The Efficiency of banks' performance in Gulf Region before, during and after crisis (Financial and Political)

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Only a few cross-country empirical studies have been conducted to measure the performance of commercial banks especially before, during, and after crises (financial or political). This study makes an attempt to fill the gap in literature by investigating the impacts of crises on Gulf corporate conceal (GCC) commercial banks performance over the period between1997-2007. The rationale behind this selection is: i) the GCC countries within this period are witnessed two major crises; the political crisis (second Gulf war) and the financial crisis (current global crisis). Hence, it is important for the manager to recognize the best bank policy under each crisis that could help both bankers and regulators in how to manage these crises; ii) Banking system within GCC countries are comprise of two different operating banking systems; Islamic and Conventional. As both are operating in similar environments, it is of interest to examine whether, one can make judgments concerning the success of their competitive strategies and other management-determined factors by using performance measures.

Two different evaluation methods are computed to measure bank performance; data envelopment analysis (DEA) and classification and regression tree (CART). The overall result shows that Conventional banks perform well during political crisis, whereas, Islamic banks perform better during the financial crisis. However, this differences is not statistical significant, which means that GCC commercial banks can be equally competitive when it comes to technical efficiency. Also, there is no statistically significant relationship between bank geographical location and it is efficiency score. Moreover, the results confirm that large and small size GCC commercial banks are more efficient than the medium size. Out of the 24 environmental factors included in the study to investigate the relationship between environmental factors (internal and external) and bank performance; only 15 factors are considered to be important in predicating the fully efficient banks.

Keywords: Data envelopment analysis, Classification and regression tree, Bank performance, Islamic bank, GCC countries

1 Introduction

In the light of the on-going international financial crisis, and the generated large costs for national and international financial systems, it is essential to assess the performance of financial sector to avert financial disaster to be more complicated. Assessing banks' performance would help managers: to examine the success of their managerial decisions that have been taken places before, during and after the crisis; to better understand their management effectiveness and provides them with valuable reference for improving their performance. Also, helps to measure

the success of these decisions compared to their counterpart decisions during same period. On the other hand, it helps policy makers to develop a strong and healthy environment for the banking sector by examining the impact of economic and financial reforms that have been taken places. Meanwhile, investors want to see how well a bank is performing before potentially investing in it. A high stock price alone is not enough measure to use; they have to see how well a bank is performing too. Therefore, bank to survive and succeed should learn the status of their efficiency and how it is compared to their counterpart in same country or other countries. Hence, to learn the suitable financial decisions that attain better allocated financial resources in a more efficient and effective manner, it is of important to assess bank performance at country and/or cross countries level. Quite, few cross-country empirical studies have been conducted to measure the performance of banking sector before, during and after crises (Mercan *et al.*, 2003; Jeon and Miller, 2004 and 2005). However, all of these studies among others are prior to the current global financial crisis. Therefore, this study makes an attempt to fill the gap in literature by assessing Gulf Corporate Council (GCC) commercial banks performance pre, during and pro the crises to guide banks manager and other stakeholders such as policy makers, and investors in their decisions.

There is a substantial body of literature discussing different methods applied to banks performance evaluation (i.e. Anouze, 2010; Fethi and Pasiouras, 2010; Berger and Humphrey, 1997). Reviewing 130 studies of efficiency of financial institutions Berger and Humphrey (1997) classified these methods according to the employed technical approach into parametric and nonparametric. Parametric methods such as; stochastic frontier approach (SFA) and nonparametric such as data envelopment analysis (DEA). Apply these methods alone to evaluate banks performance determines the efficiency scores but gives no details of factors related to inefficiency, especially if these factors are in the form of non-numeric variables such as operating style in banking sector (Emrouznejad and Anouze, 2010). This study proposes a comprehensive performance evaluation framework based on managerial, financial, and macroeconomic indicators to measure and predict banks performance. It allows to explore and discover meaningful, previously hidden information from given data. It integrates Data Envelopment Analysis (DEA) with Classification and Regression Tree (CART) technique. DEA is a nonparametric method for measuring the performance of Decision Making Units (DMUs) such as bank, hospital, university or service. It groups data into inputs and outputs to produce a productive efficiency frontier against which individual bank or entire countries banks can be benchmarked. Input variables within DEA context are resources to be minimized while output variables are product or services to be maximized to achieve a high efficiency score. The DEA efficiency score is a relative measure, which is derived for each bank from the DEA based on the quality of transforming the inputs into outputs. CART, on other hand, is a nonparametric data mining technique allows exploring and discovering meaningful information from a given data. Unlike the DEA model in which each case needs to be compared, CART produces results that can easily be applied to determine the efficiency of a bank. A unique feature of CART is that it illustrates the data in the form of a decision tree that allows CART to present the results in the form of diagrams that are easy to understand. Integrate the two techniques would help stakeholders to assess, predict and identify the most likely troubling or/ and outperforming banks. Hence, stakeholders would have an overall understanding of banks performance and consequently better improvement policies can be developed for unsuccessful banks.

The remaining part of the paper is explained as follows: section 2 reviews the previous literatures in banking sector. Section 3 briefly introduces the employed method; DEA and CART techniques and the proposed framework to assess bank performance. Section 4 presents the empirical study; describing and analyzing data. Section 5 for the results and discussion, and the final section draws some conclusions with a managerial implication and further research directions.

2 Review banking performance literature

Although, there is huge number of published research in banking efficiency, little effort has been conducted to study the impact of financial/ political crises on banking performance. To our knowledge, this is the first study to explore the combined effect of financial and political crises on banking performance. However, our work contributes and relates to several branches of bank performance literatures. It is closely related to a large extent to those studies of the impact of the: *financial crisis*; *banks health*; and *financial regulations* on *banking performance*.

Few research studies have explored the impacts of the current financial crisis on of bank performance. Xiao (2009) used qualitative and quantitative tools to examine the performance of French banks during 2006–2008. Finding shows that French banks were not immune but proved relatively elastic to the global financial crisis. Beltratti and Stulz (2009) studied the bank stock return cross the world during the period from the beginning of July 2007 to the end of December 2008. They find that large banks with more deposit financing at the end of 2006 exhibited significantly higher returns during the crisis. Cornett, McNutt and Tehranian (2010) analyzed the internal corporate governance mechanisms and the performance of US banks before and during the financial crisis. They find that largest banks faced the largest losses during the crisis. Dietrich and Wanzenried (2011) examined how bank-specific characteristics, industry-specific and macroeconomic factors affect the profitability of Swiss commercial banks over the period from 1999 to 2009. Their results provide some evidence that the financial crisis did have a significant impact on banks profitability.

These studies among other used a regression analysis and limited bank performance to a single indicator such as profit, capital, and deposit to assets ratio to measure bank performance during or after the crisis. Although, regression analysis is a useful tool, it tells nothing about how to improve the performance nor which is the best practices during or after the crisis. Also, it only counts for a single indicator, whereas banks could aim to maximize more than one indicator during their financial transactions. Furthermore, none of these studies have investigated GCC banking sector performance during the financial crises.

Other researchers paid particular attention to the impact of financial regulation on bank performance. Policy makers introduce such regulations to develop a healthy environment that increases competition and improves banking sector efficiency. Although there are numerous studies have examined the impact of financial regulations on banks performances, the overall impact of financial regulation is ambiguous. Huang, Hsiao, Cheng and Change (2008); Brissimis, Delis and Papankiolaou (2008); Koutsomanoli-Filippaki, Margaritis and Staikouras (2009); Hsiao, Chang, Cianci and Huang (2010) and Zhao, Casu and Ferrari (2010) among others find that deregulation improves banking performance and stimulates competition in financial market. In contrast, other studies such as: Fukuyama and Weber (2002); Halkos and Salamouris (2004);

Park and Weber (2006) and Fu and Heffernan (2009) finding shows a decline in banks efficiency during financial reforms period.

Finally, others studied the real effects of deterioration in bank health or competition during the financial crisis on bank performance; Almeida, Campello, Laranjeira, and Weisbenner (2009) and Duchin, Ozbas and Sensoy (2010) studied the effect of the recent financial crisis on corporate investment. Results show that the corporate investment declines significantly following the onset of the crisis. Berger and Bouwman (2010) examined the effect of pre-crisis bank capital ratios on banks' ability to survive financial crises, market shares, and profitability during the crises. Their finding shows that capital helps banks of all sizes during banking crises; higher capital helped banks to increase their probability of survival, market shares, and profitability. Gryglewicz (2011) studied the impact of both *liquidity* and solvency concerns on corporate finance. The results shows how changes in solvency affect liquidity and also how liquidity concerns affect solvency via capital structure choice.

The above studies among others provide a comprehensive examination of the effects of financial crisis on bank efficiency. This evaluation and the summary of previous literature that presented in table (A1, in the appendix) helps us to select the proper variables that should be included in our analysis. However, the impact of the crisis on bank performance has not yet been fully analyzed. Moreover, most of the reviewed researches used statistical models to study the impact of the financial crisis on firms. Statistical models make some assumptions about statistical distribution or prosperities of the data, but most of financial data doesn't meet statistical requirements of certain statistical models, also statistical tests are sensitive to sample size. On the other hand operations research technique makes no assumptions about statistical distribution and it is more accurate when testing complex or large sample (Demyank and Hasan, 2010). Therefore, operations research techniques to study the impacts of financial crisis on banking performance tend to be more useful in practical situations; hence, next section will introduce briefly the employed operational research technique in this study.

3 Methodology

3.1 Data Envelopment Analysis (DEA)

DEA is a nonparametric relative performance evaluation method developed by Charnes, Cooper and Rhodes in (1978) considering constant return to scale (CRS). CRS model compares banks performance only based on overall efficiency assuming constant returns to scale, however, it ignores the fact that different banks could be operating at different scales. To overcome this drawback Banker, Charnes and Cooper (1984) introduced the variable returns to scale (VRS) Model that is similar to CRS Model, but VRS Model ensures that an efficient bank is only benchmarked against banks of similar size, while in the CRS Model a bank may be benchmarked against banks which are substantially larger (smaller) than it. Since that time the original DEA Models (CRS and VRS) have undergone many modifications and developments. Most of these developments occurred when some of the deficiencies of the original Model were exposed during its application to solving real life problems (Thompson, Singleton, Thrall and Smith, 1986).

To introduce DEA-VRS model, Assume there are n banks ($j=1,\ldots, n$) using m inputs (x_{ij} $i=1,\ldots m$) and producing s outputs (y_{rj}, $j=1,\ldots s$). DEA measures the technical efficiency of bank j_0 compared with *n* peer group of banks as illustrated in model 1a and 1b.
In input and output oriented DEA Models 1a and Model 1b, respectively assess $bank_{j0}$ under variable returns to scale, where the efficiency of $bank_{j0}$ is the optimal value of θ in Model 1a and $1/\emptyset$ in Model 1b (Thanassoulis; 2001).

Model 1a: Standard Input Oriented DEA - VRS	**Model 1b: Standard Output Oriented DEA - VRS**
$Min\ \theta$ subject to $\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{ij_0} \quad ;\forall i$ $\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{rj_0} \quad ;\forall r$ $\sum_{j=1}^{n} \lambda_j = 1$ $\lambda_j \geq 0 \quad ; \forall j, \theta$ free	$Max\ \emptyset$ subject to $\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{ij_0} \quad ;\forall i$ $\sum_{j=1}^{n} \lambda_j y_{rj} \geq \emptyset y_{rj_0} \quad ;\forall r$ $\sum_{j=1}^{n} \lambda_j = 1$ $\lambda_j \geq 0 \quad ; \forall j, \emptyset$ free
To reach to the CRS from model 1a and 1b one can remove the following constraint from the above model $\sum_{j=1}^{n} \lambda_j = 1$	

One of the key concerns when we have a variable that takes positive values for some banks and negative values for other is that its absolute value should rise or fall for the bank to improve its performance depending on whether the bank concerned has a positive or negative value on that variable (Emrouznejad, Anouze, and Thanassoulis, 2010a). For example in the case of an output variable, if the bank has a positive value (profit) the output should rise to improve further but it should fall in absolute value as long as it continues to be negative (loss). To overcome this problem Emrouznejad and Anouze (2009) and Emrouznejad *et al.* (2010a and 2010b) treated each variable that has positive values for some banks and negative for other as consisting of the sum of two variables and proposed a semi-oriented radial model (SORM).

3.2 Classification and Regression Tree (CART)

CART is the commonly used decision tree in data mining that was developed by Breiman, Friedman, Olshen, and Stone (1984) and further improved by Ripley (1996). In principle, CART is similar to regression analysis since both are used for prediction. However, CART has some advantages over the regression model: a) a model generated by a CART is easier to understand and relatively simple to interpret for non-statisticians (Breiman et al, 1984; Torgo, 1997; Han and Kamber, 2001). b) There are no assumptions to be made regarding the underlying distribution of values of the predictor variables, as it is a nonparametric technique. c) CART can handle numerical data, as well as categorical with either ordinal or non-ordinal structure.
These are important feature of CART; as it eliminates analyst time which would otherwise be spent determining whether variables are normally distributed and making transformation if they

are not, specifically, it is important for using it with DEA since DEA scores are skewed to one side.

To validate the generated results of CART, the dataset is partitioned into two parts: *training* and *validation* datasets (Han and Kamber, 2001). Then it goes into two major phases of process: *growth* and *pruning* (Kim and Koehler, 1995). In the growth phase CART constructs a tree from the training dataset. In this phase, either each leaf node is associated with a single class or further partitioning of the given leaf would result in the number of cases in one or both subsequent nodes being below some specified threshold. In the pruning phase the generated CART in the growth phase is improved in order to avoid over-fitting. Also, in this phase, CART result is evaluated against the validation dataset in order to generate a sub-tree with the lowest error rate.
There are several criteria to measure CART results. The *predictive accuracy* of a CART is commonly measured by R-squared (average squared error); however *simplicity* and *stability* are also important measures for a CART. Simplicity refers to the interpretability of the CART and is often based on the number of leaves in the CART. Stability of a CART refers to obtaining similar results for the training and validation datasets. One way to assess the stability of the CART can be achieved by comparing the predicted mean value of the target variable (based on the training dataset) and the corresponding value for the validation dataset for each rule of the CART (Han and Kamber, 2001).

3.3 Proposed Methodology (DEA with CART)

Figure 1 illustrates the proposed analysis; DEA and CART. DEA stage is to compute the efficiency score of each bank using DEA. Accordingly, the banks are categorized into two groups; (efficient banks, target =1 and inefficient banks, target =0). In CART stage the classified efficiency score (0 or 1) is used as the target of CART while the environmental (explanatory) variables is used as an inputs. However, an accurate CART requires a large dataset, whereas, our sample is limited by 60 banks. Therefore, a new stage is introduced before CART stage to increase the original dataset using bootstrapping technique. Thus, we randomly selected 60 banks (by replacement) and we repeated this sampling 61 times to get 3660 banks, this will ensure us to get a better accuracy on the predicted CART results. The 3660 banks are divided into two datasets: train set and validation set by the ratio of 7:3 (Zhou and Jiang, 2003 and Emrouznejad and Anouze, 2010).

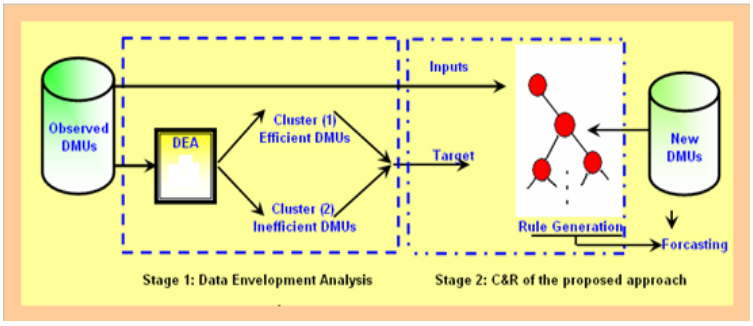

Figure 1: Integrated Data Envelopment Analysis and Classification And Regression Tree

4 Data description and analysis

4.1 Banking industries in gulf state countries

Early banking sector in the GCC countries experienced a lot of foreign ownership mostly by British bank where their braches extended across all six GCC countries. Local banks were not common as there was not sufficient experience. Later on, governments adopted central banking systems to strength local banks and to eliminate foreign involvement. Today there are 68 banks local banks operating in GCC countries. These banks could be grouped according to their operating style (way of running financial transaction) into two groups; *Islamic* and *Conventional* banks. Unlike the Conventional banks, Islamic banks are running their financial transactions with free of interest (i.e. no interest rate to be taken or given against any financial transaction). Out of the 68 local banks there are 18 Islamic banks and 50 Conventional banks.

Figure 2 illustrates the share of Islamic and Conventional bank assets within each country. Saudi Arabia is the largest investor in GCC, shares 32% of the total banks assets, with 9 Conventional banks and 2 Islamic banks and had a total asset of $239,095 Million in 2007. UAE with 15 Conventional and 5 Islamic banks and a total asset of $224,542 Million is the second largest investor in the area. Bahrain with 9 Conventional and 6 Islamic banks and a total asset of $108,307 Million and Kuwait with 7 Conventional and 3 Islamic banks and a total asset of $108,174 Million are placed in the 3rd position. Then, Qatar with 4 Conventional and 2 Islamic banks and a total asset of $56,429 Million represents only 7% of the total assets. Finally, Oman with only 6 Conventional banks and a total asset of $ 22,259 Million represents only 3% of the total assets. Although, our study aimed to include all GCC commercial banks, 8 banks are excluded due to data availability; the remaining are 48 Conventional and 12 Islamic banks.

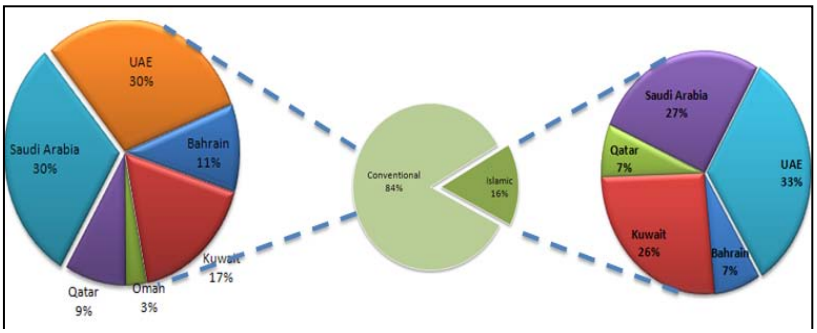

Figure 2: Share of assets, GCC commercial banks (2007 data)

4.2 Data Description

Selection of proper input and output variables to define and measure bank performance is always an extremely important decision (Mercan *et al.*, 2003). It is especially in using DEA, as different results may obtain from different sets of variables. Traditional bank behaviour theories described banks as accepting deposits, from house-holds, and making loans, to investors (Diamond and Dybvig, 1983; Diamond, 1984; Gorton and Winton, 2003). Yet, the change in bank involvement in markets and bank behaviour during crises requires a new theory of financial intermediation. Table A1 in the appendix summarizes selected recent studies input and output variables. In this

study, the input variables include: fixed assets; non-earning assets and deposit, while the output variables are investment, loans, off-balance sheet and net profit.

Table 1 illustrates descriptive analysis of the selected input and output variables. These variables are varying over the study period. Table 1 shows that the minimum value of fixed assets which is one of the inputs is US$ 0.03 Million whereas the maximum value is US$ 413.34 Million, with average US$ 7.28 Million and standard deviation US$ 24.16 Million. The same thing for other variables, take for example the net profit, the minimum net Profit (loss) is US$ -289.01 Million, and the maximum value is US$ 195.97 Million, with average US$ 8.70 Million and standard deviation US$ 21.52 Million. Given the long time period of analysis it is expected to find such variation, nonetheless since DEA models are sensitive to observations it is likely to find significant levels of variation in banks performance too.

Table 1: Descriptive analysis of input and output variables (2007, in Million US$)

Inputs/ Outputs	Variables	Mean	Std. Dev	Min	Max
Inputs	Fixed Assets	7.28	24.16	0.03	413.34
	Non-earning	21.86	55.08	0.00	609.61
	Deposits	424.11	940.28	0.00	11,161.00
Outputs	Investments	226.01	525.43	0.00	5,766
	Loans	256.26	531.37	1.27	7,528.63
	Off-balance sheet	166.87	423.91	0.00	4,619.70
	Net profit	8.70	21.52	-289.01	195.97

4.3 Data Envelopment Analysis (DEA)

4.3.1 The overall GCC commercial banks performance

To study bank performance before, during and after the crises one grand-frontier (common-frontier) is computed for all banks in all countries. Grand-frontier provides a trend in the efficiency of banks, which would not be available if we computed the efficiency of banks using a separate frontier for each year. The employed approach, therefore, provides variations in the efficiency of banks over both time and space. This comparison across time and countries is on the same principles as the use of global frontier in Portela and Thanassoulis (2010). VRS-output-oriented model is used to measure banks efficiency, since; CRS model is not possible in technologies where negative data can exist (Portela, Thanassoulis and Simpson, 2004). The obtained efficiency score for all GCC commercial bank at the individual bank level is aggregated to get the annual average efficiency scores of all banks, and then it is aggregated at country level and at operating style level.

For better capturing of bank performance during the crises the study period (1998-2007) is divided into four periods: 1) before the political crisis (second gulf war, 1998-2002); 2) political crisis (2003); 3) after political crisis (2004-2006); and 4) during the financial crisis (2007). Table 2 shows that the overall average efficiency score has turned out to be 85.6% for all banks (60 banks); this suggests that, by adopting best practices, GCC commercial banks can be, on an average, increase their outputs by 14.4 % (i.e.$100\% - 85.6\%$) with the same level of inputs. However, the potential increment in outputs from adopting best practices varies from bank to

bank. In general, GCC commercial banks have the scope of producing 1.17 times (i.e.$\frac{1}{0.856}$) as much outputs from the same level of inputs.
The technical efficiency literature provides no consensus on how efficiency in banking varies with the passage of time in response to market forces (Berger, 1993). But, since the study period is a long and turbulent times (includes the second gulf war in 2003 and 2007 financial crisis), it is expected that the political and financial crises will dominate the market force.

Table 2: summary of banks technical efficiency

Bank Code	Efficiency score										
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
Average	89	88	89	88	87	86	92	77	81	79	85.6
No of	27	30	26	26	27	27	29	24	26	26	10

Also, table 2 shows that, out of 60 commercial banks covered in this study, there are 10 fully efficient banks over the enter study period. The overall results show relatively low average efficiency scores; nevertheless, it is possible to detect a slight improvement in the efficiency levels over the study period (+2.2% between 1998 and 2004). In general, the table shows that the technical efficiency remain slightly stable over the period 1998-2003, then little improved to reach the highest level (92%) during the 2004, while the period 2005-2007 witnessed volatility of the efficiency score to reach 79% at the end of the period. The year 2005 that is two years after the gulf war (political crisis) exhibits a fallen technical efficiency across banks under study (77%). It seems that, over time, banks are wasting higher resources on average relative to the industry's best practice technical frontiers.

To find out whether the efficiency scores show a particular trend during the period 1998–2007, we ask whether the mean efficiency score has increased since 1998. Figure 3 shows that the trend of mean efficiency scores is decreased over the time. It moves in the same direction over period 1998-2002 (before the political crisis), then it is little bit declined to reach 86% during the gulf second war. It is fluctuated over the study period 2004-2006; it reaches the highest level in 2004 whereas it is deteriorated to reach it is lowest efficiency level in 2005-2006. It is further declined in 2007 (the year of financial crisis) to reach 79%. Although, 2004 seem to be atypical year, it is important to note that the performance of GCC commercial banks is varying over the study period.

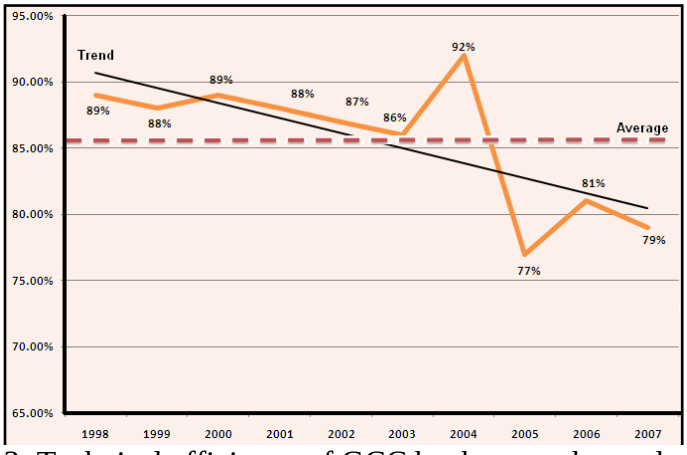

Figure 3: Technical efficiency of GCC banks over the study period

Another appropriate way to study the trend is by looking at mean and the standard deviation of technical efficiency. If GCC's banking markets have become more alike over our 10 year period under consideration, we expect an increase in mean technical efficiency and a decrease in the spread of technical efficiency. Table 3 shows the exact mean technical efficiency is slightly stable for the period 1998-2003, and then reached its highest level in the 2004. The lowest efficiency score exhibited during the year 2005, which is two years later to second Gulf crisis, then fluctuated below the average for the last two years. The standard deviation slightly stable for the period 1998-2003, and then reached it is lowest level in the 2004. The standard deviation tends to be low when average technical efficiency is high, and vice versa. This result strongly support the view that traditional efficiency techniques based on pooled frontier efficiency scores tend to estimate the actual efficiency levels of each banks.

Table 3: Statistical descriptive of the average overall technical efficiency

	1998-2002	2003	2004-2006	2007
Mean	88.02	86.20	83.37	79.30
Std Dev	14.04	16.50	20.03	24.60

4.3.2 Islamic and Conventional banks performance before and during the crises

To compare commercial bank performance based on their operating style; Islamic and Conventional, the efficiency score of all banks at the individual bank level is aggregated at operating style level to get the annual average efficiency scores of Islamic and Conventional banks, as illustrated in figure 4.

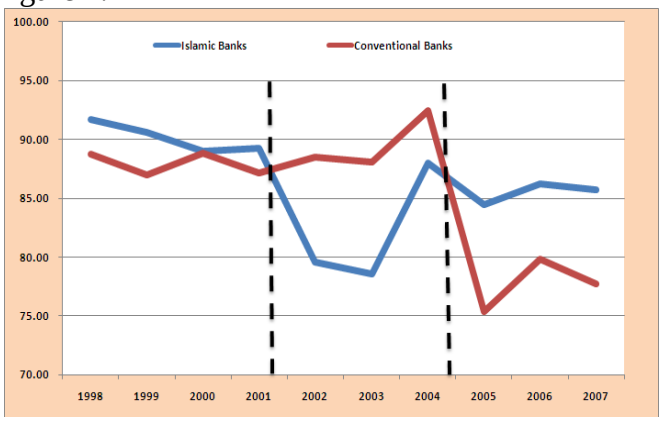

Figure 4: Islamic and Conventional bank performance before and during the financial crisis

Figure 4 shows that the Islamic banks outperform the Conventional banks for the first four years (1998-2001) thereafter the performance is decline. It reaches the lowest level over the study period (78.6%) by the year 2003 (second gulf war). The performance is improved to reach (88%) by the year 2004, however it is still below the Conventional banks performance. After that the Islamic banks appear to be ahead of the GCC commercial banks with average efficiency score, around 89.3%.

For further analysis and comparison between the performance of Islamic and Conventional banks over the study period a Mann Whitney rank sum test is applied. Mann-Whitney test, which is an alternative to the independent group t-test, is non-parametric (distribution-free) test for testing

whether the number of times scores from one sample are ranked significantly higher than score from another unrelated sample. Like many non-parametric tests, it uses the ranks of the data rather than their raw values to calculate the statistic. For this test efficiency score is considered as group variable and bank operating style is considered as test variable. Table 4 shows the result of this test.

Table 4: Mann-Whitney test concerning 2007 results

Bank Type	Sample Size	Mean Rank	Mann-Whitney U	Z- value
Islamic	12	29.6	245.5	-0.82
Conventional	48	34.04		

The results of the Mann-Whitney test reveal that there is no significance difference in bank efficiency performance due to the differences in their operating style. Hence, the null hypothesis that two efficiency scores have the same value of median is rejected at 5% level of significance.

4.3.3 Commercial banks efficiency cross GCC countries

To measure commercial bank technical efficiency cross countries the efficiency score for all banks is aggregated at country level to get the annual average efficiency scores for each country. Figure 5 shows that the Kuwaiti banks outperform other countries banks before and during the second gulf crisis. Thereafter Kuwaiti banks decline to be the worst performance between all GCC countries, and it becomes worse during the financial crisis. Although there is a tough competition between Saudi and Emirates commercial banks as they appear to be the follower before and during the second gulf war, Emirates banks performance deteriorated after and during the financial crisis.

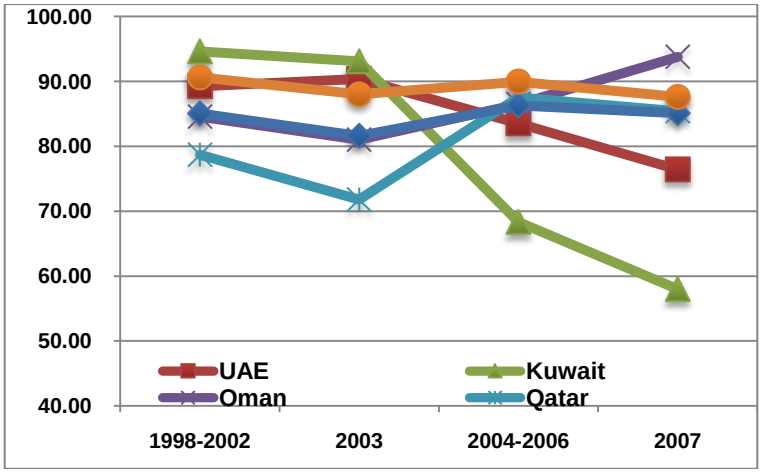

Figure 5: Bank performance before and during the financial crisis cross GCC countries

Qatari banks performed badly at before and during the second gulf war, however, the performance increased rapidly after the crisis but it is decline again during the financial crisis. Bahraini and Omani banks performance followed the same behaviour before, during and after the second gulf war, whereas Omani banks outperform all GCC commercial banks during the financial crisis.

For further investigation of the efficiency score across GCC countries, we adopted the Kruskal-Wallis rank test (Sueyoshi and Aoki, 2001) to examine whether scores vary among countries or

not, table 5 shows the test results. The Kruskal Wallis χ^2 statistics are 6.952 ($p=0.224$), means Kruskal Wallis test reveals that there is no statistically significant relationship at ($\alpha \leq 0.05$) between bank geographical location and its efficiency scores.

Table 5: Kruskal-Wallis results

Bank Location	N	Mean	χ^2	d.f.	Asymp.
Bahrain	11	34.32	6.952	5	0.224
Kuwait	9	19.94			
Oman	5	39.20			
Qatar	6	32.00			
Saudi Arabia	9	36.00			
UAE	20	28.05			

The previous analyses are mainly directed to banks managers; however, regulators may require different information in order to help them to develop a strong and healthy environment. Similarly, investors want to know where to invest their money in a way that maximizes their return. Therefore, regardless to the study period next part provides an insight analysis to provide such useful information.

4.4 Classification and Regression Tree (CART) analysis

The first stage results show the differences in inefficiency among banks in the six countries. In this stage the efficient score is treated as a target variable, while the internal and external environmental factor are considered as predictors to CART algorithm. These factors are collected from the related literatures and include; economical, financial and political factors. Data of 24 factors are collected and tested to determine the appropriate factors to be included in CART analysis. Correlation tests show high correlation between numbers of factors, for example; number of branches and number of employees are highly correlated hence we included only a number of branches to reflect the size of banks. Also, Price/ Book value and Price Earnings ratio are highly correlated hence we included only a Price/ Book value factors to reflect the size of stock market price for each banks. Therefore, 15 factors are considered as input factors for CART algorithm, table 6 illustrates descriptive analysis of these factors.

Table 6: Statistical Description of the Environmental Factors

Variable	Descriptive Statistics				
	Variable type	Minimum	Maximum	Mean	Std. Deviation
Establish Date	Categorical	1	5		
Country	Categorical	1.00	6.00		
Inflation	Numerical	3.60	14.00	8.61	4.71
Population Density	Categorical	0.70	23.60		
Operating Style	Categorical	1.00	2.00		
Internal Growth	Numerical	0.27	45.15	14.93	8.74
GDP Growth	Numerical	1.90	8.40	6.34	1.98
Bank Size	Categorical	1	3		
Return on Assets (ROA)	Numerical	- 2.53	8.28	2.76	1.53
Return on Equity (ROE)	Numerical	- 34.18	33.37	17.79	8.86
Financial Strength	Numerical	1.00	13.00	7.90	4.36
Support Rating	Categorical	1.00	4.00		
Loan to Deposit Ratio	Numerical	28.50	1,904.35	138.76	263.59
Market Share	Numerical	0.00	8.44	1.67	1.80
Asset Structure	Numerical	0.02	3,534.00	209.70	518.82

Established date: Banks are grouped according to their established date into 5 groups to capture the age affect: group 5 banks established before 1960; group 4 (1960-1970); group 3 (1970-1980); group 2 (1980-1990) and group 1 (1990-2000). It is expected to have strong positive relationship between bank performance and the established date; the older are the more efficient.

Country: Although, GCC countries mostly have the same regime, it is expected to have a variation in efficiency score according to the bank geographical location due to differences in each country regulations.

Inflation: is an indicator of macroeconomic stability, and is directly related to the interest rate levels and, thus, interest expense and revenue.

Population density: is measured as a ratio of country population to the GCC countries total populations. It is believed that banks in heavily populated countries are more likely to operate closer to their optimal size than banks in less populated country. Hence it is easier for bank management to sustain higher efficiency levels in heavily populated areas than in less populated.

Operating style: to capture the efficiency of Islamic rule and regulations.

Internal growth rate: is calculated as the percentage of retained profits of the year on the equity at the beginning of the year.

Bank size: is measured by the bank total assets, which classified into three groups hence, the larger banks (with total assets more than US $15,000 Million), medium size (with total assets between US $5,000 – 15,000 Million) and small size (total assets less than US $5,000 Million).

Profitability ratios: we measure this variable using return on assets (ROA) and return on equity (ROE).

Financial strength rating: it provides an opinion of a bank's intrinsic safety, soundness and risk profile (Arab banking and finance, 2007). It takes a scale from AAA (extremely strong finance and highly attractive operating environment) to D (extremely weak financial condition and untenable position).

Support rating: it assesses the possibility that the bank will receive enough financial assistance from the government or private owners in the event of difficulties to enable them to meet their financial obligations. It takes a scale from 1 (very likely) to 5 (very unlikely) (Arab banking & finance, 2007).

Loan/ Deposit: loan-to-deposit ratio is a measure of the extent to which banks are able to transform deposits into loans. It is mainly used to measure the loan and deposit fund utilization of banks.

Market Share: is the ratio of total deposit of each bank to total deposit of all banks.

Asset structure: is the ratio of tangible assets to the total assets.

4.4.1 All factors as an input of CART Algorithm

We built different CART models with a different selection of input factors for CART with the efficiency score as target. First we included all factors as inputs and efficiency classification as

output. Figure 6 shows the importance of variables. The 15 environmental factors are considered to be important in predicating the fully efficient banks; only 7 of them are considered as primary splitters for the decision tree. Assets structure is the most important factor (100%), followed by financial strength (92%) and ROA (91%), whereas, operating style, population density, size and support rating have low importance. This suggests that banks should give more importance to their assets structures as it is one of the important factors for banks to be efficient.

Variable	Score
ASSET_STRUCTURE	100.00
FIN_STRENGTH	91.74
ROA	91.16
INT_GROWTH	69.04
MARKET_SHARE	65.85
GDP_GROWTH	60.33
ESTABLISH_DATE	45.97
LOAN_DEPOSIT	40.09
ROE	37.92
COUNTRY	28.10
INFLATION	26.14
OP_STYLE	23.06
TOTAL_POP	20.64
SIZE	12.89
SUPP_RATING	4.62

Figure 6: Factor importance in predicting fully efficient banks

Figure 7 shows the predicated accuracy of the generated tree.

Actual Class	Total Cases	Percent Correct	1 N=1586	0 N=2074
1	1,586	100.00	100.00	0.00
0	2,074	100.00	0.00	100.00
Total:	**3,660.00**			
Average:		100.00		
Overall % Correct:		100.00		

Figure 7: Predicated accuracy of the tree

Out of 3,660 cases, 1586 cases are actually efficient and predicted to be efficient and 2074 cases are inefficient and predicted to be inefficient. This means that the accuracy in predicting the efficient and inefficient banks is 100.00%, which represents a high level of confidence. Followings are few of the extracted rules for efficient and inefficient banks.

Rules for efficient banks: banks are efficient (total of 1586 cases) if;

Rule one: Financial strength is greater than or equal 4.0, ROA is greater than or equal to 2.59 and country is less than 4 (122 cases).

Rule two: Financial strength is greater than or equal 4.0, ROA is greater than or equal to 2.59, country is greater than or equal to 4 and internal growth is greater than or equal to 4 (61 cases).

Rule three: Financial strength is greater than or equal to 4.0, ROA is less than 2.59, internal growth is greater than or equal to 5.66 and established date is greater than or equal 4 (100 cases).

Rules for inefficient banks: banks are inefficient if;

Rule one: Financial strength is greater than or equal 4.0, ROA is greater than or equal to 2.59, country is greater than or equal to 4 and the internal growth is less than 4.44.

Rule two: Financial strength is greater than or equal 4.0, ROA is less than 2.59 and internal growth is less than 5.66 (854 cases).

4.4.2 External factors as an only input of CART Algorithm

To investigate the impact of the economic and political factors (external) on bank performance, CART is drawn by only including the external factors. All the external environmental factors are

considered to be important in setting rules for the fully efficient banks. Operating style and established date are the most important factor, followed by inflation (89.14%). Support rating and GDP growth seems to have medium importance whereas country and total population density have low. The predictive accuracy of the generated tree is 92%, which represents a high level of confidence. The rules of efficient and inefficient banks that extracted as follow:

Rules for efficient banks: banks are efficient if:

Rule one: established date is greater than or equal to 5, GDP growth is less than 7.95%, inflation is less than 5.72, country less than or equal to 4, support rating is greater than or equal to 2.5 but less than or equal to 3.5 and operating style is 1 (61 cases).

Rule two: established date is greater than or equal to 5, GDP growth is less than 7.95%, inflation is less than 5.72, country less than or equal to 4, support rating is greater than or equal to 2.5 but less than or equal to 3.5 and operating style is 2 (61 cases that represent 16.7%).

Rule three: established date is greater than or equal to 5, GDP growth is less than 7.95%, inflation is less than 5.72, country less than or equal to 4, support rating is greater than or equal to 2.5 but less than or equal to 3.5 and operating style is 2 (183 cases).

5 Results and discussion

The overall technical efficiency for all GCC commercial banks over the study period is 85.6%. It reaches its highest level in 2004, which is one year after the second Gulf crisis. The reason behind unexpected improvement in performance could be due to injecting more money in the market through producing more oil by policy makers and regulators to avoid their banking sector failure or bankruptcy after the Gulf crisis. Therefore, the banking sector perform well, thereafter when regulators stopped the injecting the performance is declined to reach it is lowest level over the study period. It is worth to note that the performance of banking sector in countries like Saudi Arabia, the largest oil producer and Qatar the largest Gas producer and Oman are improved after the second Gulf war. Banks performance of all GCC countries is deteriorated during the financial crisis except for Omani commercial banks were the performance reached it is highest level during the crisis.

The highest average efficiency score is the Saudi banks, around 89.8%, followed by United Arab Emirates banks with efficiency score 86.3%. It seems to be a tight competition between Omani and Bahraini commercial banks with average efficiency score 85.7% and 85.1% respectively. Banks operating in Qatar are the lowest efficient banks, around 81.3%.

Although, this result is results are incomparable as the frontier, inputs and output variables and the study period are not same, however it is in the line with Al Shammari (2003) were he found that Saudi Arabia and United Arab Emirates banks are ahead of the GCC countries while Qatar and Bahrain the poorest performed banks.

To compare GCC commercial banks efficiency score with their counterpart in other countries, results show that on average it is below; Singapore banks (95%), Japan (87%), Germany (92%), and Peru (98%). Nevertheless, the results relatively is similar to the average of efficiency for the banks in industrial countries like France 84.3%, US 83% and UK 83.9% Spain (82-84%) or developed countries like, Lebanon 84% and China (85%) (Ariss, 2008; Avkiran, 2009; Burki and

Niazi, 2009; Emrouznejad and Anouze, 2010; Emrouznejad and Anouze, 2009; Hermes and Nhung, 2008; Huang *et al.*, 2010; Ismail, Davidson and Frank, 2009; and Koetter, 2008)
The aforementioned results suggest that, even though it is possible to detect a slight improvement in the overall efficiency scores, there are marked insignificant differences in bank efficiency levels across GCC countries. Islamic banks seem to be more affected by the Gulf war than Conventional banks, whereas, during the international financial crisis Islamic banks seem to be more resistance than Conventional banks. This could be due to the involvement level of both banks in the international financial institutes; Islamic banks might have less involved than Conventional one, hence they are less affected. Also, it could be due to the differences in the relation between bank and clients; it is based on profit/ losses sharing in Islamic banks, while it is based on fixed rate (interest rate) in Conventional banks, which make Conventional banks, make less profit compared with Islamic banks

Assets structure, followed by financial strength and ROA, whereas, operating style, population density, size and support rating have low importance. Only considering for the external factor the set of efficient rules show that banks to be predicted as fully efficient banks it should be old, operate in a country with high GDP growth and lower level of inflation. Such rules benefits regulators or policy makers in their search to establish a health environment that help their banking sector to achieve high efficiency level as well as to be a regional financial hub. Also, managers could benefit from this analysis in their way to improve their bank performance. DEA produces an improvement policy for inefficient banks, such improvement may guide them to be considered as a fully efficient banks. Furthermore, investors will find such results of their interest if they want to invest their money in a way that maximizes their return. Therefore, managers, policy makers, investors and researchers are encouraged to use the proposed methodology to gain more information about the performance of banking sector and to establish set of rules for the efficient banks

6 Conclusion

This paper investigates the banks' performance in Gulf States before, during and after crises (political and financial). The study period (1998-2007) includes two crises; the second Gulf crisis (2003) and the global financial crisis (2007). This period allows us to look deeper to each banks performance under two different situations. The results show that the overall technical efficiency of all GCC commercial banks, are relatively stable over the time. Saudi Arabia commercial banks appear to be ahead of the GCC countries, followed by United Arab Emirates banks, whereas, Qatar banks are the lowest efficient banks. However, there is no reason to believe that bank performance differs in their ratings from a statistical perspective according to their location. Also, different regulations (if any) that have been taken places during the crisis within GCC countries are more or less have the same impact on banks performance. Furthermore, the Conventional banks perform better than the Islamic banks during the second Gulf crisis, whereas, Islamic perform better during the global crisis. Nevertheless, from a statistical perspective both are equally, Islamic and Conventional banks ranks more or less are same.

Out of the 24 environmental factors; 15 are tested and considered to be important and only 7 of them are considered as primary splitters for the decision tree. Assets structure is the most important factor followed by financial strength and ROA. The operating style, population

density, size and support rating have low importance. Testing only for the external environmental factors; operating style and established date are the most important factor, whereas country and total population density have low importance.

Finally, this study contributes to the theory in developing a comprehensive framework to measure bank performance, and in identifying the most important factor that improve bank performance. Also, it has a practical contribution as it is the first to assess the impact of financial and political crises on Gulf states banks, and it provides a useful information for banks managers, investors and policy makers to track banks' efficiencies to maintain a sustainable growing sector and to provide early warning signals for a potentially at risk bank.

However, the result of this study is limited to the selected banks and study period, therefore researchers and encouraged to study the performance of GCC banking sector after the current global financial crisis. Also, to compare the performance of Islamic and Conventional banks as each of them using difference in financial tools that may lead to different performance.

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Appendix

Table A-1: Summary of selected studies

Study	Country	Study Period	Approach	Inputs	Outputs
Banker, Chang, & Lee (2010)	Korea	1995 – 2005	Intermediation	(i) interest expense and (ii) other operating expense	(i) interest revenue, & (ii) other operating revenue
Casu & Girardone, (2010)	European Countries	1997 - 2003	Intermediation	(i) Personnel expenses, (ii) other administrative expenses, (iii) interest paid, (iv) non-interest expenses.	(i) total loans and (ii) other earning assets.
Chiou (2009)	Taiwan	1999-2004	Intermediation	(i) staff, (ii) fix asset, (iii) bank deposits (including current deposits, savings deposits, time deposits, check deposits, & other deposits), & (iv) salary expense.	(i) Provision of loan services (business & individual loans), (ii) investments (iii) interest revenue and (iv) non-investment revenue.
Chiu & Chen (2009)	Taiwan	2002 - 2004	Intermediation	(i) Number of employees, (ii) total deposits, (iii) fixed assets	(i) Total amount of loans, (ii) total investment, (iii) non-interest revenue.
Das & Ghosh (2009)	India	1992 - 2004	Intermediation	(i) deposits, (ii) labor, (iii) capital / fixed assets (iv) equity	(i) Loans & advances, (ii) investments, (iii) other income.
Fukuyama & Weber (2010)	Japan	2000 – 2006	Production and intermediation	1st stage: (i) labor, (ii) physical capital, (iii) financial capital 2nd stage: (i) deposits	1st stage: (i) deposits 2nd stage: (i) loans, and (ii) securities investments, and (iii) other business activities.
Grifell-Tatjé (2010)	Spain	1994 - 2004	Intermediation	(i) Real operating profit from intermediation activities, (ii) real gross loan and financial income, and (iii) average value of loans & financial investments.	(i) financial expense (interest on deposits, loans, labor expense)
Hsiao et al. (2010)	Taiwan	2000 - 2005	Intermediation	(i) interest expenses, (ii) non-interest expenses, and (iii) total deposits.	(i) interest revenue, (ii) non-interest

Study	Country	Study Period	Approach	Inputs	Outputs
					revenue, and (iii) total loans.
Lozano-Vivas & Pastor (2010)	European Countries	2004	Production	(i) labour, (ii) funds and (iii) physical capital	(i) loans, & (ii) other earning assets
Ray & Das (2010)	India	1996 - 2006	Intermediation	(i) deposits, (ii) labor, (iii) capital / fixed assets (iv) equity & reserves	(i) investments, (ii) earning advances, & (iii) other income
Siriopoulos & Tziogkidis (2010)	Greece	1995 - 2003	Intermediation	(i) Personnel expenses, (ii) provisions, (iii) operational expenses.	(i) Financial claims, (ii) operational income, (iii) net income before taxes.
Staub, Souza, & Tabak (2010)	Brazil	2000 - 2007	Intermediation	(i) Labor, (ii) capital, & (iii) purchased funds.	(i) outputs, and (ii) loans & (iii) investments,