007-2008 financial crisis on the efficiency of top GCC Islamic financial Institutions considering the create importance of efficiency in IFI assessment. The next section presents the motivation and objective of the study.

The purpose and Motivation of the study

One of the most important motivations of this research is the introduction of Islamic Finance and banking initiative by H.H Sheikh Mohammad bin Rashid Al Maktoom Ruler of Dubai, which aims to make Dubai and GCC the International Hub of Islamic finance. This study aims to make GCC Islamic IFIs more aware about their current efficiency levels. Also, it aims to identify the effect of the financial crisis on IFIs efficiency. It will be valuable information for such Financial Institutions to know how resilient their structure is to such events. On the top of that, this study aims to explain the reason behind efficiency change.

Moreover, this study is unique from similar studies that were applied on the effect of 2007-2008 banking crisis on bank's efficiency in different ways. Firstly, this study is one of the few studies that assess GCC Financial institutions efficiency and more rarely GCC Islamic IFIs. Also, this study will compare a GCC IFI sample with a non-GCC sample in order to examine how different GCC IFI from International IFIs. Thus, it will not implement comparative between conventional banks and Islamic banks as many other studies. To be more precise this study will compare the efficiency scores among the Islamic financial institutions. Secondly, most of the studies available included only one or two years of the post-crisis period. This study is different that it will test the maximum available post-crisis periods in order to present the full effect of the crisis and whether IFI are improving and recovering in the most recent years.

Thirdly, the methodology used in this study will include simple and advance window techniques to test for the efficiency change during the period tested. This study is one of the few studies that apply Malmquist Index on a GCC sample, which will provide more detailed analysis on the sources of efficiency increase or decreases for the sample selected. The detailed objectives of the study will be presented in the next section.

Objectives of the study

Going forward with what was discussed in the previous sections. This study aims to analyze GCC IFIs efficiency throughout the pre and post financial crisis period 2005-2011 in order to investigate the effect of the crisis on efficiency. As well, this study will use a non-parametric data analysis technique which is Data envelopment analysis (DEA) with assumption of input oriented variable return to scale (VRS).This methods will be thoroughly discussed in chapter 3. Also, this study will implement Malmquist total productivity index into the analysis of efficiency score in order to test for the change over time. The objectives and the hypothesis of this study are summarized as follows:

(Objective 1)

> To examine the Technical efficiency change of GCC and non-GCC IFIs before and after the financial crisis using Data Envelopment analysis (DEA).

This goal will be tested using the following Hypotheses:

Null Hypothesis 1: There is no statistically significant difference in the average Technical efficiency scores of IFIs between pre and post-crisis periods**.**

Alternative Hypothesis 1: There is a statistically significant difference in the average Technical efficiency scores of IFIs between pre and post-crisis periods.

Another objective that would be tested is to check whether GCC IFIs are different from non-GCC IFI for efficiency perspective the following test will be applied: **(Objective 2)**

Null Hypothesis 2: There is no statistically significant difference in the average Technical efficiency scores of IFIs between GCC and non-GCC IFIs

Alternative Hypothesis 2: There is a statistically significant difference in the average Technical efficiency between GCC and non-GCC IFIs

The second goal of the analysis is as follows: **(Objective 3)**

> To examine the efficiency change of GCC and non-GCC IFIs using DEA-type Malmquist total factor productivity index (MTFPI) for the period 2005 to 2011.

This goal will be tested using the following Hypotheses:

Null Hypothesis 3: The annual average efficiency change indicated progress (Increasing) efficiency during the period tested.

Alternative Hypothesis 3: The annual average efficiency change indicated regress (Decreasing) efficiency during the period tested.

The fourth goal of the analysis is as follows: **(Objective 4)**

> To examine the relation between IFI size (by total Asset) and Annual Total Factor Productivity Change

Null Hypothesis 4: The Average Total factor productivity growth is statistically related to IFI size

Alternative Hypothesis 4: The Average Total factor productivity growth Change is unrelated to IFI size.

Limitations of study

Although DEA as a method for evaluating firm's efficiency should be applicable on any dataset, the result will always be applicable only to this specific dataset. This means that it is not always accurate to compare DEA result from different datasets. Moreover, GCC data and Islamic bank's data is generally limited, incomplete and inaccurate in many cases. This could be due to poor reporting or because of using different accounting standards, especially Islamic accounting standards AAOIFI which uses a modified set of accounting standards. This limitation affects generalizing the finding of this study. Also, GCC equity market is known for being not efficient. Thus, for a study that depends

on accounting inputs and outputs, any equity market related indicators into the analysis should be avoided.

Structure Plan

This study will be structured as follows; chapter 1 is an introduction to the dissertation which will include a brief introduction on GCC Islamic banking Sector and financial crisis, and a brief introduction on technical efficiency. Also, it includes the purpose and Motivation of the study, Objectives of the study and Limitations of the study. Chapter 2 reviews the literature in GCC bank efficiency. Chapter 3 focus on the methodology used in the analysis, Chapter 4 includes data used, analysis and results followed by the conclusion and suggestion for future researches.

Chapter 2: Literature Review

Last decade has shown an increased awareness of the importance of improving efficiency; this was translated into an increased number of researches on this subject especially on bank efficiency and performance analysis. However, this increase in Literature was not reflected on the Islamic banking sector studies where only few studies are available. Meanwhile, the number of researches on GCC banking sector is increasing. This section will be organized as follows; firstly Studies on GCC banks using DEA will be presented then Studies on GCC bank's efficiency using Traditional methods. The next section will discuss papers on Islamic banks efficiency. Finally, Studies using DEA and window analysis will be presented followed by Conclusion, criticism section.

Studies on GCC banks using DEA:

DEA is becoming quite popular method in measuring financial institutions efficiency. Anouze (2010) made a statistical study on Technical efficiency literature and found that about 53 percent of the studies implemented DEA and the remaining implemented other parametric and non-parametric methods. These methods will be discussed in detail in the methodology section of this study.

In his study, Anouze (2010) estimated the comparative technical efficiency of GCC banking sector by selecting 60 banks as a sample and covered the period of 1998 to 2007. The first stage of analysis was done by proposing a modified DEA approach called SORM (Semi-Oriented Radial Measure) to overcome the problem of negative data. The second stage of analysis integrated classification and regression tree method with DEA which provides a better way of understanding efficiency analysis results.

The study used the intermediation approach to define the output and input variables. Three variables were used to define inputs including non-earning and fixed assets and total deposits. Also, four outputs were chosen; off-balance sheet items, investments, loans, net income. SORM result shows that GCC banks are relatively highly efficient. However, the efficiency results were volatile through the study period. In addition, Anouze found that Saudi banks are the most efficient banks in GCC followed by Emirati banks. Additionally, the study found that Islamic and non-Islamic banks are not significantly different in efficiency. Yet the study found that Islamic banks were the least to be effected by the 2007-2008 crisis. The author recommends banks managers not to focus on increasing inputs in order to increase outputs since there is no evidence that investing in inputs would increase outputs.

Similarly, Miniaoui and Tchantchane (2010) conducted a Dynamic DEA analysis on the top 50 banks from UAE, Saudi Arabia, Qatar, Oman, Kuwait and Bahrain. The cross sectional data used covered the period of 2005-2008. The study implemented both variable return to scale VRS and constant return to scale CRS in order to obtain technical efficiency scores. This study was simple in regard to the selection of inputs and outputs, three variables were selected using the intermediation assumption. The variables used are namely; Total Assets and Total Equity as inputs and Net Income as the only output. The VRS and CRS revealed that only 28 percent of the banks in the sample were considered efficient in the period tested .In fact, Rajhi banking and Investment Corporation was the most efficient and was efficient for most of the periods.

Another study that conducted cross-country bank study was the work of El Moussawi and Obeid (2010). The study tested both technical and allocative efficiency for a sample of 23 Islamic banks that are operating in the GCC. The study covered the period of 2005 to 2008. The authors used data envelopment analysis (DEA) method to measure technical efficiency. The study found that factors such as inflation affect the efficiency of GCC banks significantly. Equally important, the DEA result showed that on average allocative inefficiency increased by 29 percent and technical inefficiency increased by 14 percent with the assumption that banks are intermediate firm.

In like manner, the same authors with the addition of Salloum conducted a very similar study, but on both Islamic and Conventional Banks in GCC with the aim of evaluating the productive Efficiency of Islamic banks in this region. El Moussawi et.al (2012), conducted the study for the period of 2005 to 2010 using Data envelopment analysis. The study used the same variables of the 2010 study under intermediation assumption. The variables are; earning assets and off balance sheet items as outputs. The selection of Inputs is interesting, since the study selected fixed assets to account for physical capital, and personal expanse to account for labor. Moreover, the ratio of operating expense and Capex (capital expenditure) were used to measure the cost of fixed assets, the last input variable was deposits.

Based on the empirical results, El Moussawi et.al (2012) found that there is no statistically significant difference between Conventional and Islamic banks efficiency. Furthermore, the study found that efficiency is negatively related with factors such as liquidity, total assets and risk. However, the relation between profitability and productive efficiency was not clear.

Mohamed M. Mostafa has contributed to the literature of Islamic bank's efficiency in GCC by several papers. In his most recent work, Mostafa (2011) measured the efficiency of the top 100 Islamic banks for the year 2009. Mostafa has selected the most popular non-parametric method

which is DEA for this purpose. Regarding the selection of inputs and outputs for this model, Mostafa (2011) claims that there is no single and explicit classification of financial institutions inputs and outputs and for the purpose of simplicity he selected return on assets, net income, and return on equity as outputs based on bank intermediation approach. It should be noticed that the availability Islamic banks data affected his selection of inputs and outputs.

In the same way, Mohamed M. Mostafa conducted two studies with different samples using DEA. The first study aimed to analyze the top 50 GCC banks efficiency while the second study aimed to build a benchmark for the top 100 banks in Arab world .Both studies selected five different variables as inputs and outputs of the DEA model under the intermediation assumption. The variables were: Total equity and assets as inputs, and ROE, ROA and net profit as outputs.

Both studies implemented the exact methodology with the usage of both VRS and CRS Data envelopment analysis (DEA) types. The result for GCC banks show that the average efficiency scores for was 73 under VRS and 55 percent under CRS. While the Arab banks study result shows 50 percent for both models VRS and CRS.

Both studies confirm the assumption of Banker et al. (1984) which state that efficiency scores computed with the VRS assumption are usually more than or equal to the efficiency scores computed with CRS assumption. Additionally, It should be noted that Mostafa (2007) paper regarding Arab bank's efficiency was criticized by the work of Emrouznejad and Anouze (2009). This paper recalculated the efficiency scores of top the 100 Arab banks and found that the efficiency scored as presented by Mostafa (2007) is incorrect. The error in calculation is due to two main issues; an error in data source and an error in the methodology itself. Emrouznejad and Anouze yet suggest that Arab banks have potential efficiency improvement based on the new result arrived.

Another study that was conducted in GCC banks was the work of Alsarhan (2009). Alsarhan examined the technical efficiency of a sample of 50 GCC banks for the period 2000 to 2007 using two stages of analysis. Firstly, Alsarhan implemented a variable return to scale VRS-type DEA to account for efficiency, while the second stage of analysis the study implemented Tobit regression analysis model. The main purpose of using Tobit model is to explain the result of DEA (efficiency score) by regressing on three financial indicators which are Banks’s total Assets, ROA and bank type i.e. Islamic or conventional.

The First stage of analysis result shows that on average GCC bank's efficiency scores were increasing. However, country-wise analysis shows that the result usually varies between GCC

countries. For Instance, Qatari banks followed by Emirati banks seem to be the most efficient within GCC. these findings are similar to the conclusion of Moussawi (2008).

Moreover, the findings of Tobit analysis were interesting particularly for the part related to Islamic banks. Regression analysis showed that GCC Islamic banks seem to be more efficient than conventional banks for the period tested. Also, the result showed that the correlation between DEA efficiency scores and both banks size (Total Assets) and profitability (return on equity) is positive.

Hassan, Sanchez, and Ngene (2012) performed a study on micro financial institutions from Middle East and north Africa region (MENA). The study estimated the scale and technical efficiency for the period 2000 to 2005. Different from most of the papers reviewed which implemented intermediation approach, Hassan, Sanchez, and Ngene (2012) implemented DEA approach with both intermediation and production assumption. Inputs for the intermediation approach were labor and operating expense while for production approach inputs were cost per borrower, labor and total assets. On the other hand, outputs for the intermediation approach was gross loan portfolio and total funds, while for production approach one output was used which is borrowers per staff member.

The result of this paper is interesting since it shows a relatively low and not improving efficiency scores under both intermediation and production assumptions for MENA micro financial institutions. This could mean that this kind of financial institutions are inefficient in using there inputs and transforming them to the maximum output possible. The author suggested that this result should be used by regulators and decision makers to help microfinance institutions to improve their efficiency.

Al-Tamimi (2002) used both DEA and traditional methods to evaluate the performance of UAE banks for the period 1997 to 2001. The study found that commercial banks are not efficient using both DEA and traditional financial ratios. On the other hand, national banks seem to be more efficient. The author claimed that this is due to the government support of National banks.

A Different angle of examining GCC bank sector efficiency is to measure how similar individual GCC banks in relation to each other. Maghyereh and Awartani (2012) studied the integration of different GCC banking sector efficiency which was originally derived from DEA. The study premier goal was to examine how similar GCC banks from efficiency and performance perspective.

The study implemented statistical methods, including smoothed bootstrap to test the convergence of bank's efficiency scores for the period 2003 to 2009. The bootstrap convergence test included two sub-tests; Beta and sigma. The result of both sigma and beta bootstrap test support the hypothesis that GCC banking sector efficiency is homogeneous and integrated. The evidence from this study

suggests that GCC government movements towards harmonization and integration of bank sector have a significant effect on the homogeneity and efficiency of the regional banking sector.

Studies on GCC banks Using Traditional methods

It can be noticed from the previous section that the majority of researches that was applied on GCC banks efficiency implemented data envelopment analysis for the purpose of evaluating bank's performance. However, Traditional methods of evaluating performance are also used in Literature. Siraj and Pillai (2012) examined and compared the efficiency and performance of Islamic and conventional banks in GCC region for the period 2005 to 2010. The study used Traditional accounting ratios to compare and contrast between the two types of banks.

As per selection of ratios, the study assumes that profitability is the major indicator of bank's performance and efficiency. Several ratios were implemented to account for profitability such as net profit ratios, return on assets (ROA), and return on equity (ROE), return on share capital (ROSC) and net operating ratio. Additionally, the study tested the time window effect on these ratios by tracking the growth rate per year for each of the ratios used.

The major finding of the study was that the financial crisis affected the GCC conventional banks more than GCC Islamic banks. The impact of the financial crisis on financial ratios was minimal in Islamic banks in comparison to conventional banks for the same period.

Similarly, Al-Tamimi and Charif, (2011) examined UAE commercial banks performance for the period 1996 to 2005 using indicators such as ROA,ROE, net interest margin, loans to Deposits ratio, equity to total assets etc. The result shows that large banks (by total assets) are highly efficient and performs better. Moreover, the study found that capital adequacy is the most significant factor when assessing the performance and efficiency of banks.

Studies on Efficiency of Islamic banks

As previously mentioned Islamic Finance in general and the Islamic banking sector is growing rapidly. In fact, It is worth to discuss whether this growth is reflected by higher performance or not. Several studies compared between the efficiency and productivity of Islamic banks and other type of banks from several angles. For instance, Said (2012a) compared the change of technical efficiency of Islamic and non-Islamic banks during the period of 2007 to 2009.The study selected forty seven Islamic banks randomly and forty eight non-Islamic banks.

In order to obtain efficiency scores, Said (2012a) implemented Data envelopment analysis based on intermediation approach to select the efficiency variables for DEA analysis. The output selected were; other income, liquid Assets and Total Loans. While inputs were; Total Fixed Asset, Total Deposits and total Labor cost. Based on the analysis result, it can be inferred that there is no significant difference between small conventional banks and Islamic banks. However, the financial crisis (referring to year 2007) seems to have more impact on small non-Islamic banks.

Studies using DEA and Malmquist Index

Data envelopment analysis is a useful method for determining efficiency for a single period. Nevertheless, the study objective may require a multiple period analysis or a comparison between two or more different periods. In like manner, the study may require examining the effect of certain event on efficiency scores. It is important to realize that there are several methods that can account for the change in efficiency. One of the most important statistical methods is the method developed by Professor Sten Malmquist in 1953. This method was further developed and integrated with DEA (the methodology section will elaborate more about Malmquist index).In fact, Malmquist Index was used by several studies like Akhtar (2010), who examined Saudi Arabia bank's efficiency over the period of 2001 to 2006. The study used bank intermediation assumption for the Malmquist-DEA analysis. The main purpose was to examine the efficiency change over the period. Thus, the study employed DEA and Malmquist productivity index. The parameters for Malmquist-type DEA analysis were interest and non-interest expense as Inputs and interest and non-interest income as outputs. The findings of DEA analysis shows that average technical efficiency is about 53 percent while pure technical efficiency is less than scale technical efficiency.
In addition, Malmquist result shows increasing average efficiency scores derived from both pure efficiency and technological change .The highest MI component was from technological change, all things considered, the findings revealed the fact that Saudi banks are improving due to technological advancement rather than any other factor.

Another study which implemented DEA and Malmquist Index was the work of Saad and El-Moussawi(2008) .This study implemented DEA-type Malmquist index in order to analysis the efficiency change of Arab commercial banking sector. The main motivation of the study was to measure the effect of the changes and reforms which occurred at period 1994 to 2004. The study sample contained about 125 Arab commercial banks out of which 44 banks were GCC commercial banks.

The study used Intermediation approach, Hence the input and outputs were defined as follows, total earning assets, other earning assets and off balance sheet Items as outputs and deposits, personal expanse and fixed assets as inputs. Overall, the results suggest that most of the banks improved efficiency scores over the period tested this improvement was mainly due to technological efficiency change. However, the total factor productivity index (TFPI) showed a decline for the period tested. It's worth to mention that out of GCC banks Qatari banks were considered among the most efficient Arab banks.

Said (2012b) analyzed the change on Islamic banks efficiency for the period 2006-2009 using VRS-type Data envelopment analysis (DEA). The main objective of the research methodology was to determine certain attributes of Islamic banks during this period. Firstly, the research focused on the differences between efficiency scores of Islamic banks from different geographic areas such as the Middle East and far eastern banks. The second objective aimed to regress DEA efficiency scores against banks size measured by total asset size.

The result suggests that there is no significant difference between the efficiency scores of Middle Eastern Islamic banks from international Islamic banks except for the year 2008. In addition, Islamic banks efficiency scores had an increasing trend for the period 2006-2009.

The second stage of analysis addressed the change of efficiency scores in accordance with bank's size. The study divided the Islamic banks sample into two categories, Large and small to medium banks. The research concluded that Islamic bank size doesn't affect the efficiency scores. However, large banks showed an increasing efficiency score trend, especially during the period 2006 to 2008.

Malmquist-type DEA analysis was applied in several cases from all over the globe. For instance, Dacanay (2007) tested the effect of the 1997 Asian Financial Crisis on the Philippine banking industry. For this purpose, the author selected a sample of thirty five banks and implemented Malmquist Index to account for the change of efficiency score after the Asian crisis. The study aimed to examine how different types of banks are dissimilar in their reaction to crisis based on Malmquist multifactor productivity index and based on DEA technical efficiency scores. For this purpose, the study compared between universal and commercial banks. Also, the study compared between domestic and foreign banks. The study selected an interesting objective, which is to check the difference between the efficiency of old and newly established foreign banks.

For DEA analysis, the inputs were fixed assets and total equity while the outputs were equity investment, net loans and deposits. Given this mix of inputs and outputs, it can be inferred that the

author implemented the intermediation approach. The study thus concluded that Philippine banks efficiency have recovered after the Asian financial crisis by about five percent on average. Malmquist index analysis shows that technological change has boosted the efficiency improvement.

Using a method similar to Dacanay (2007) but with different purpose, Lina et al. (2007), investigated the managerial efficiency of Taiwan banking sector between the years 2002-2003. The inputs included interest and noninterest revenue and pretax revenue and outputs included interest and non-interest expenses. DEA result showed that six out of 37 banks achieved perfect efficiency score of one, while the Malmquist index showed that twenty out of 37 banks are improving due to managerial improvements.

Conclusion and criticism

A considerable amount of literature was reviewed in the previous section aim to examine a certain event effect of efficiency. In fact, one of the most important events tested was the 2007 – 2008 financial crisis. One question that needs to be asked, however, is whether these researches really captured the full effect of the financial crisis. For instance; Anouze (2010) claims that efficiency was higher in years after the year 2008, but it should be noted that the time interval selected in the study before the crisis and don't capture the actual effect of the financial crisis. Likewise, Said (2012b) found that Islamic banks efficiency has increased during the year 2009 which is not enough indication that Islamic banks have recovered from the financial crisis. In addition, for the result to reflect the full effect of the financial crisis a better study would examine several post-crisis periods. This conclusion is supported by the work of Dacanay (2007) who selected several periods to test for post-crisis period.

A serious weakness with any DEA analysis is a poor selection of inputs and outputs. Some of the articles reviewed showed the effect of choosing few or incorrect mix of inputs and outputs. For example, Miniaoui and Tchantchane (2010) findings are not necessary accurate when indicated that only 14 banks were efficient since only a single output was used for DEA analysis which is net profit. Net profit as a single component doesn't reflect the efficiency of utilizing inputs. Hence, for DEA result to be more accurate more than one carefully selected output must be used in the analysis.

Siraj and Pillai (2012) assumption that profitability is the major indicator of performance might not be always correct since window dressing might be an issue that affects the reported inputs and outputs. Notwithstanding the limitation of such accounting figures in assessing performance. All things considered it is believed that non parametric approach would be more appropriate for such

analysis. Another non appropriate selection of input and output was the selection of Akhtar (2010) who used interest expense and income as an input and output for a sample that covers Saudi Arabia banking sector which is known of containing many Islamic banks. IFI by nature dose neither deals with interest nor is interest the main source of income or expanses. Thus, it is believed that the selection of such variables was not the best option for such sample and might have led to misleading conclusions.

Literature reviewed covered problems and limitation that is expected to be faced by this study. Mostafa (2011) faced the problem of limited Islamic banking data availability. This problem is expected to affect this research. Thus, the most available inputs and outputs will be selected. In addition, another problem addressed in the literature was the existence of negative data. Anouze (2010) used a complicated method of dealing with negative data, although it might overcome some of the drawbacks of other methods. The current study will implement a simple method of dealing with negative number as discuses in Zhu (2009).

Implications on methodology and data selection

Based on the literature reviewed above it can be concluded that DEA is the most used, most accurate and most reliable techniques when it comes to efficiency measurement. The selection of traditional methods in this study should not be the best option. El Moussawi et.al (2012) findings are significant since it shows that despite a bank might have excellent accounting ratios in items such as profitability and liquidity might look a good signal, it might not necessarily mean that it is an efficient bank. Thus, relaying in traditional methods only is not an appropriate option.

Also, data selected should cover the maximum number of years of the post-crisis period and should carefully select inputs and inputs for the DEA analysis. In addition, implementing a sophisticated window analysis methodology is necessary since using a simple method to account for yeas change is quite naïve and weak method and might not capture all changes.

Chapter 3: Methodology

This section is an introduction about different methods used to measure efficiency with a detailed explanation of all DEA and Malmquist index methods.

Methods of Efficiency measurement

The production efficiency function is practically unidentified. For that, Anouze (2010) emphasized on the importance of estimating the production efficiency function by analyzing a set of data and using appropriate methods to measure efficiency. Efficiency measurement methods are divided into two main categories: Parametric and non-parametric. There are fundamental differences between the two approaches; this was the motivation behind explaining and outlining both methods which will affect the selection the most applicable method to the research objectives. The next section will present the parametric methods.

Parametric Methods

Parametric Methods are divided into two main groups stochastic and deterministic. The stochastic methods include: Thick frontier Analysis (TFA), distribution free analysis (DFA) and stochastic frontier analysis (SFA). SFA is one of the most common parametric methods in literature; this method requires assumptions about efficiency related functions such as production and cost functions. SFA Deals better with large samples in order to give more reliable outcomes. Furthermore, it cannot deal with categorical variables easily.

The other type of parametric Methods is deterministic methods which include ordinary least squares (OLS), modified ordinary least square (MOLS) and corrected ordinary least squares (COLS). These methods are very similar to SFA that it deals better with large samples in order to give more reliable outcomes and it requires assumptions about efficiency related functions such as production and cost functions , not to mention the difficulty of applying it with categorical variables. Anouze (2010) claims that stochastic and deterministic methods don’t show the source of inefficiency. That makes this category of methods inappropriate for a study that aims to explain the source of efficiency change.

Non-Parametric Methods

There are two main non- parametric methods, Free Disposal Hull Model (FDH) and Data envelopment analysis (DEA). The next section will briefly introduce FDH while DEA will be introduced in details in a separate section.

Unlike parametric methods which based on regression theory, Non-parametric methods are based on liner programming where FDH is considered a more general form of DEA since it only shows actual performance observed. Leleu (2006) state that FDH is an alternative to DEA where the free outputs and inputs are taken to avoid the convexity assumption under DEA. Data envelopment analysis is the most used non-parametric efficiency measurement method in literature. This method has different varieties which will be explained thoroughly in the next section.

Data Envelopment Analysis

Data Envelopment Analysis was initially developed by Charnes et al. (1978). Since then this model is under several modification and enhancements. One of the most important additions to DEA was the work of Cooper et al. (2004) in which variable return to scale (VRS) and constant return to scale (CRS) was introduced and considered the two basic models of DEA.

DEA method is based on linear programming which uses input and output to reach a non-parametric performance frontier. This frontier is built from the best performers (benchmark) Decision making Units (DMUs). DEA compares different efficiency scores to reach the benchmark DMUs. The constant return to scale (CRS) Model **(Model 2)** assumes that DMU outputs will change proportionally to the change in inputs regardless the DMUs size; therefore, a small DMU is benchmarked against the largest DMU. This makes CRS not applicable in most of financial institutions related studies. However, the alternative method which is the variable returns to scale (VRS) **(Model 3**) is based on the fact that technology might change the return to scale direction. Therefore, outputs don't move in proportion to inputs change. Also, VRS only compares (benchmark) DMU of similar size. The following chart **(Figure1)** illustrates the difference between VRS and CRS.

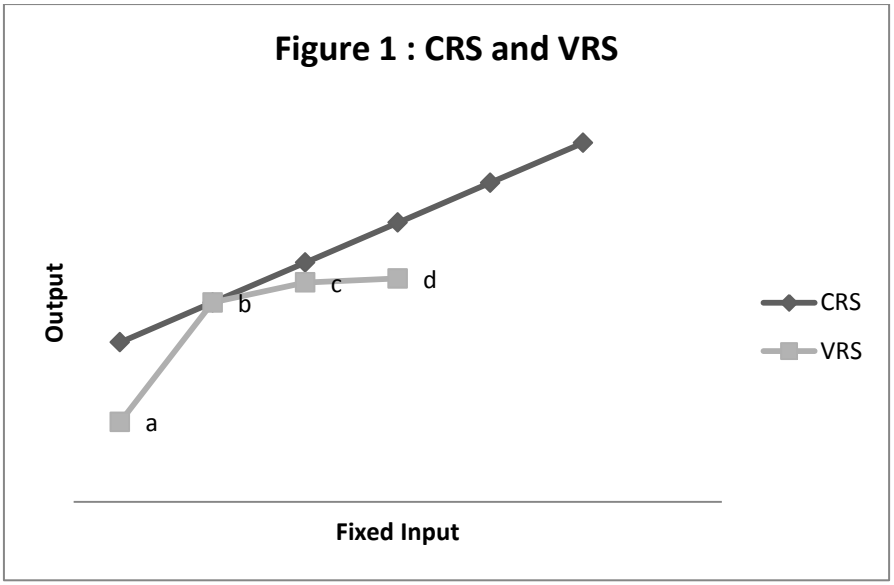

Figure 1: Variable and constant return to scale

In **(Figure 1)** input are assumed to be Fixed and the points a, b, c and d refers to the level of capacity unitization (Efficiency) .In CRS curve, any point under the frontier is considered underutilized capacity i.e. only point B is considered Fully utilized. On the other hand, VRS considers any point below the VRS frontier underutilized points which mean that point a, c and d are also considered a fully unitized points.

DEA formulas

This section will outline the basic models and formulas of multi-input-output oriented data envelopment analysis. If it is assumed that for a z IFIs with j from 1 to z producing output of O_{rj} using input k input of I_{ij} The basic technical efficiency model can be expressed as follows: **(Model 1)**

$$Max\ E_0 = \frac{\sum_{r=1}^{s} U_r O_{rj0}}{\sum_{i=1}^{m} V_i I_{ij0}}$$

Subject to;

$$\frac{\sum_{r=1}^{s} U_r O_{rj0}}{\sum_{i=1}^{m} V_i I_{ij0}} \leq 1\ ; j = 1, \dots z$$

$$u_r \geq \varepsilon\ ; r = 1, \dots s$$

$$v_i \geq \varepsilon\ ; i = 1, \dots k$$

Where; E_o= the efficiency score of IFI Jo
O_{rj} = value of r^{th} output produced by IFI j,

I_{ij} = quantity of i^{th} input used by IFI j,
U_r = the weight given to output r as determine by DEA,
V_i = the weight given to input i as determine by DEA,
z = IFIs number, k = number of inputs used by the module
s number of outputs produced by each IFI
j_0 is the IFI being assessed in the set of j=1,…,n IFIs.
ε= value to enforce strict positivity of the weights. (Zhu (2009) , Anouze (2010))

It can be implied from the model above (model 1) that the efficiency of an IFI j_0 is beaning benchmarked and maximized to efficiency of other IFI on the sample , thus if an IFI scored an efficiency above 1 it will be considered relatively efficientDMU vis-à-vis if it is less than 1 it will be considered relatively inefficient DMU.The following model (Model 2) represents the linear programing version which was originally presented by Charnes, Cooper, and Rhodes which isusually referred to as CCR model this model is formatted as follows:

$$Max\ E_0 = \sum_{r=1}^{s} U_r O_{rj0}$$

Subject to:

$$\sum_{i=1}^{m} V_i I_{ij0} = 1$$

$$\sum_{r=1}^{s} U_r O_{rj0} - \sum_{i=1}^{m} V_i I_{ij0} \leq 0\ ; j = 1, \dots z$$

$$u_r \geq \varepsilon\ ; r = 1, \dots s$$

$$v_i \geq \varepsilon\ ; i = 1, \dots k$$

(Model 2) is another version of (model 1) rewritten assuming constant return to scale (CRS) and in a linear programming format. It can be implied from (Model 2) first constraint that all IFIs should be below the efficiency frontier or on the frontier. The second constraint shows that weighted summation of all inputs of IFI j_0^{th} should equal to one.

As a matter of fact, CRS doesn't account for variable changes in efficiency. Banker et al. (1984) introduced variable returns to scale (VRS) linear programming function which is presented as**(Model 3):**

$$Max\ E_0 = \sum_{r=1}^{s} U_r O_{rj0} + U_0$$

Subject to:

$$\sum_{i=1}^{m} V_i I_{ij0} = 1$$

$$\sum_{r=1}^{s} U_r O_{rj0} - \sum_{i=1}^{m} V_i I_{ij0} \leq 0 \; ; j = 1, \dots z$$

$$u_r \geq \varepsilon \; ; r = 1, \dots s$$

$$v_i \geq \varepsilon \; ; i = 1, \dots k$$

VRS model **(Model 3)** is identical to CRS model except for the addition of an extra variable (U_0). This variable determine the return of scale frontier direction .If the scale it is positive that means VRS curve is upwards sloping and increasing and vis-à-vis if it is negative it implies a decreasing return to scale. On the other hand, if U_0 variable return zero then VRS frontier will be identical to CRS frontier.

The dual of previously mentioned model return **(Model 4),** presented as follows:

$$Min\ E_0 - \varepsilon(s_r^+ + s_j^-)$$

Subject to:

$$\sum_{j=1}^{n} \lambda_j I_{ij} + s_j^- = E_0 I_{ij0} \quad ; \quad \forall i = 1, \dots, k$$

$$\sum_{j=1}^{n} \lambda_j I_{ij} + s_j^+ = I_{ij0} \quad ; \quad \forall r = 1, \dots, s$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0 \quad ; \quad \forall j = 1, \dots, z$$

As can be seen, (**Model 4)** is referred to as Input orientation VRS since it compares outputs to inputs. The most efficient IFI (benchmark) is the one that uses the lowest amount of inputs to reach a certain output level. Also, it assumes that DMU weight is greater than zero $\lambda_j \geq 0$ and allow for VRS in the third constraint. The second constrained check that inefficient IFIs output are compared to the benchmark IFI output level. If the model is inverted then an output-oriented VRS can be obtained which is presented in the following formula :**(Model 5)**

$$Max\ E_0 - \varepsilon(s_r^+ + s_j^-)$$

Subject to:

$$\sum_{j=1}^{n} \lambda_j I_{ij} + s_j^- = I_{ij0} \quad ; \quad \forall i = 1, \dots, k$$

$$\sum_{j=1}^{n} \lambda_j I_{ij} + s_j^+ = E_0 I_{ij0} \quad ; \quad \forall r = 1, \dots, s$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0 \quad ; \quad \forall j = 1, \dots, z$$

Comparing Parametric with Non-parametric Methods

There are several studies that compare the result of parametric and non-parametric methods, and the conclusion seems to differ given the sample and a method applied. For instance, the empirical study of Fiorentino et.al (2006) used special measures of efficiency such as ranking, accounting numbers and stability over the period 1993 to 2004 in order to measure the efficiency of all International German banks. The study found that parametric method such as SFA give higher efficiency scores compared to DEA. On the other hand, DEA seems to be more sensitive to the degree of homogeneity of the bank sample. In addition, according to Fiorentino et.al (2006) DEA and SFA result is similar when applied in a certain homogenous group for a certain year.

Similarly, both Delis et.al (2008) and Kumar and Arora (2010) provided evidence of significant differences in results between the two methods, both studies was applied in emerging markets for the similar range of years. Anouze (2010) reviewed more than fifteen articles that applied both Parametric with Nonparametric Methods and found that differences between both methods depend on the sample used. Parametric with Nonparametric methods are useful in measuring efficiency, and that it is not a question of which on is better than other, but it is a question of which one of them is more applicable to the sample under analysis. In the current study, the selection of method is based on certain assumptions and limitations which will be discussed in the following section.

The Method selected in this study

The main objective of this study relies on obtaining the technical efficiency scores for a sample of IFIs. In fact, financial institutions have several inputs and outputs by nature and the amount of data available is usually insufficient for a comprehensive analysis. The discussion in the previous section about parametric and non- parametric methods draws attention to the importance selecting an appropriate method. IFIs data is usually incomplete since majority of IFIs are in developing or underdeveloped countries where market is inefficient. Furthermore, transparency in providing data is not yet a standard in most of these countries. That's why it is complicated to apply parametric

methods such as DEA in such data. However, it's clear for us that DEA is the best and the most realistic method as it does not require huge set of data, but requires homogenies and balanced data. Also, reviewed literature supported the selection of such method for similar set of data.
This study will implement input ordinated-VRS DEA for two simple reasons. Firstly, the method used to treat negative numbers requires using VRS, Secondly IFI scale of operation is by nature not homogenous. Thus, this method is believed to be more applicable to the selected sample. Also, cooper et.al (2000) suggested that VRS should be used with data with firms with different sizes which are applicable to the current sample.

The other objective of this study relies on measuring the change of efficiency for the sample. Statistical change measurement methods can be used as well as more sophisticated model. For this reasons Malmquist total productivity index is selected as a measure of time interval measure. The next section will elaborate on Malmquist index.

Malmquist Index

DEA is not only implemented under static (one period) condition, but also can be implemented using other window analysis tools. One of the most implemented tools used for this purpose is Malmquist productivity Index (MPI). This Index was initially developed by Malmquist back in year 1953. Malmquist productivity Index (MPI) was developed several attempts such as the work of Fare et al. (1998) and others. Kirika (2005) claimed that MI can be defined by distance function which measures the basic change in frontier.
MPI basically measures the efficiency change between two periods. There are two main parameters in Malmquist index frontier shift measures the efficiency change between different periods. Firstly, catch-up effect measure the change of individual DMU efficiency. Catch up can be measured by the following formula: **(Model6)**

$$CU = \frac{\delta^i\left((x_0, y_0)^i\right)}{\delta^k((x_0, y_0)^k)}$$

In **(Model6)** the catch-up effect(CU)is simply the efficiency for the period i with respect to i frontier divided by the efficiency of k with respect to frontier k , Hence if CU is greater than one it would mean progress in efficiency while, if less than one it means regress or no change.

Catch up efficient contain two important components Scale efficiency change (SEC) and Pure efficiency change (PEC). These components are related to VRS and CRS respectively. The following formula present (SEC) with VR and CR scripts is shows the VRS and CRS components. **(Model7)**

$$SEC = \sqrt{\frac{\delta_{vr}^{i}(x_0, y_0)^i / \delta_{cr}^{i}(x_0, y_0)^i}{\delta_{vr}^{i}(x_0, y_0)^k / \delta_{cr}^{i}(x_0, y_0)^k} \; x \; \frac{\delta_{vr}^{k}(x_0, y_0)^i / \delta_{cr}^{k}(x_0, y_0)^i}{\delta_{vr}^{k}(x_0, y_0)^k / \delta_{cr}^{k}(x_0, y_0)^k}}$$

While the Pure efficiency changes (PEC) is formulated as follows: **(Model 8)**

$$PEC = \frac{\delta_{vr}^{i}(x_0, y_0)^i}{\delta_{vr}^{k}(x_0, y_0)^k}$$

Similar to catch up, if PEC or SEC is higher than one it would mean progress in efficiency while, if less than one it means regress or no change. The remaining factor under MI is the frontier shift which is formulated as follows: **(Model 9)**

$$FC = \sqrt{\frac{\delta^{k}(x_0, y_0)^k}{\delta^{i}(x_0, y_0)^k} \; x \; \frac{\delta^{k}(x_0, y_0)^i}{\delta^{i}(x_0, y_0)^i}}$$

Frontier shift measures the innovation change. If Frontier shift is greater than one it would indicates progress in technology and vis-à-vis if less than one it means regress or no change.

The main objective in this section is the Malmquist Index which simply the product of catch up and frontier change. MI is presented by the following formula: **(Model 10)**

$$MI = \sqrt{\frac{\delta^{k}(x_0, y_0)^i}{\delta^{k}(x_0, y_0)^k} \; x \; \frac{\delta^{i}(x_0, y_0)^i}{\delta^{i}(x_0, y_0)^k}}$$

In this formula MI is interpreted as Geometric mean of efficiency scores for two periods. Similar to its component if MI > 1 it would mean progress in total efficiency while if, MI ≤ 1 it would mean no progress or regress in selected periods.

Chapter 4: Data and analysis and result

This section present the Data and sample used on the study. Also, it defines the inputs and outputs of the analysis followed by a detailed outline of the steps of the analysis and finding and results.

Sample

The initial data sample used in this paper is a balanced panel of all Islamic Financial institutions available in the bankscope database. This data was extracted in order to obtain two samples that would represent the top GCC and Non-GCC Islamic banks. this resulted in a list of 141 Islamic financial institutions out of this list 97 banks and financial institution were removed because of incomplete data, due stopping of operations or poor reporting. It should be noticed that most Iranian Islamic banks had incomplete data. Also, some of the GCC banks are international and based in one of the GCC countries. After adjustment for negative data 3 more banks were removed because of having nil amounts of ROA, ROE or NI and thus might unnecessarily spoil the outcome of the analysis. After that, the remaining IFIs were then divided into two groups GCC and Non GCC to include additional comparability possibility to the study. GCC group consist of 22 IFIs and non-GCC group consist of 19 IFIs. A list of these IFIs is presented in the appendix (tables 9 and 10).

Data

Bureau van Dijk Bankscope database is one of the best and most complete databases for banking sector where banks data are unified to a global format which is significant for a data sample that consist of Islamic banks that report at different accounting standards such as IFRS local GAAP or Islamic accounting standards. For the data analysis both MS Excel and PIM-DEA software is used for the analysis

The annual data for the period 2005-2011 was extracted, year 2012 is not included since not all IFIs data is available at the date this analysis is done. One of the most important requirements of efficiency analysis is the balanced panel data. Dacanay (2007) argues that if the study period is too long, changes in company structure might lead efficiency score to be less meaningful. On the other hand, if the study period is too short, errors will not average out.

Definitions of inputs and outputs

There is no agreement in the perfect input and output to measure Islamic bank's performance. The reason behind that is that Islamic banking is not based on interest. Thus, interest income and expense are not appropriate parameters for this study. Similar to Mostafa (2011) the study selected total assets and total Equity as inputs and return on average assets (ROAA) and return on average equity (ROAE) and net income as outputs. This selection assumes that Islamic financial institutions function as intermediary between different parts of the economy.

Pre analysis stage: Negative data

One of the fundamental problems that faced this study is the existence of negative data, i.e. some of the inputs and outputs for some banks in the sample were negative. DEA model cannot handle negative data since it assumes that output and inputs are positive. Literature reviewed suggested different methods to convert negative data. Zhu (2009) (see also Ali and Seiford 1990) indicated that such data can be transformed using "Translation invariance property" were all negative output or input is transferred by simply adding an amount equal to the greatest negative value in the sample. However, this method can only be applied by using VRS-DEA frontier where and input or output of x_{ij} is replaced by $\bar{x}_{ij}$

$$\widehat{x_i} = x_{ij} + \pi_r$$

In our sample the inputs were positive in nature. However, in the output side many figures for several banks were negative and should be transformed accordingly. The following table presents the adjustment to different outputs:

Table i: Translation invariance property (adjustment to outputs :**)**					
x_{ij}	ROAA 2011	ROAA 2010	ROAA 2009	ROAA 2005	ROAE 2011
π_r	6%	27%	29%	3%	34%
x_{ij}	ROAE 2010	ROAE 2009	ROAE 2005	NI 2011	NI 2010
π_r	128%	105%	17%	188,000 $	560,000 $
x_{ij}	NI 2009	NI 2005			
π_r	729,000	27,000			

This method is simple and easy to implement. However, it is not disadvantages free. Anouze(2010) indicated that "translation invariance property " don't provide measure of efficiency when estimating efficiency levels and it is only restricted to VRS models. Anouze (2010) suggested the use of a method called SORM (semi-oriented radial measure). This method has advantages of dealing with a different combination of negative dataset and can overcome other methods disadvantages. However, as VRS is already the choice of this study and given the type of data analyzed and to simplify the analysis. The simple translation invariance property will be used. In addition, In order to illustrate an overall picture of the period tested, Geometric means of Malmquist indices have been used to calculate several periods efficiency index. Geometric mean was used in several papers such as such as Fare (1998), Lovell (2003) , Kirikal (2005) and others.

The actual steps of analysis are summarized as follows. Firstly, IFIs data was collected and cleaned from negative numbers. Secondly, Data was analyzed for DEA and for Malmquist Index. Finally, Geometric means were tested against several hypotheses as it will be discussed in the next sections.

Empirical Results and analysis

The introduction of this study suggested three main goals which included four hypotheses for measuring and examining the efficiency change for GCC and non-GCC Islamic banks for the period 2005 to 2011. The following sections of the study will present the result for each hypothesis and goal examined and will present analysis the outputs obtained. The first objective of the study is as follows: **(Objective1)**

> To examine the Technical efficiency change of GCC and non-GCC IFIs before and after the year 2007-2008 financial crisis using Data Envelopment analysis (DEA).

This goal was one of the most important motivations of this study. The research needed to find in what way the efficiency of GCC and non-GCC Islamic banks changed during the 2007-2008 financial crisis. For this purpose, this research defines pre-crisis period to be 2005, 2006 and 2007 and the post-crisis period to be 2008, 2009, 2010 and 2011.

Efficiency is one of the most important indicators of financial institutions health. By examining efficiency change during the financial crisis period, the study can judge whether GCC a non GCC Islamic Financial Institutions has been affected by the financial crisis from the efficiency point of view. The importance of efficiency was discussed thoroughly in previous parts of this study. The following hypothesis was examined for the goal Number 1:

Null Hypothesis 1: There is no statistically significant difference in the average Technical efficiency scores of IFIs between pre and post-crisis periods

Alternative Hypothesis 1: There is a statistically significant difference in the average Technical efficiency scores of IFIs between pre and post-crisis periods

This study examined two sets of data, GCC Islamic financial institutions and non-GCC Islamic institutions. The following table (Table 1) shows the efficiency results for GCC Islamic financial institutions in the post and pre-crisis period:

Table 1 : GCC Islamic FI technical efficiency score									
IFI Code	**post -crisis**	2011	2010	2009	2008	**pre-crisis**	2007	2006	2005
G01	**19**	6	5	13	51	**42**	36	63	27
G02	**37**	2	10	35	100	**38**	48	35	32
G03	**30**	7	11	3	100	**89**	100	68	100
G04	**40**	7	6	100	46	**90**	69	100	100
G05	**24**	11	21	22	42	**63**	77	55	57
G06	**23**	10	14	31	38	**60**	52	77	52
G07	**11**	14	16	4	9	**25**	35	22	18
G08	**56**	16	9	100	100	**52**	63	48	46
G09	**43**	25	82	20	43	**24**	30	17	25
G10	**34**	24	7	28	76	**67**	57	100	45
G11	**38**	30	48	41	33	**10**	16	8	7
G12	**55**	46	39	69	64	**62**	76	44	66
G13	**52**	53	60	54	43	**29**	33	23	31
G14	**21**	43	16	12	15	**12**	7	14	14
G15	**36**	34	1	9	100	**67**	69	33	100
G16	**42**	38	49	62	20	**27**	36	23	24
G17	**47**	60	69	10	50	**38**	37	45	33
G18	**79**	61	71	93	89	**65**	74	54	67
G19	**86**	81	100	100	63	**72**	53	62	100
G20	**100**	100	100	100	100	**100**	100	100	100
G21	**42**	100	14	9	46	**71**	30	82	100
G22	**100**	100	100	100	100	**100**	100	100	100
Average p-value	**46** 0.278	**39**	**38**	**46**	**60**	**55**	**54**	**53**	**57**

The first hypothesis examined whether GCC IFI Efficiency scores have significantly changed before and after the financial crisis .The t-test result suggests that there is no significant difference between

post and pre crisis efficiency scores since p-value score is greater than the critical value of 0.05.Thus, it provides support for the Null Hypothesis 1.

Individual IFI efficiency scores showed that G03 had the maximum reduction in average efficiency, which is a reduction from 89% efficiency to 30%, this was similar to G04 which had efficiency decline from 90% to 40%. On the other hand, other banks such as G11 increased efficiency scores from 10% to 38% after the financial crisis.it should be noticed that G20 and G22 have stable and constant efficiency score of 100% for the full period tested.

The following table (Table 2) shows the efficiency results for Non-GCC Islamic financial institutions in the post and pre-crisis period:

Table 2 : Non-GCC Islamic FI technical efficiency score

IFI Code	**post -crisis**	2011	2010	2009	2008	**pre-crisis**	2007	2006	2005
N02	**64**	70	69	50	66	**58**	26	49	100
N03	**55**	37	64	62	58	**58**	49	55	71
N04	**21**	12	8	16	48	**44**	36	50	46
N05	**19**	16	27	20	15	**39**	22	55	41
N06	**46**	49	45	45	43	**39**	42	52	25
N07	**70**	100	100	48	31	**47**	36	5	100
N08	**100**	100	100	100	100	**89**	100	100	68
N10	**100**	100	100	100	100	**89**	68	100	100
N11	**100**	100	100	100	100	**100**	100	100	100
N12	**22**	32	19	9	29	**39**	53	40	26
N13	**28**	32	5	20	53	**100**	100	100	100
N14	**58**	35	37	58	100	**91**	97	77	100
N15	**90**	100	59	100	100	**51**	100	36	18
N16	**100**	100	100	100	100	**85**	100	100	55
N17	**5**	1	1	1	17	**14**	13	9	21
N18	**37**	53	39	46	11	**69**	64	42	100
N19	**23**	19	18	20	36	**70**	92	82	35
N20	**67**	40	89	63	75	**100**	100	100	100
N22	**90**	78	83	100	100	**100**	100	99	100
Average	**58**	**57**	**56**	**56**	**62**	**68**	**68**	**66**	**69**
p-value	**0.304**								

The first hypothesis examined whether non-GCC IFIs Efficiency scores have changed before and after the financial crisis .The t-test result suggests that there is no significant difference between post and pre crisis efficiency scores since p-value score is greater than the critical value of 0.05. Thus it provides support for the Null Hypothesis 1.

Individual IFI efficiency scores showed that N19 which is had the greatest reduction in average efficiency scores, which is a reduction from 70% efficiency to 23%. This is similar to N14 which had efficiency decline from 91% to 58%.On the other hand, other banks such as N15 increased efficiency scores from 51% to 90% after the financial crisis.it should be noticed that N11 had stable and constant efficiency score of 100% for the full period tested.

Another hypothesis that could be tested to check whether GCC IFIs efficiency is different from non-GCC IFIs efficiency during the period tested. The following test is applied. **(Objective 2)**

Null Hypothesis 2: There is no statistically significant difference in the average Technical efficiency scores of IFIs between GCC and non-GCC IFIs

Alternative Hypothesis 2: There is a statistically significant difference in the average Technical efficiency between GCC and non-GCC IFIs

T-test was applied to examine and compare between the two samples. P-value is equal to 0.00966 which is less than critical value of 0.05 the alternative hypothesis was supported in this case which indicate that there is a statically significant difference in the average Technical efficiency between GCC and non-GCC IFIs samples.

The next objective will provide more information about the efficiency change during the period tested. **(Objective 3)**

> To examine the efficiency change of GCC and non-GCC IFIs using DEA-type Malmquist total factor productivity index (MTFPI) for the period 2005 to 2011.

In order to investigate more in the efficiency change differences between GCC and non-GCC IFIs samples before and after the recent financial crisis. This study is one of the first studies that implement the Malmquist productivity index on the in GCC Islamic financial institutions efficiency analysis.

As mentioned in the previous section Efficiency is one of the vital indicators of financial institutions health. By examining the efficiency change during the financial crisis period the study can judge whether GCC a non GCC Islamic banks has been negatively affected by the financial crisis from the efficiency point of view. Also measuring productivity is important in monitoring IFIs performance. Malmquist-type DEA was thoroughly discussed in the previous sections. The following hypothesis is examined for the goal Number 3:

Null Hypothesis 3: The annual average efficiency change indicated progress (Increasing) efficiency in during the period tested.

Alternative Hypothesis 3: The annual average efficiency change indicated regress (Decreasing) efficiency during the period tested.

To satisfy the pervious hypothesis Malmquist Index results are obtained and the empirical findings are presented in the following table 3 which shows the change of Malmquist index as well as its components, i.e. Technical, pure and scale efficiency for the GCC IFIs sample.

Table 3 : Annual Total Factor Productivity Change Indexes MI for GCC sample

Period	TC	SEC	PEC	TFPG (MI)
2006 - 2005	1.624	1.180	1.039	1.991
2007 - 2006	1.017	1.007	0.933	0.957
2008 - 2007	1.471	0.982	0.912	1.316
2009 - 2008	0.110	1.907	1.764	0.371
2010 - 2009	0.981	0.719	1.295	0.926
2011 - 2010	7.700	0.341	0.866	2.283
Geometric means	**1.124**	**0.904**	**1.098**	**1.119**

Notes:
Total factor productivity growth :TFPG (MI)= TC X SEC X PEC
TC : Technical change
SEC: Scale efficiency change
PEC: Pure efficiency change
MI : Malmquist Index
All indexes are geometric Means

The result presented in table 3 suggests that GCC Islamic Financial institutions experienced 11.9 percent annual efficiency change for the period 2005 to 2011. This increase is mainly the result of technical change which is an average of 12.4 percent. The average Scale efficiency change was negative (-9.6 % per period)[1]. Pure efficiency change was 9.8 percent for the period tested.

There was a clear drop of efficiency in the after crisis period by -62.9 percent in 2009 – 2008 period, and -7.4 percent in 2010 – 2009 period, Also Malmquist result for the most recent year exaggerate the possibility of movement towards recovery in the period following year 2011 since the period of 2011 – 2010 was exceptional with a huge increase in in efficiency mainly due to dramatic increase in Technical efficiency. It can be concluded that Null **Hypothesis 3** cannot be rejected since the overall efficiency have improved throughout the period tested though there was a clear decline in some periods after the financial crisis.

[1] *(1- 0.904) X 100= -9.6%*

The same hypothesis is tested on the non-GCC sample, the following (table 4) presents the change of Malmquist index as well as its components i.e. the change Technical, pure and scale efficiency, for the non-GCC IFIs sample.

Table 4 : Annual Total Factor Productivity Change Indexes MI for Non-GCC sample				
Period	TC	SEC	PEC	TFPG (MI)
2006 - 2005	1.663	1.424	1.105	2.619
2007 - 2006	0.965	0.966	0.904	0.844
2008 - 2007	0.961	0.992	1.152	1.097
2009 - 2008	0.221	0.782	1.335	0.232
2010 - 2009	1.313	0.858	1.072	1.209
2011 - 2010	5.307	0.702	0.899	3.339
Geometric means	**1.155**	**0.929**	**1.068**	**1.146**

Notes:
Total factor productivity growth :TFPG (MI)= TC X SEC X PEC
TC : Technical change
SEC: Scale efficiency change
PEC: Pure efficiency change
MI : Malmquist Index
All indexes are geometric Means

The non-GCC sample result is very similar to GCC IFI sample ,The result presented in table 4 suggest that non-GCC IFI experienced 14.6 percent annual efficiency change for the period 2005 to 2011. And similar to GCC IFI sample the increase is the result of technical change which is an average of 15.5 percent, while The average Scale efficiency change was negative (-7.1 % per period)[2]. Pure efficiency change was 6.8 percent for the period tested.

However, the individual period results were a bit different for non-GCC IFI sample, There was a clear drop of efficiency in the after crisis period by -76.8 percent in 2009 – 2008 period, and -7.4 percent in 2010 – 2009 period, the averages for period 2009-2010 and period 2010-2011 which was 20.9 percent and 233 percent respectively show huge progress in efficiency. Malmquist results for the most recent years exaggerate the possibility of movement towards recovering since the period of 2011 – 2010. It can be concluded that **Null Hypothesis 3** cannot be rejected since the overall efficiency has improved throughout the period tested though there was a clear decline some periods after the financial crisis.

The last objective of this study aims to examine the relation between IFI size (by total Asset) and Annual Total Factor Productivity Change. For this the following hypothesis is tested.

[2] *(1- 0.929) X 100= -7.1%*

Null Hypothesis 4: The Average Total factor productivity growth is statistically related to IFI size

Alternative Hypothesis 4: The Average Total factor productivity growth is statistically unrelated to IFI size

In order to satisfy the research goal number 2 which aims to examine the efficiency change of GCC Islamic banks and Non-GCC Islamic banks using DEA-type Malmquist total factor productivity index one more tests is done to find the relation between IFI size measured by the average total asset and the Malmquist Total factor productivity growth index .Table 5 presents IFI ranking based on average total assets and Malmquist Total factor productivity growth index.

Table 5 : Efficiency change Ranking with bank size

IFI Code	TFPG (MI)	Total Assets in $	Ranking by total Assets size	Ranking by(MI)
N17	1.86	1929672	9	1
G05	1.42	4561269	3	2
N07	1.37	3008000	5	3
G02	1.33	458606	26	4
N18	1.33	994130	16	5
N14	1.32	1400150	12	6
N05	1.31	3041491	4	7
G18	1.25	1708166	10	8
N16	1.23	2175027	8	9
G20	1.22	6475739	2	10

Table 5 presents efficiency change scores of both GCC and Non-GCC Islamic IFIs and the ranking based on IFI size. A non-GCC IFI namely Kuwait Finance House (Malaysia) Berhad (N17) scored the highest average efficiency change for the studied period and its main parent bank in Kuwait (Kuwait Finance House), G05 came in the second place. In general, the correlation coefficient between efficiency change scores and total assets equal 0.2. Therefore, as per results it can be concluded that the size of IFI and the total asset is positively, but weakly, related to the value of productivity change. However, it can be noted that the largest IFI by average total asset which are Islamic Development Bank (G11) and Al Rajhi Banking & Investment Corporation (G20) have not achieved the highest score of Malmquist productivity change index for the period of 2005-2011. This result is different than Miniaoui and Tchantchane (2010) in which Rajhi scored the highest efficiency. The difference in results could be due to using different inputs and outputs. Said (2012a) found out that there is no relation between Islamic banks size and efficiency results. The full list of ranking is provided in the appendix.

Conclusion

This dissertation has investigated the efficiency change of GCC Islamic financial institutions before and after the 2007-2008 financial crisis. The introduction stated the importance and historical development of GCC Islamic banking sector and economy. GCC Islamic banks are not different of other IFIs by containing especial type of risk, thus it should be exposed to the latest financial crisis. The exposer might affect a financial institutions performance from different angles. One of the most important attributes of any successful IFI is high efficiency.

Technical efficiency is defined as using an optimal amount of inputs to achieve the maximum desired output where banks might be considered either producer of outputs (services) or intermediate between owners of inputs and outputs.

The purpose of the current study was to determine GCC IFIs efficiency before and after the 2008 financial crisis. The first aim was to examine the Technical efficiency change of GCC IFIs using Data Envelopment analysis (DEA) before and after the year 2007-2008 financial crisis and to compar it with non-GCC IFIs sample. The second aim was to examine the efficiency change of GCC IFIs using DEA-type Malmquist total factor productivity index (MTFPI) and comparing it with non-GCC IFIs sample.

To satisfy these objectives the present study analyzed a main sample set of 22 GCC IFIs and a secondary sample set of 19 non-GCC IFIs and covered the period of 2005 to 2011. The study covered the maximum available post and pre crisis periods.

This study results have shown that there is no statistically significant difference in the average Technical efficiency scores of both GCC and non-GCC IFIs between pre and post-crisis periods. Individual DEA scores show mixed results for both GCC and non GCC samples. Some of the GCC IFIs improved after crisis and other banks experienced regress on average efficiency scores. In addition, one of the most significant findings to emerge from this study is that there is a difference in the average Technical efficiency between GCC and non-GCC IFIs. These findings suggest that in general IFIs efficiency was not affected by the recent financial crisis, although some bank's efficiency changed during this period. the result for both sample suggest that efficiency scores was not affected by the crisis .GCC and non-GCC sample are significantly different meaning that GCC IFI efficiency change in different manner to non GCC IFIs. It is worth to mention that non GCC IFI average efficiency was higher than GCC IFIs.

Malmquist productivity index analysis revealed that both GCC and non-GCC sample experienced efficiency progress of 12 percent and 15 percent respectively throughout the period tested. Malmquist index reveals more information about the source of efficiency. For GCC most of the efficiency change was due to technical change and pure efficiency change while scale efficiency was on average regressing. The Non-GCC sample result was not different regarding the causes of total Malmquist efficiency change.

The differences between two samples arise in single period analysis. Malmquist index divided the period tested into six intervals. For all periods non-GCC sample index changes were higher than GCC for instance; 2006-2005 period showed non-GCC IFIs increased 63 percent more than GCC sample, Also non-GCC sample was higher by about 105 percent in period 2011-2010 which showed huge progress for both samples. This result support the previously mentioned hypothesis that GCC and non GCC efficiency score are significantly different. The evidence from this part of study suggests that the most significant type of efficiency that affects both GCC and non GCC IFI is Technical efficiency. In addition, the present study provides additional evidence with respect to the future of IFIs efficiency. The huge progress experience by both samples in the last period indicted that IFIs is expected to have an upward trend of efficiency increase's The final test indicated that IFI size is not related to total factor productivity index. This could mean that large banks should study the reasons behind having relatively low efficient even though spending huge investments.

Finally, a number of important limitations need to be considered. Firstly, the lack of reliable financial data affected the choice of the sample, with this sample size; caution must be applied, as the findings might not be transferable to all non-GCC Islamic financial Institution. However, as non-GCC is a secondary sample, GCC sample is enough representation of all GCC IFIs since only few and small GCC banks were excluded from the sample. Secondly, Islamic Financial standards use different terminologies to disclose significant accounting Items even though bankscope have created a unified statements for all banks, it highly questionable how accurate such form in representing IFI accounting data.

Managerial, Policy and Future Research recommendations

The previous findings suggest several courses of action. IFIs managers should take efficiency scores as an alternative to other performance indicators such as EBTIDA or operating profit. Hence, bonus schemes should be linked with DMU efficiency. Furthermore, regulators in general and central banks in specific should pay more attention to efficiency in general and technical efficiency particular Also the current study suggest that regulators should give more attention to bank's efficiency when

imposing any new policy or regulations. As Dubai government plans to establish a central Islamic finance regulatory bored, such bored is advised to include efficiency measures as an important tool of oversight and rating. In addition, IFIs with poor efficiency should be required to put more legal reserve as a cushion for future risk that might arise from poor efficiency. Also, auditing reports should include parameters in different DMU efficiency and should disclose reasons behind change in efficiency. Finally, as the results suggest that the largest banks are not among the highly efficient IFIs. These banks should review and study the sources of such low efficiency especially during the financial crisis.

Further research might investigate the effect of window dressing and poor reporting on efficiency studies result. Moreover, further work needs to be done to establish whether performance auditing can play a certain role in evaluating in evaluating real performance and efficiency of financial institutions.

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Appendix-I

Table 6 :GCC sample – Descriptive statistics						
Year	Input/output	Mean	Sum	Std. Dev.	Minimum	Maximum
2011	TA	11,387,796.74	250,531,528.18	15,455,421.99	16,100.00	58,883,576.40
	Equity	2,010,754.71	44,236,603.58	2,734,756.79	15,800.00	10,199,538.64
	ROAA	8.36	184.01	5.35	4.04	30.48
	ROAE	40.05	881.08	10.06	16.72	58.91
	NI	359,494.62	7,908,881.73	418,396.75	65,848.88	2,155,546.77
2010	TA	10,524,565.93	231,540,450.45	13,627,247.30	12,500.00	49,290,909.24
	Equity	1,901,402.51	41,830,855.32	2,608,799.12	12,300.00	9,758,484.76
	ROAA	23.66	520.54	9.96	0.73	30.81
	ROAE	119.19	2,622.20	35.04	0.85	150.93
	NI	670,595.09	14,753,092.02	432,910.37	600.00	2,365,600.09
2009	TA	9,470,974.95	208,361,448.92	12,233,358.04	12,100.00	45,527,922.37
	Equity	1,824,980.70	40,149,575.33	2,430,787.31	12,000.00	9,061,846.32
	ROAA	27.39	602.48	6.83	0.59	33.05
	ROAE	100.62	2,213.69	26.35	0.96	129.27
	NI	829,172.44	18,241,793.69	436,728.54	600.00	2,533,586.76
2008	TA	8,957,734.98	197,070,169.59	11,655,980.15	27,700.00	43,566,188.94
	Equity	1,755,941.37	38,630,710.04	2,337,307.88	27,600.00	8,624,863.53
	ROAA	3.51	77.20	2.44	0.24	10.19
	ROAE	14.91	327.99	8.98	1.37	31.62
	NI	247,221.71	5,438,877.72	375,376.15	1,600.00	1,739,893.42
2007	TA	7,381,931.62	162,402,495.61	9,722,223.13	26,200.00	33,347,530.31
	Equity	1,596,562.95	35,124,384.83	2,224,848.99	26,000.00	8,396,516.95
	ROAA	6.38	140.32	6.77	0.52	30.84
	ROAE	20.86	458.87	9.81	2.37	44.37
	NI	276,895.81	6,091,707.86	420,927.27	7,000.00	1,722,216.30
2006	TA	5,534,145.38	121,751,198.26	7,588,664.14	19,200.00	28,093,111.04
	Equity	1,241,941.33	27,322,709.35	1,823,743.95	19,100.00	7,220,963.35
	ROAA	6.13	134.92	7.61	0.74	35.10
	ROAE	20.75	456.53	16.74	2.12	73.18
	NI	219,313.20	4,824,890.46	418,156.29	400.00	1,949,773.05
2005	TA	3,041,041.09	66,902,904.08	5,828,849.68	529.84	25,377,303.28
	Equity	908,202.98	19,980,465.46	1,530,876.96	18,700.00	6,598,285.87
	ROAA	7.84	172.49	4.78	0.90	21.44
	ROAE	36.92	812.18	17.48	11.92	86.92
	NI	180,411.18	3,969,046.06	321,034.78	805.07	1,531,218.97

Table 7 :Non-GCC sample – Descriptive statistics						
Year	Input/output	Mean	Sum	Std. Dev.	Minimum	Maximum
2011	TA	2716352.23	59759749.02	3478678.28	25207.76	13565551.8
	Equity	213184.72	4690063.74	211527.25	3920.25	770088.44
	ROAA	7.46	164.2	2.31	0.33	13.08
	ROAE	44.52	979.39	13.55	0.16	79.96
	NI	204224.13	4492930.96	55515.57	338.68	307261.16
2010	TA	2342216.56	51528764.33	2933551.08	20608.82	11687495.4
	Equity	207562.66	4566378.58	221877	3878.85	827720.73
	ROAA	28.5	627.04	1.84	25.28	34.58
	ROAE	140.62	3093.59	11.99	123.31	174.32
	NI	582667.9	12818693.73	32540.17	535482.41	669162.39
2009	TA	1885124.01	41472728.16	2192967.5	29615.58	7980789.42
	Equity	170879.1	3759340.24	177643.45	3544.68	668652.37
	ROAA	30.68	674.97	1.69	28.71	35.67
	ROAE	117.07	2575.46	10.22	103.48	148.17
	NI	745427.71	16399409.64	21149.32	719976.78	819067.07
2008	TA	1,410,790.56	26,805,020.70	1,643,028.66	40,699.58	5,385,112.12
	Equity	134,865.25	2,562,439.66	143,541.85	4,488.82	513,596.98
	ROAA	2.19	41.7	1.81	0.2	7
	ROAE	13.22	251.24	8.63	2.42	36.08
	NI	14,459.22	274,725.23	16,417.38	465.72	62,599.89
2007	TA	1,090,225.64	20,714,287.16	1,234,576.21	36,374.96	3,945,171.60
	Equity	107,658.27	2,045,507.05	92,980.54	5,173.29	348,009.63
	ROAA	2.23	42.38	1.56	0.35	6.52
	ROAE	13.88	263.66	8.2	4.72	33.53
	NI	13,403.63	254,668.92	13,569.29	685.7	52,492.04
2006	TA	946332.15	20819307.34	1114472.17	33957.42	3808749.68
	Equity	82670.95	1818760.89	64073.49	4901.79	202916.6
	ROAA	1.84	40.44	1.57	0.06	6.2
	ROAE	12.75	280.51	10.81	0.78	47.59
	NI	9002.19	198048.19	8998.09	293.7	28358.41
2005	TA	1101211.87	24226661.2	1455685.57	19000	6307100
	Equity	62472.45	1374393.84	49634.63	4437.78	171229.32
	ROAA	4.69	103.16	2.13	0.3	11.53
	ROAE	28.05	617.15	12.5	0.3	67.61
	NI	32597.56	717146.37	6173.47	22660.05	45476.73

Table 8: IFI Ranking by total Assets				
Name	**TFPG (MI)**	**TA $**	**Asset ranking**	**Malmquist ranking**
G22	1.04	17938.48804	41	30
N11	0.89	45860.57383	40	40
N22	0.95	64869.07412	39	39
N10	0.85	91459.15693	38	41
G21	1.09	108540.2315	37	24
G08	1.15	149857.028	36	21
N06	0.95	170911.1989	35	38
G04	1.13	263234.4808	34	22
N02	1.16	268933.7192	33	18
G01	1.10	301208.9251	32	23
N15	0.99	322625.4615	31	34
N13	1.15	325823.5136	30	20
N03	1.18	409625.514	29	15
G03	1.04	421255.3977	28	31
N04	1.06	440086.8993	27	29
G02	1.33	458605.6085	26	4
G10	1.08	475985.9441	25	26
G07	1.07	511457.5978	24	28
G06	1.20	549678.8805	23	13
N20	1.17	566495.0117	22	16
G09	1.16	604081.0287	21	17
G19	1.20	682602.7144	20	14
G14	0.95	828496.4005	19	37
G16	1.02	868715.6007	18	32
N08	1.08	897747.6185	17	25
N18	1.33	994129.7515	16	5
G15	1.15	1017807.879	15	19
N12	1.08	1201567.465	14	27
G17	1.01	1377278.215	13	33
N14	1.32	1400149.939	12	6
G13	0.98	1439886.241	11	35
G18	1.25	1708166.239	10	8
N17	1.86	1929672.187	9	1
N16	1.23	2175027.215	8	9
G12	1.21	2297061.759	7	12
N19	1.22	2772357.111	6	11
N07	1.37	3007999.615	5	3
N05	1.31	3041490.736	4	7
G05	1.42	4561269.364	3	2
G20	1.22	6475739.051	2	10
G11	0.97	8464077.106	1	36
Correlation	0.2	T-test	0.00107%	

Table 9: GCC Islamic FI Code and Official Name	
Code	**Name**
G01	Bahrain Islamic Bank B.S.C.
G02	Emirates Islamic Bank PJSC
G03	Gulf Finance House BSC
G04	Bank Alkhair BSC
G05	Kuwait Finance House
G06	Kuwait Finance House -Bahrain
G07	Boubyan Bank KSC
G08	ABC Islamic Bank (E.C.)
G09	Kuwait International Bank
G10	Tamweel PJSC
G11	Islamic Development Bank
G12	Dubai Islamic Bank plc
G13	Albaraka Banking Group B.S.C.
G14	Bank AlBilad
G15	Arcapita Bank B.S.C.
G16	Sharjah Islamic Bank
G17	Abu Dhabi Islamic Bank - Public Joint Stock Co.
G18	Qatar Islamic Bank SAQ
G19	Qatar International Islamic Bank
G20	Al Rajhi Banking & Investment Corporation-Al Rajhi Bank
G21	Capivest
G22	Citi Islamic Investment Bank

Table 10: Non-GCC Islamic FI Code and Official Name	
Code	**Name**
N01 (excluded)	Al Baraka Bank Egypt SAE
N02	Al Baraka Bank Sudan
N03	Albaraka Bank Tunisia
N04	Arab Islamic Bank
N05	Bank Muamalat Malaysia Berhad
N06	Banque Al Wava Mauritanienne Islamique-BAMIS
N07	CIMB Islamic Bank Berhad
N08	Faisal Islamic Bank (Sudan)
N09 (excluded)	Faisal Islamic Bank of Egypt
N10	First Habib Modaraba
N11	First National Bank Modaraba
N12	Islamic International Arab Bank
N13	Jordan Dubai Islamic Bank
N14	Jordan Islamic Bank
N15	Kurdistan International Bank for Investment and Development
N16	Kuveyt Turk Katilim Bankasi A.S.-Kuwait Turkish Participation Bank Inc
N17	Kuwait Finance House (Malaysia) Berhad
N18	Meezan Bank Limited
N19	RHB Islamic Bank Berhad
N20	Shahjalal Islami Bank Ltd
N21 (excluded)	Shamil Bank of Yemen & Bahrain
N22	Standard Chartered Modaraba