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Efficiency of performance of banks in the Gulf region before, during and after crises (financial and political)

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Abstract - 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 the literature by investigating the impacts of crises on Gulf Corporate Council (GCC) commercial banks' performance over the period 1997–2007. The rationale behind this selection is that the GCC countries within this period witnessed two major crises: a political crisis (the second Gulf war) and a financial crisis (the current global crisis). Clearly, it is important that a manager recognizes the best bank policy in the face of each crisis that could help both bankers and regulators in managing these crises. Also, the banking system within GCC countries comprises 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 results show that conventional banks perform well during a political crisis, whereas Islamic banks performed better during the financial crisis. However, this difference is not statistically 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 its efficiency score. Moreover, the results confirm that large and small size GCC commercial banks are more efficient than medium-sized banks. 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 predicting 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 large costs generated for national and international financial systems, it is essential to assess the performance of the financial sector in order to avoid the financial disaster becoming more complicated. Assessing banks' performance would help managers examine the success of managerial decisions that they have taken before, during and after the crisis; to better understand their management effectiveness, and it would provide them with valuable reference for improving their performance. Also, such assessment would help managers to measure the success of these decisions compared with those made by their counterparts during same period. On the other hand, it also 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 taken place. Meanwhile, investors want to see how well a bank is performing before potentially investing in it. A high stock price alone is not a sufficient measure to use; they have to see how well a bank is performing too. Therefore, if a bank is to survive and succeed, it should learn the status of its efficiency and how it compares with counterparts in same country or other countries. Hence, to identify appropriate financial

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decisions that will achieve better allocation of financial resources in a more efficient and effective manner, it is important to assess bank performance at the country and/or international level. A number of international empirical studies have been conducted to measure the performance of the banking sector before, during, and after crises (Mercan et al. 2003; Jeon and Miller 2004 and 2005). However, all of these studies among others were carried out prior to the current global financial crisis. Therefore, this study attempts to fill the gap in the literature by assessing GCC commercial banks' performance before, during and after the crises to guide bank managers and other stakeholders, such as policy makers and investors, in their decisions.

There is a substantial body of literature discussing different methods applied to evaluate the performance of banks (e.g., Anouze 2010; Fethi and Pasiouras 2010; Berger and Humphrey 1997). Reviewing 130 studies of the efficiency of financial institutions, Berger and Humphrey (1997) classified these methods according to the technical approach employed into parametric, such as the stochastic frontier approach (SFA), and nonparametric, such as data envelopment analysis (DEA). Application of these methods alone to evaluate banks' performance determines 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 the operating style of the 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 exploration and discovery of meaningful, previously hidden information from given data. It integrates Data Envelopment Analysis (DEA) with the Classification and Regression Tree (CART) technique. DEA is a nonparametric method for measuring the performance of Decision Making Units (DMUs) such as banks, hospitals, universities, or services. It groups data into inputs and outputs to produce a productive efficiency frontier against which an individual bank or the banks of an entire country can be benchmarked. Input variables within the DEA context are resources to be minimized, while output variables are product or services to be maximized in order 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 which allows meaningful information to be explored and discovered from a given data set. 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 so that the results can be presented in the form of diagrams that are easy to understand. Integration of the two techniques would help stakeholders to assess, predict and identify the banks that are most likely to be troubling or, on the other hand, outperforming. Hence, stakeholders would have an overall understanding of banks' performance and, consequently, better improvement policies could be developed for unsuccessful banks.

2. Literature review: Banking performance

Although there is a huge volume of published research on banking efficiency, little effort has been made to conduct studies of the impact of financial or 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 closely to several branches of literature on bank performance, including studies of the impact of the financial crisis, bank 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. The findings showed that French banks were not immune but proved relatively elastic to the global financial crisis. Beltratti and Stulz (2009) studied the bank stock return across the world during the period from the beginning of July 2007 to the end of December 2008; they found 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 found that the largest banks faced the largest losses during the crisis. Dietrich and Wanzenried (2011) examined how bank-specific characteristics, industry-specific, and macroeconomic factors affected 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 others, 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 practice 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 the performance of the GCC banking sector during the financial crisis.

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 are numerous studies have examined the impact of financial regulations on banks' performance, 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, found that deregulation improves banking performance and stimulates competition in the financial market. In contrast, findings from other studies such as those of Fukuyama and Weber (2002); Halkos and Salamouris (2004); Park and Weber (2006): and Fu and Heffernan (2009) show a decline in bank efficiency during a period of financial reform.

Finally, others researchers studied the real effects on bank performance of deterioration in bank health or competition

during the financial crisis. Almeida, Campello, Laranjeira, and Weisbenner (2009) and Duchin, Ozbas and Sensoy (2010) studied the effect of the recent financial crisis on corporate investment. Their results show that corporate investment declined 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 findings show that capital helps banks of all sizes during banking crises; possession of 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, and showed how changes in solvency affect liquidity, and also how liquidity concerns affect solvency through capital structure choice.

These studies, among others, provide a comprehensive examination of the effects of a financial crisis on bank efficiency (see table A1 in appendix for summary of previous literature). Evaluation of this literature that presented in table helped us to select the appropriate variables to 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 research made use of statistical models to study the impact of the financial crisis on firms. Statistical models make some assumptions about statistical distribution or propensities of the data, but most financial data do not meet the statistical requirements of certain statistical models; also, statistical tests are sensitive to sample size. On the other hand, an operations research technique makes no assumptions about statistical distribution, and it is more accurate when testing complex or large samples (Demyank and Hasan 2010). Therefore, use of such a technique to study the impacts of the financial crisis on banking performance tends to be more appropriate in practical situations.

3. Methodology

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). The CRS model compares banks' performance based only 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 the CRS Model, but it 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 or smaller than it. Subsequently, the original DEA models (CRS and VRS) have undergone many modifications and developments. Most of these developments occurred when the deficiencies of the original model were exposed during its application to solving real life problems (Thompson, Singleton, Thrall and Smith 1986).

To introduce the DEA-VRS model, assume there are n banks (j = 1,…, n) using m inputs (xij i = 1,…m) and producing s outputs (yrj, j = 1,…s). DEA measures the technical efficiency of bank j0 compared with n peer group of banks, as illustrated in model 1a and 1b.

Model 1a: Standard Input Oriented DEA – VRS	**Model 1b: Standard Output Oriented DEA – VRS**
$Min\ \theta$ subject to $\sum_{j=1}^{n}\lambda_j x_{ij} \le \theta x_{ij_0};\ \forall i$ $\sum_{j=1}^{n}\lambda_j y_{rj} \ge y_{rj_0};\ \forall r$ $\sum_{j=1}^{n}\lambda_j = 1$ $\lambda_j \ge 0;\ \forall j, \theta\ free$	$Max\ \phi$ subject to $\sum_{j=1}^{n}\lambda_j x_{ij} \le x_{ij_0};\ \forall i$ $\sum_{j=1}^{n}\lambda_j y_{rj} \ge \phi y_{rj_0};\ \forall r$ $\sum_{j=1}^{n}\lambda_j = 1$ $\lambda_j \ge 0;\ \forall j, \phi$ free

To reach to the CRS from model 1a and 1b one can remove the following constraint from the above model $\sum_{j=1}^{n}\lambda_j = 1$

In the input and output oriented DEA models (model 1a and 1b, respectively) bankj0 is assessed under variable returns to scale, where the efficiency of bankj0 is the optimal value of ? in Model 1a and 1/? in Model 1b (Thanassoulis 2001).

One of the key concerns when we have a variable that takes positive values for some banks and negative values for others 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 value for some banks and negative for others as consisting of the sum of two variables, and proposed a semi-oriented radial model (SORM).

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 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)
- There are no assumptions to be made regarding the underlying distribution of values of the predictor variables as it is a nonparametric technique
- CART can handle numerical data, as well as categorical, with either ordinal or non-ordinal structure.

These are important features of CART as they will eliminate analyst time which would otherwise be spent determining whether variables are normally distributed and making transformations if they are not; specifically, it is important to use CART with DEA since DEA scores are skewed to one side.

To validate the results generated by CART, the dataset is partitioned into two datasets, training and validation (Han and Kamber 2001). The data then go 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 CART generated in the growth phase is improved in order to avoid over-fitting. Also in this phase, the CART result is evaluated against the validation dataset in order to generate a sub-tree with the lowest error rate.

There are several criteria for measuring 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 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).

Proposed methodology (DEA with CART)

Figure 1 illustrates the proposed analysis, that is, DEA and CART. The 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 the 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 input. However, an accurate CART requires a large dataset, whereas our sample was limited to 60 banks. Therefore, a new stage was introduced before the CART stage to increase the original dataset using the bootstrapping technique. Thus, we randomly selected 60 banks (by replacement) and repeated this sampling 61 times to achieve 3660 banks, so ensuring better accuracy on the predicted CART results. The 3660 banks were divided into the two datasets, training and validation, by the ratio of 7:3 (Zhou and Jiang 2003; Emrouznejad and Anouze 2010).

Data description and analysis

Banking industries in Gulf state countries

The early banking sector in the GCC countries experienced much foreign ownership primarily by British banks with branches extending across all six GCC countries. Local banks were uncommon as there was insufficient experience. Subsequently, governments adopted central banking systems to strength local banks and to eliminate foreign involvement. Today there are 68 local banks operating in GCC countries. These banks can be grouped according to their operating style (mode of running financial transactions) into two groups: Islamic and conventional banks. Unlike conventional banks, Islamic banks run their financial transactions free of interest (i.e., no interest rate is taken or given against any financial transaction). Among the 68 local banks, 18 are Islamic banks and 50 are conventional banks.

Figure 2 illustrates the share of Islamic and conventional banking assets within each country. Saudi Arabia is the largest investor in the GCC, holding 32% of the total bank assets, with nine conventional banks and two Islamic banks, and had total assets of US$ 239,095 million in 2007. The UAE, with fifteen conventional and five Islamic banks, and total assets of US$ 224,542 million is the second largest investor in the area. Bahrain follows, with nine conventional and six Islamic banks and total assets of US$ 108,307 million, along with Kuwait, which has seven conventional and three Islamic banks and total assets of US$ 108,174 million. Qatar is in fourth position, with four conventional and two Islamic banks and total assets of US$ 56,429 million, which represents only 7% of the total GCC assets. Finally, Oman has only six conventional banks and total assets of US$22,259 million, this representing only 3% of the total assets. Although our study aimed to include all GCC commercial banks, eight banks are excluded on the basis of lack of availability of data, the remainder comprising 48 conventional and 12 Islamic banks.

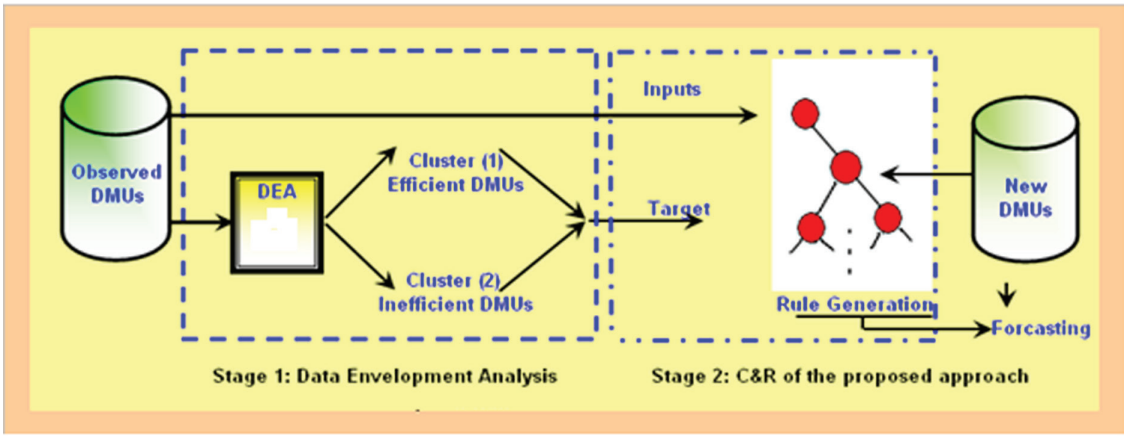

Figure 1. Integrated data envelopment analysis and classification and regression tree.

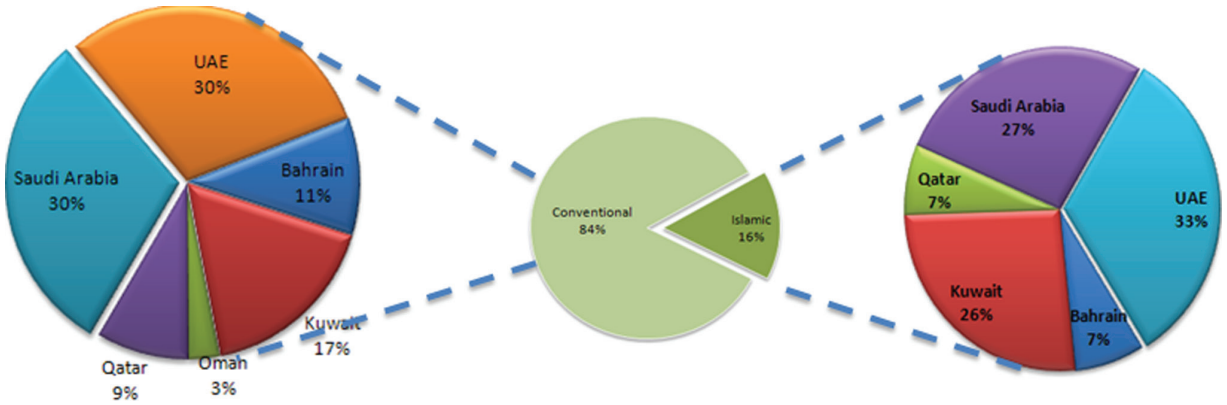

Figure 2. GCC commercial banks: Share of assets, (2007 data).

Table 1. Descriptive analysis of input and output variables (2007).

Inputs/Outputs	Variables	Mean	Std Dev	Min	Max
Inputs US$M	Fixed Assets	7.28	24.16	0.03	413.34
	Non-earning assets	21.86	55.08	0.00	609.61
	Deposits	424.11	940.28	0.00	11,161.00
Outputs US$M	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

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 so when using DEA, as different results may obtain from different sets of variables. Traditional bank behaviour theories described banks as accepting deposits from households, 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. In this study, the input variables include fixed assets, non-earning assets, and deposit, while the output variables are investments, loans, off-balance sheet, and net profit.

The selected input and output variables varied over the study period. It can be seen from table 1 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 of US$ 24.16 million. Similarly for other variables, 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 of US$ 8.70 million and standard deviation of US$ 21.52 million. Given the long time period analysed, such variation would be expected; nonetheless, since DEA models are sensitive to observations it is likely that significant levels of variation would also be found in banks' performance.

Data Envelopment Analysis (DEA)

Overall performance of GCC commercial banks

To study bank performance before, during and after the crises one grand-frontier (common-frontier) is computed for all banks in all countries. The 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 approach employed, therefore, provides variations in the efficiency of banks over both time and space. This comparison across time and countries is on the same principle as the global frontier used by Portela and Thanassoulis (2010). A VRS output-oriented model is used to measure banks' efficiency, since the CRS model is not possible in technologies where negative data can exist (Portela, Thanassoulis and Simpson 2004). The efficiency score obtained for all GCC commercial banks at the individual bank level is aggregated to obtain the annual average efficiency scores of all banks, and this is thenaggregated 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).
4. During the financial crisis (2007).

It can be seen from able 2 that the overall average efficiency score is 85.6% for all banks (60 banks); this suggests that with the same level of inputs and by adopting best practices, GCC commercial banks can, on average, increase their outputs by 14.4% (i.e., 100–85.6%). 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., 1/0.856) as much outputs from the same level of inputs.

The literature on technical efficiency provides no consensus on how efficiency in banking varies through time in response to market forces (Berger 1993). However, since the study period covers a long and turbulent time (including the second Gulf war in 2003 and the 2007 financial crisis), it is expected that the political and financial crises will dominate the market forces.

It can also be seen from table 2 that, of the 60 commercial banks covered in this study, there are ten banks which are fully-efficient over the entire 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 remains relatively stable over the period 1998–2003, then improved a little to reach its highest level (92%) during 2004, while the period 2005–2007 witnessed a volatility of the efficiency score, reach 79% at the end of the period. The year 2005, that is, two years after the Gulf war (political crisis) exhibits a decreased technical efficiency (77%) across all banks studied. It seems that, over time, banks were wasting more resources on average, relative to best practice technical frontiers for the industry.

To find out whether the efficiency scores show a particular trend during the period 1998–2007, the question is whether the mean efficiency score increased since 1998. In fact, Figure 3 shows that the trend of mean efficiency scores decreased over time. It moved in the same direction over the period 1998–2002 (before the political crisis), then declined a little to reach 86% during the second Gulf war. It fluctuated over the study period 2004–2006, reaching its highest level in 2004, and deteriorating to the lowest efficiency level in 2005–2006. The mean efficiency score further declined in 2007 (the year of the financial crisis) to reach 79%. Although 2004seemed to be an atypical year, it is important to note that the performance of GCC commercial banks varied over the study period.

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 efficient banks	27	30	26	26	27	27	29	24	26	26	10

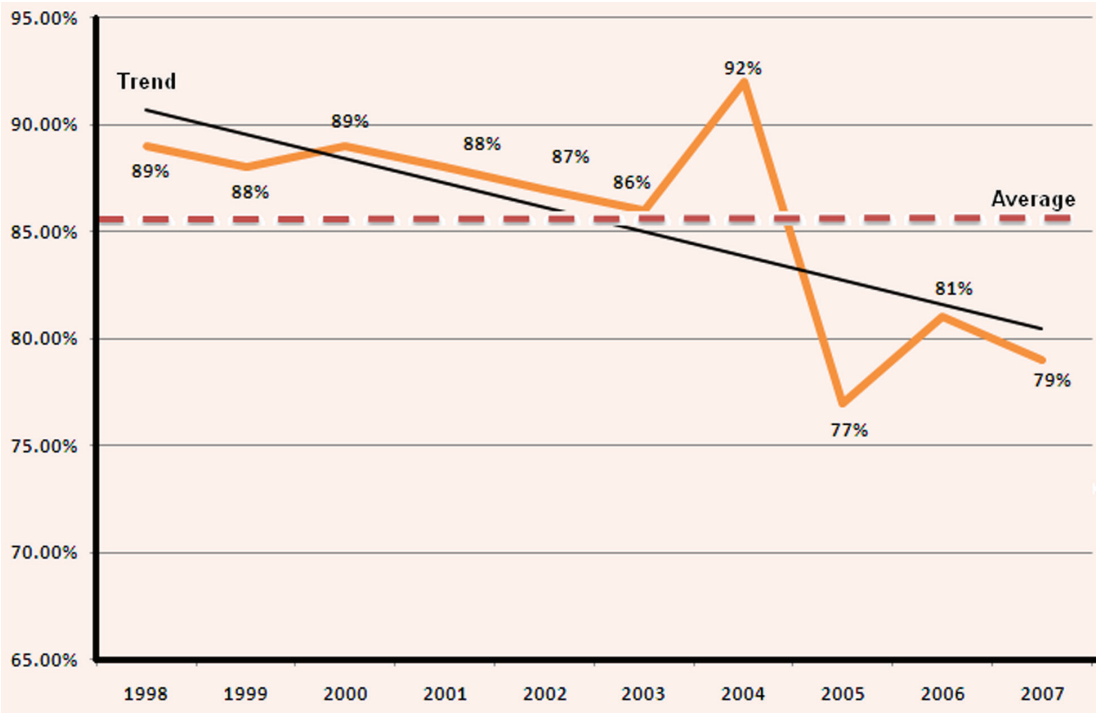

Figure 3. Technical efficiency of GCC banks during study period (1998–2007).

Table 3. Statistical descriptive of 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

Another appropriate way to study the trend is by looking at the mean and the standard deviation of technical efficiency. If the banking markets of the GCC became more alike during the ten-year period under consideration, an increase in mean technical efficiency and a decrease in the spread of technical efficiency would be expected. Table 3 shows that the exact mean technical efficiency was relatively stable for the period 1998–2003, and then reached its highest level in 2004. The lowest efficiency score was exhibited during the 2005, which is two years after the second Gulf crisis, then fluctuated below the average for the last two years. The standard deviation was relatively stable for the period 1998–2003, and then reached its lowest level in 2004. The standard deviation tends to be low when average technical efficiency is high, and vice versa. These results strongly support the view that traditional efficiency techniques based on pooled frontier efficiency scores tend to estimate the actual efficiency levels of each bank.

Islamic and conventional banks performance before and during the crises

To compare commercial bank performance based on their operating style, whether Islamic or conventional, the efficiency score of all banks at the individual bank level is aggregated at the operating style level to obtain the annual average efficiency scores of Islamic and conventional banks, as illustrated in the figure below.

Figure 4 shows that the Islamic banks outperformed the conventional banks for the first four years (1998–2001), and thereafter their performance declined. It reached its lowest level of the study period (78.6%) by 2003 (second Gulf war). The performance improved to reach 88% by 2004; however, it was still below the performance of the conventional banks. Subsequently, the Islamic banks appeared to be ahead of the GCC commercial banks, with an average efficiency score of 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 was applied. The Mann-Whitney test, which is an alternative to the independent group t-test, is a nonparametric (distribution-free) test for testing whether the number of times scores from one sample are ranked significantly higher than scores from another, unrelated, sample. Similar to many non-parametric tests, it uses the ranks of the data rather than their raw values to calculate the statistic. For this test, the efficiency score is considered as the group variable and the bank operating style as the test variable.

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

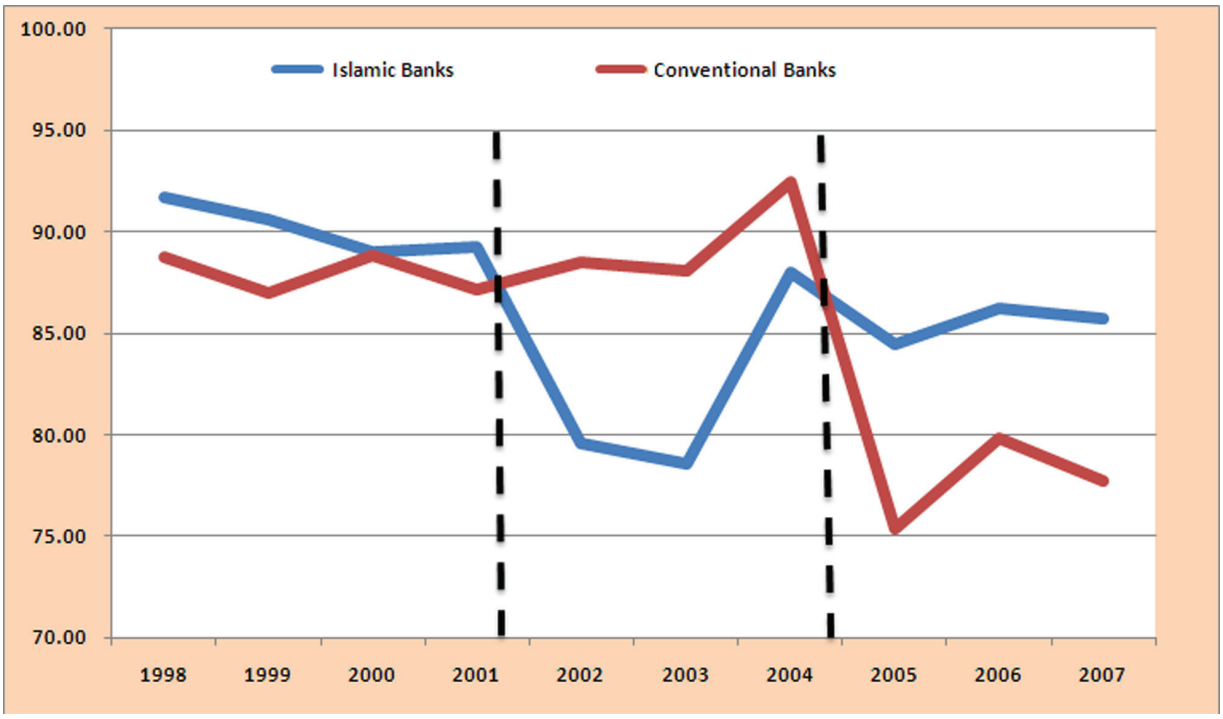

Figure 4. Performance of Islamic and conventional banks before and during the financial crisis.

Table 4. Mann-Whitney test for 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		

Table 5. Results of Kruskal-Wallis test.

Bank Location	N	Mean Rank	x^2	d.f.	Asymp. Sig.
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			

Efficiency of commercial banks across GCC countries

To measure commercial bank technical efficiency across 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, becoming the worst performers of all GCC countries, and then become even worse during the financial crisis. Although there is tough competition between Saudi and UAE commercial banks as they appear to be following the same pattern before and during the second Gulf war, UAE banks' performance deteriorated during and after the financial crisis.

Qatari banks performed badly before and during the second Gulf war; however, performance increased rapidly after the crisis, but declined again during the financial crisis. The performance of Bahraini and Omani banks followed the same behaviour before, during and after the second Gulf war, whereas the Omani banks outperformed all other 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 or not scores vary among countries. The Kruskal Wallis X^2 statistics are 6.952 (p = 0.224), meaning that there is no statistically significant relationship between the geographical location of a bank and its efficiency scores.

Previous analyses have been directed mainly at bank managers; however, regulators may require different information in order to assist them in developing a strong and healthy environment. Similarly, investors want to know where to invest their money in a way that will maximize their return.

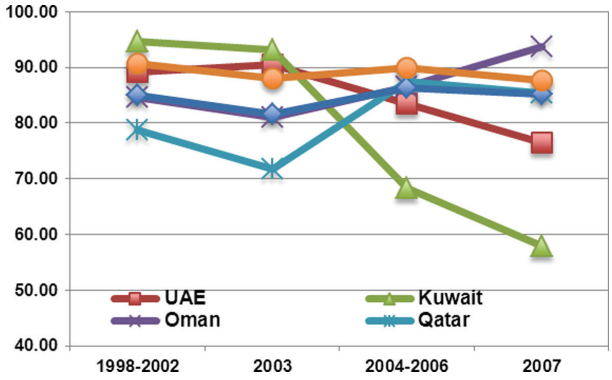

Figure 5. Bank performance across GCC countries before and during the financial crisis.

Classification and Regression Tree (CART) analysis

The first stage results show the differences in inefficiency among banks in the six countries. In this stage an efficient score is treated as a target variable, while the internal and external environmental factors are considered as predictors for the CART algorithm. These factors were identified from the related literature and include economical, financial and political factors. Data of 24 factors was collected and tested to determine the appropriate factors to include in the CART analysis. Correlation tests showed a high correlation between numbers of factors. For example, number of branches and number of employees were highly correlated so we included only a number of branches to reflect the size of banks. Also, the price/book value and price earnings ratio was highly correlated so we included only a price/book value factor to reflect the size of the stock market price for each bank. Therefore, fifteen factors were considered as input factors for the CART algorithm (see table 6).

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 fifteen environmental factors were considered to be important in predicting the fully-efficient banks; only seven of these factors 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 structure as it is one of the most important factors for the efficiency of banks.

Figure 7 shows the predicated accuracy of the generated tree:

Out of 3,660 cases, 1586 cases are actually efficient and predicted to be efficient; and 2074 cases are inefficient

Table 6. Statistical description of 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.

and predicted to be so. This means that the accuracy in predicting the efficient and inefficient banks is 100%, which represents a high level of confidence. Certain of the rules extracted for efficient and inefficient banks are as follows:

4. Rules for efficient banks

Banks are efficient (total of 1586 cases) if:

1. 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).
2. 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).
3. Financial strength is greater than or equal to 4.0, ROA is less than 2.59, internal growth is greater than

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. Factors importance in predicting fully-efficient banks.

or equal to 5.66, and established date is greater than or equal 4 (100 cases).

5. Rules for inefficient banks

Banks are inefficient if:

1. 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.
2. 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).

External Factors as a Single Input of CART Algorithm

To investigate the impact of the economic and political factors (external) on bank performance, CART is drawn by including only the external factors. All the external environmental factors are considered to be important in setting the rules for 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:

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 tree.

6. Rules for efficient banks

Banks are efficient if:

1. 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).
2. 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%).
3. 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).

7. 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 this unexpected improvement in performance could be due to the injection of more money into the market through policy makers and regulators deciding to produce more oil in order to avoid failure of the banking sector or bankruptcy after the Gulf crisis. Therefore, the banking sector performed well, until the regulators stopped the injection of funds, when performance declined to reach its lowest level over the study period. It is worth noting that the performance of the banking sector in countries like Saudi Arabia (the largest oil producer), Qatar (the largest gas producer), and Oman all improved after the second Gulf war. The performance of banks in all GCC countries deteriorated during the financial crisis, except for Omani commercial banks, which reached their highest performance level during the crisis.

The highest average efficiency score is for the Saudi banks, at around 89.8%, followed by banks of UAE, which have an efficiency score of 86.3%. There seems to be tight competition between Omani and Bahraini commercial banks, which have average efficiency scores of 85.7% and 85.1%, respectively. Banks operating in Qatar are the least efficient banks, with a score of around 81.3%.

Although, not really comparable as they differ in terms of frontier, inputs and output variables, and the study period, these results are in the line with the research of Al Shammari (2003), who found that the banks of Saudi Arabia and UAE are ahead of those in the other GCC countries, while Qatar and Bahrain have the poorest performing banks.

When the GCC commercial banks efficiency scores are compared with those of their counterparts in other countries (e.g., Singapore banks –95%; Japan –87%; Germany –92%; Peru –98%), the results show that, on average, those of the GCC banks are lower. Nevertheless, the results are relatively similar to the average efficiency for banks in industrial countries like France (84.3%), US (83%), UK (83.9%), Spain (82–84%), or other developed countries such as

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; Koetter 2008)

The 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 seemed to be more affected by the Gulf war than were conventional banks, whereas, during the international financial crisis, Islamic banks seemed to be the more resistant. This could be due to the level of involvement of the banks in the international financial institutes: Islamic banks might have less involved than conventional ones and, hence, they were less affected. Also, it could be due to the differences in the relation between bank and clients, which is based on profit-loss sharing in Islamic banks and based on fixed rate (interest rate) in conventional banks, so the latter made less profit compared with Islamic banks

Assets structure, followed by financial strength and ROA were most important, whereas, operating style, population density, size, and support rating were found to be of low importance. Considering only the external factors, the set of efficiency rules that allow the prediction that a bank is fully-efficient indicate that it should be old, and operate in a country with high GDP growth and a lower level of inflation. Such rules benefit regulators or policy makers in their quest to establish a healthy environment that will help their banking sector to achieve a high level of efficiency as well as be a regional financial hub. Managers could also benefit from this analysis in working to improve their bank performance. DEA produces information to guide an improvement policy for inefficient banks, and any such improvement may result in them being considered fully-efficient banks. Furthermore, investors will find such results in their interest as they will want to invest their money in such a way as to maximize returns. Therefore, managers, policy makers, investors and researchers are encouraged to use the proposed methodology to gain more information about the performance of the banking sector and to establish a set of rules for the efficient operation of banks.

8. Conclusion

This paper investigates the performance of banks in the 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 allowed us to take look deeply into each bank's performance under two different situations. The results show that the overall technical efficiency of all GCC commercial banks is relatively stable over time. The commercial banks of Saudi Arabia appear to be ahead of the GCC countries, followed by banks of UAE, whereas Qatar has the least efficient banks. However, there is no reason to believe that bank performance differs from a statistical perspective according to location. Also, different regulations (if any) that have been put in place within GCC countries during the crises have had more or less the same impact on banks' performance. Furthermore, conventional banks performed better during the second Gulf crisis, whereas it was the Islamic banks that performed better during the global financial crisis. Nevertheless, from a statistical perspective,Islamic and conventional banks rank more or less are same.

Out of the 24 environmental factors, fifteen were tested and considered to be important, and only seven of them are viewed 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 all have low importance. Testing only for the external environmental factors, operating style and established date are the most important factors, whereas country and total population density have low importance.

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

The results of this study are limited to the selected banks and study period. Researchers are therefore encouraged to study the performance of the GCC banking sector after the current global financial crisis; also, to compare the performance of Islamic and conventional banks as the different financial tools used by each of them may lead to differences in 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 revenue, and (iii) total loans.
Lozano-Vivas & Pastor (2010)	European Countries	2004	Production	(i) labour, (ii) funds and (iii) physical capital	(i) loans, and (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, and (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, (ii) loans and (iii) investments,

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