

June 2013

The British University in Dubai
Masters in Finance and Banking

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Dissertation submitted in partial fulfillment of
MSc in Finance and Banking

تحليل مصارف دولة العربية المتحدة عن طريق أسلوب البيانات المغلفة

دراسة الكفاءة التشغيلية والوسيط النسبية للبنوك الوطنية للإمارات العربية المتحدة

A data envelopment analysis of banks in the UAE

A Study of the Relative Operational and Intermediary Efficiency of National
Banks of the United Arab Emirates

ACKNOWLEDGEMENTS

The MSc. Finance and Banking program at the British University in Dubai has been one of the most beneficial learning experiences throughout my life. Without the support of the below mentioned people and many other people that I have not mentioned, this dissertation may not have materialized and may not have been possible.

Firstly I would like to extend my upmost appreciation to my dissertation advisor Dr. Elango Rengasamy, whom provided the encouragement and support needed for me to convert this idea into a study. I would also like to thank the other professors, library, information technology and administration staff who all provided me the support I needed in their respective fields throughout the years.

Lastly I extend my highest appreciation and love to my wife whom has supported me throughout the dissertation through love, care, motivation and ensuring I always had what I needed to have the perfect working environment at home and never complained when I would spend hours a day researching or paying little attention to her.

A DATA ENVELOPMENT ANALYSIS OF BANKS IN THE UAE: A STUDY OF THE RELATIVE OPERATIONS AND INTERMEDIARY EFFICIENCY OF NATIONAL BANKS OF THE UNITED ARAB EMIRATES

ABSTRACT

Similar to all countries that are in the mid development or developing stage, commercial banks play a key role in the economy. Proper analysis of the performance and that the efficiency of these banks is important to all stakeholders including, and not limited to, investors, creditors and the government itself. This paper aims to analyze the efficiency of the national commercial banks in the United Arab Emirates by defining and using different approaches of Data Envelopment Analysis in order to identify the relatively efficient and relatively less efficient national commercial banks. This study concentrates on the main approaches of the operating efficiency and the financial intermediary role efficiency. Through this study we observed that over the period of 2008 – 2012 that (i) A general and consistent level of high operational efficiency can be observed in the United Arab Emirates banking Sector; (ii) A general and consistent level of high intermediary role efficiency can be observed in the United Arab Emirates banking Sector with the presence of efficiency fluctuations in some banks; (iii) The age of individual banks had little or no effect on the relative efficiency of the bank; (iv) Compared to previous studies we can observe a general raise in operating efficiency levels among banks.

على غرار جميع البلدان التي هي في مرحلة التطور المتوسطة أو النامية، البنوك التجارية تلعب دوراً رئيسياً في الاقتصاد. التحليل السليم للأداء وكفاءة هذه البنوك هو مهم لجميع أصحاب المصلحة. منهم المستثمرين والدائنين والحكومة وغيرهم من أصحاب المصلحة. تهدف هذه البحث إلى تحليل كفاءة البنوك التجارية الوطنية في دولة الإمارات العربية المتحدة عن طريق تحديد واستخدام أساليب مختلفة من أسلوب "تحليل مغلف البيانات" من أجل تحديد البنوك التجارية الأكثر كفاءة والأقل كفاءة نسبياً. تركز هذه الدراسة على المناهج الرئيسية للكفاءة التشغيلية للبنك والكفاءة دور البنك كوسيط مالي في الاقتصاد.

من خلال هذه الدراسة لاحظنا ان خلال الفترة من 2008 – 2012 ان (أ) مستوى العام من الكفاءة التشغيلية عالية و ثابتة و يمكن ملاحظتها في القطاع المصرفي الإمارات العربية المتحدة؛ (ب) ويمكن ملاحظة مستوى العام من كفاءة عالية و ثابتة في دور البنوك كوسائط المال في الاقتصاد مع وجود تقلبات الكفاءة في بعض البنوك؛ (ج) تأثير سن البنوك الفردية كان قليلاً أو أي تأثير على الكفاءة النسبية للبنك؛ (د) بالمقارنة مع الدراسات السابقة يمكننا أن نلاحظ ارتفاع عام في مستويات الكفاءة التشغيلية بين البنوك.

Keywords: Bank Performance; Bank Efficiency; DEA Analysis; UAE Banks

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1. INTRODUCTION

Among the Gulf Cooperation Council (GCC) countries, the United Arab Emirates is historically and still is one of the strongest economies. In 2012 it was ranked 2nd among the GCC countries in terms of GDP per capita with a GDP per capita at current prices of USD 65,377. This figure shows an impressive growth over the decade as in 2002 this figure was only USD 18,903. The UAE GDP per capita is also second to Qatar which has an impressive GDP per capita of USD 100,377 and is followed by Kuwait with a GDP per capita of USD 46,142 and all other member countries falling within the range of USD 22-25,000. (IMF, 2012)

The banking industry in the United Arab Emirates is one of the major, and arguably the most important, industry in the United Arab Emirates after the oil and gas industry. This is mainly due to its role as an intermediary and facilitator for the better allocation of assets in a country that is seen as the regional hub for international finance, a free zone and international trade hub, a leader in the development and sale of real estate mega-developments and centre for a large concentration of ultra high net worth individuals with large multibillion dollar conglomerates. All of these key industries in the United Arab Emirates require the presence of banks in order to allow the right allocation of funds through financing the key projects and industries of the country.

According to the 2011 Emirates Banks Association annual report (Emirates Bankers Association) as of the end of 2011 there were 51 banks operational in the UAE, out of which 23 banks were nationally owned. These banks have a branch network of 1066 branches, of which 904 are national bank branches. The main reason for this large difference is the United Arab Emirates restrictions on the number of branches a foreign bank can open in the country which is restricted to 8 branches. Since the study of the commercial banks in the United Arab Emirates by Al Tamimi (Tamimi, 2004) these figures show an additional 3 national and one foreign bank and an increase of 580 local branches and 53 additional foreign bank branches.

With regards to loans deposits and total assets over the same period of time (2001-2011) the total loans have increased from AED 129 billion (approx. USD 35.33 Billion) in 2001 to AED 1,071 billion (approx. USD 291 billion) in 2011 (730% increase). Total deposits have increased from AED 193.6 billion (approx. USD 52.733 billion) in 2001 to AED 1,069.7 billion (approx USD 291.27 billion) in 2011 (453% increase). Finally total assets of commercial banks in the United Arab Emirates have increased from AED 261 billion (approx USD 71,081 billion) in 2001 to AED 1,662 billion (approx USD 452.5 billion) in 2011 (537% increase). (Emirates Bankers Association)

With the above information at hand a study on the efficiency of the performance of the banking industry, especially the national banks, is key to assessing how healthy the extremely competitive industry is and how well each bank performs its key roles in the economy compared to one another. Measuring the efficiency of and performance of these banks is important in any developed or developing country. In a country such as the United Arab Emirates that is in the developing/mid-development stage banks dominate the financial intermediary role among financial institutions and it is therefore extremely important for analysts, practitioners and policymakers to be able to understand the relative performance of banks benchmark the efficiency of the banks against each other. (Jemric, 2002)

1.1 ORGANIZATION OF THE STUDY

This study is split in to four major sections. The first section, being the introduction to the study, lays out the overall goals, objectives and methods used within the study. Here I was able to highlight the main aims and objectives of this study followed by the importance of these aims and the limitations I faced during my study. It also highlights the main research questions that came to mind throughout the process of researching the topic. The final sub-sections of the introduction give an in depth summary of the Data Envelopment Analysis Methodology and the specific model that I used along with my reasoning for picking this model over others.

The next section of the paper is the literature review where I have provided my thoughts and opinions on the different papers I read in the research process. In this section I have also cross analyzed these papers showing which papers support and point out the limitations of my study. The literature review also shows previous similar local and regional studies to mine and the criticisms of other authors on these studies. This was a valuable guide to further develop and add value to the topic and industry.

The third stage of this paper is the research methodology section where I lay out the steps I took when performing my analysis starting with the data sample and reasons for any exclusions from this sample. I then go on to describe the data envelopment analysis approaches used and conclude with any assumptions needed during this study.

The final section of this paper starts of with the results of each of the approaches used along with my comments and vital information that the results from each approach provide. I then go on to comparative and inter-approach observations that highlight any key differences and information that could be found using the different approaches. To conclude the essay I then give a summary of my findings and any key areas of further research I could identify for myself or other researchers of the field.

1.2 MAIN AIMS AND OBJECTIVES

The main objective of this paper is to provide a comparative analysis of the relative efficiencies of the national banks based in the United Arab Emirates (UAE) over the period of 2008 to 2012. Through using a Data Envelopment Analysis (DEA) technique, we will be able to assess the different banks, referred to henceforth as Decision Making Units (DMUs). The DEA is a method of frontier analysis and is able to provide efficiency scores for each Decision Making Unit ranging from 100%, for the Decision Making Units that are on the efficient frontier, to 0% depending on how far away the Decision Making Unit is from the efficient frontier. This paper aims to identify the most efficient national banks and the relatively less efficient ones. By doing this it will rank the Decision Making Units according to the different efficiency score results achieved through the Data Envelopment Analysis.

This paper will use several approaches in order to measure different aspects of efficiency in the banking industry in order to provide higher insight on the general efficiency level of the industry, interbank relative efficiencies and any link between efficiency and market conditions. Due to the small sample size restriction of number of banks in the United Arab Emirates, the Data

Envelopment Analysis approach will overcome other parametric techniques that are less applicable for this same reason. (Moffat, 2009)

To conclude, this paper aims to be an important tool in several aspect of analyzing the efficiency of a key industry in the United Arab Emirates and a more detailed description of the implications, importance and uses of this paper will be described in the next section.

1.3 IMPORTANCE OF THE STUDY

This study covers several key areas of importance for the banking industry in the United Arab Emirates. This is especially important to major stakeholders of the banks in question and will provide them additional information and knowledge to help make their strategic decisions; mainly comparing the individual bank to the market as a whole. The major stakeholders that will be able to benefit from this study are the customers, employees, investors, bank management, regulating authorities and the government policy makers.

This paper will provide important information to local and international investors a different perspective on how efficient the banking industry in the United Arab Emirates is. Apart from giving an overall view on the general level of efficiency in the industry, this study aims to identify the most efficient banks in the industry to and provide additional support and a clearer decision when deciding on investment and diversification strategies.

For bank management it will provide upper management with an idea on where there banks stands among the competition in terms of efficiency. This is important as with additional research and internal inter-branch or inter-department efficiency testing, they will be able to identify exactly where there lies the opportunity to either increase output with the same level of resources or to be able to cut back on unnecessary usage of resources without the sacrifice of output.

For the regulators of the United Arab Emirates economic, fiscal, monetary and banking policies this study will provide an in depth evaluation of the health of the efficiency of the operational and intermediary role efficiencies of the commercial banks and allow them to then adjust and act accordingly to meet their long term economic goals.

For the bank management, this paper will also bring to light the required optimization levels needed to bring the bank to the efficiency frontier and be a guide to adjust their strategies accordingly. Regulators and the United Arab Emirates Central Bank will be able to better evaluate the market at a macroeconomic level and manage their policies accordingly. Investors will also now be able to make key and informed decisions on picking their next investments where other methods of evaluation may lack quality information.

1.4 LIMITATIONS TO THE STUDY

The major limitations or obstacles faced by this study are the general lack of information available to the public. Firstly, we faced the lack of publicly available information of the foreign banks as there are no separate financial statements available to researches or investors for the United Arab Emirates' activity. This means that all foreign banks had to be omitted from the study.

The second major area of lack of information is with the few national banks with no public financial information available. This is mainly due to them being privately owned (Mashreq Bank), a subsidiary of a larger bank with no or missing separate financials (Emirates Islamic Bank) or the fact that they are new and do not have the sufficient amount of financial information available (Ajman Bank).

To overstep these limitations I concentrated on the study on the national banks without including the few national banks with missing/no information. As the 15 out of the 23 national banks included in this study include the majority of major banks in the United Arab Emirates banking industry I believe that they are sufficient to show a clear picture of the banking industry as a whole.

1.5 RESEARCH QUESTIONS

This study intends to answer the following questions:

- **Question one:** What are the most efficient banks in the United Arab Emirates in an operating perspective and what is required by the less efficient banks to become efficient?
- **Question two:** What are the most efficient banks in the United Arab Emirates in a financial intermediary perspective what is required by the less efficient banks to become efficient?
- **Question three:** What banks can be used as benchmarks for the different efficiency approaches?
- **Question four:** What information and knowledge can be provided on the general efficiency of the United Arab Emirates banking sector?

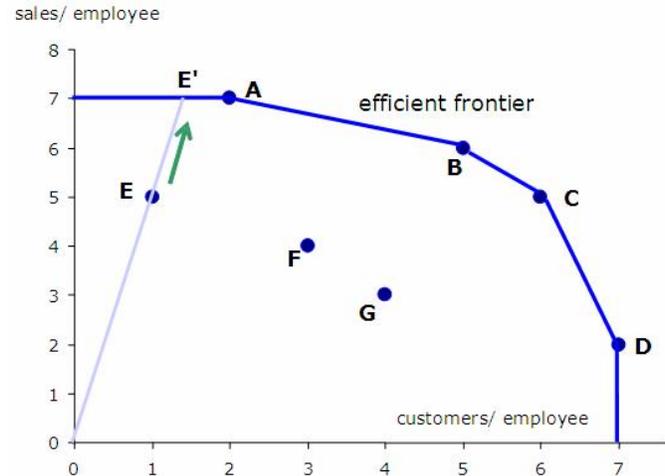
1.6 DATA ENVELOPMENT ANALYSIS

A Good definition of data Envelopment Analysis can be found in Jemric and Vujcic's 2002 paper where they say that "Data Envelopment Analysis is a nonparametric, deterministic methodology for determining the relatively efficient production frontier, based on the empirical data on chosen inputs and outputs of a number of entities called Decision Making Units". (Jemric, 2002)

Introduced in 1957 by M.J. Farrell (Farrell, 1957) and further enhanced by Charnes (Charnes, 1978), Data Envelopment Analysis, or also known as Frontier Analysis, is an efficiency measurement tool that utilizes the methods of linear programming. By using a combination of inputs (resources) and outputs (results) Data Envelopment allows us to measure the relative efficiency of different Decision Making Units. Each Decision Making Unit can be a business unit, organization, individual person or any producing unit whose relative efficiency is to be compared to another similar unit. Data Envelopment Analysis was introduced for analyzing efficiency of units where traditional methods such as ratio analysis failed or was ineffective due to two Decision Making Units having a different quantity of inputs and outputs or due to strategic managerial decisions where a different mix of assigned weights are being used for each available input to produce a varied required set of outputs. According to Gavirneni the Data Envelopment Analysis technique was developed and highly successful in overcoming these difficulties in several industries that include but are not limited to banking, healthcare, military, education and many other fields. Basically the result of Data Envelopment Analysis is the identification of the highest efficient

Decision Making Units and the plotting of them on the efficiency frontier where the relatively less efficient DMUs fall below the efficiency frontier (Gavirneni, 2006).

The graph on the right displays a simplified version of the efficiency curve for a retail store where the inputs were the employee costs and the outputs were the number of customers served and the sales made. The points of A to D are the Decision Making Units that are on the efficiency curve and display the most efficient utilization of their inputs to produce outputs and points E to G are the Decision Making Units that are relatively less efficient. Point E' and the line connecting it to point E show the distance or additional outputs able to be produced to reach the frontier curve while keeping a proportionately lower utilization of inputs.



When comparing Data Envelopment Analysis to Regression Analysis there are several key advantages of the former over the latter. The main difference between Regression and Data Envelopment Analysis is the fact that Data Envelopment Analysis treats each Decision Making Unit individually where regression generalizes the behavior of the different Decision Making Units. According to Jermic and Juvic, Data Envelopment Analysis is based on external observations where regression Analysis depends on the analysis of central tendencies of the group. This basically means that Regression Analysis would use a single mathematical formula and apply it to all individual DMUs where Data Envelopment Analysis would apply individual weights for each DMU relative to the sample and an individual efficiency equation to each Decision Making Unit as well. (Jemric, 2002)

Data Envelopment Analysis does not come without its disadvantages. Data Envelopment analysis has one key disadvantage, highlighted by Moffat and Valadkhani, which is that due to the consideration of all decision making units under the efficient frontier being inefficient and the assumption of the non-existence of random errors of measurement, extreme observations in Data Envelopment Analysis can be effected by the high tendency to be highly sensitive to these observations. (Moffat, 2009) (Jemric, 2002)

There are many different methods and models of Data Envelopment Analysis with the main model being the CCR model named after the authors Charnes, Cooper and Rhodes (Charnes, 1978) and the BCC model also named after the authors Banker, Charnes and Cooper (Banker, 1984). The main difference between the two models is that the CCR model assumes constant returns to scale where the BCC model assumes variable returns to scale. The model used in this study is the CCR model as both Noulas (Noulas, 2001) and Berg (Berg, 1991) agree that the BCC model raises the possibility of errors in efficiency results between banks with different sizes where larger banks will appear to efficient simply due to the fact that there are no truly efficient banks.

1.7 CCR MODEL

As mentioned previously, the Data Envelopment Analysis technique used to measure the efficiency of the national commercial banks that was used in this study is the CCR Model that was developed by Charnes, Cooper and Rhodes in 1978. The CCR Model uses the maximum ratio of weighted outputs to weighted inputs in order to obtain an efficiency score for each decision making unit in the study. The basic formula for this model is as follows:

$$DMU \text{ Efficiency Score} = \frac{\text{Weighted Sum of Outputs}}{\text{Weighted Sum of Inputs}}$$

The way this method works is where each of the weighted sums of outputs and weighted inputs is turned into a 'Virtual Output' and 'Virtual Input' using yet unknown weights (v_i) and (u_r) where:

$$\text{Virtual Input} = v_1 x_1 + \dots + v_m x_m$$

$$\text{Virtual Output} = u_1 y_1 + \dots + u_m y_m$$

In the CCR Model the weights are derived from the data itself and not pre-determined weights where each Decision Making Unit is given the best set of weights that maximizes the ratio scale. This means that each Decision Making Unit may have a different set of weights form another. The main condition on the efficiency formula is that the weights cannot be negative and that the efficiency score cannot be higher than one.

To conclude, the below output oriented linear programming model needs to be run for each of the Decision Making Units in the study:

$$\max h_0(u, v) = \frac{\sum_{r=1}^s u_r y_{r0}}{\sum_{i=1}^m v_i x_{i0}}$$

Subject to:

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1; \quad j = 1, 2, \dots, n$$

$$u_r, v_i \geq 0; \quad r = 1, 2, \dots, s; \quad i = 1, 2, \dots, m$$

Where:

y_{rj} = the amount of (positive) output utilized by the j^{th} DMU

x_{ij} = the amount of (positive) input utilized by the j^{th} DMU

u_r is the weight given to output r

v_i is the weight given to input r

In order to make the above linear programming model compatible with most linear programming software, it can be rewritten as follows:

$$\max z_0 = \sum_{r=1}^s v_r y_{r0}$$

Subject to:

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} \leq 0 ; j = 1, 2, \dots, n$$

$$\sum_{i=1}^m v_i x_{i0} = 1$$

$$u_r \geq 0 ; r = 1, 2, \dots, s$$

$$v_i \geq 0 ; r = 1, 2, \dots, m$$

Once the above is run for each and every Decision Making Unit and the best suitable weights are assigned to maximize each individual Decision Making Unit's efficiency score we will have a table of results where the efficient Decision Making Units will have a efficiency score of one (or 100%) and any relatively lower efficient Decision Making Units will have an efficiency score between zero and one (or 100%.) (Chansarn, August 2008) (Gavirneni, 2006)

2. LITERATURE REVIEW

This section will cover the key articles reviewed throughout the research process and include the supporting articles behind the reasoning and methodology used in this study. At the end I will conclude with a summary of my review and the main comments and criticisms that I have.

2.1 KEY ARTICLES

THE IMPORTANCE AND USES OF DATA ENVELOPMENT ANALYSIS

Data Envelopment Analysis originated in 1957 in the paper called ‘The Measurement of Productive Efficiency’ by M. J. Farrell and that was published in the Journal of the Royal Statistical Society. In this paper Farrell explains the problem at the time of a lack of accurate measurement of productive efficiency and the ability of a certain industry to increase its output by simply increasing efficiency without the use of additional inputs. He mentions that till the time of his paper that a number of attempts had been made to solve this problem; however, they all failed partly due to the error of measuring efficiency based solely on labor output without counting for other inputs or a method using ‘indices of inputs’ which run into the traditional index number problems. His model was designed for ‘everyday’ businessmen, policy makers, academics and other interested persons with limited mathematical capability and that takes into account all inputs without the problems of index numbers and that is applicable to a wide range of industries.

The Data Envelopment Model used in this study is the same method outlined in Charnes, Cooper and Rhodes (1978) article called ‘Measuring the efficiency of decision making units.’ This paper presents a revision of an earlier method also by them where they describe a model of nonlinear programming model in measuring the efficiency of ‘decision making units.’ The CCR Model uses common inputs and outputs of the different Decision Making Units and by applying different weights to the inputs and outputs in order plot the Decision Making Units on a frontier where the most efficient producing Decision Making Units will be on the frontier and the less efficient ones will be below. There method was aimed at evaluation of non-profit organizations mainly due to its study of the non-financial aspects of the Decision Making Unit. It is mentioned that the model can be used to measure efficiency of utilization of resources and can therefore be applied to many industries such as schools, hospitals, banks and any other industry that has easily definable inputs and outputs.

A second Data Envelopment Analysis approach which is widely used is the one further developed by Banker, Charnes and Cooper in their 1984 study and that is called the BCC approach was also looked into for the purpose of this study. However; after going through different Data Envelopment Analysis studies in the banking industries of different countries, this model was seen to be inaccurate and prone to skewed results which may negatively impact the effectiveness of the study. These will be pointed out later on when discussing other studies and in the main body of the paper.

In order to provide further insight to the usefulness and importance of the Data Envelopment Analysis technique as a tool for powerful analysis, Gavirneni in his 2006 paper, provided a case study of Alphachem, a multinational chemical company. In this case he shows how Data

Envelopment Analysis is sometimes the only tool available for management to efficiently assess the efficiency of their individual decision making units due to the nature of these units.

Among the many different methods of measuring the efficiency of commercial banks; whether, they be through financial ratios, data envelopment analysis, stochastic frontier analysis or any of the various methods used, it has been shown that the use of data envelopment analysis (DEA) has been a commonly used and successful method in obtaining dependable results. Berger and Humphrey (1997) have provided us a study in which they surveyed and reviewed 130 efficiency studies of financial institutions across 21 different countries, specifying the different methods used and any shortcomings or improvements that could have been used instead. I have included below some of the key studies they have reviewed including some of the most recent ones.

In the 1991 paper by Berg, Forsund and Jansen, titled ‘Technical Efficiency of Norwegian Banks: The Non Parametric Approach to Efficiency Management,’ an important method of data envelopment analysis was defined and developed and used which is the ‘output method.’ This method measured the efficiency of different banks by taking into consideration the inputs of interest and non-interest expense and the outputs of interest and non-interest revenue. This method was later used by many authors such as Noulas (2001), Tamimi (2004) and others. Another key point was stated through their study which was that the BCC model could introduce misconceptions in the results where large banks appear to be more efficient for the simple fact that no banks are truly efficient.

One of the most basic and commonly used approaches is the one used by Noulas (2001) in his study of Greek banks where the effect of deregulation of private and state controlled banks. His Data Envelopment Analysis showed that a gap in efficiency levels was present yet not significant. Noulas’ model employed a Data Envelopment Analysis approach where the inputs were Interest and Non-Interest Expense and the outputs were Interest and Non Interest Revenues. This approach is the same as one of the approaches used in this study and which is referred to as the ‘Traditional Operating Approach.’

In 2008 Chansarn provided us with further insight on the detailed calculations behind the data envelopment analysis model as well as outlining the two approaches which are a base to this study. These approaches are the operational efficiency and the intermediary role efficiency of banks. This was a study of 13 Thai banks split into three groups of large, medium and small banks. However; Avkiran(2001) both show that although Chansarn shows that banks in all groups are efficient, these results may not be completely accurate as this categorization resulted in the number of decision making units lower than the amount of inputs and outputs. This extremely low number of decision making units may mean that the Data Envelopment Analysis model may fail to accurately discriminate between the different decision making units studied. (Avkiran, 1999)

LOCAL AND REGIONAL DATA ENVELOPMENT ANALYSIS STUDIES

Noulas’s approach was again replicated for the United Arab Emirates Banks by Al Tamimi (2004) in his study that analyzed the efficiency differences between national and foreign banks in the United Arab Emirates over the period of 1997-2001. His study used the same inputs and outputs as

Noulas(2001) but also employed the traditional techniques of ratio analysis and used the ratios of Return on Assets, Return on Equity, Loans to Deposits and Loans to Assets. This was an attempt to measure the efficient use of available resources (mainly deposits and funds available to them) and to measure any consistency or relation between the traditional ratio approach and the data envelopment analysis approach.

In 2004 Tamimi, who is an Associate Professor at the College of Business Management at the University of Sharjah, wrote an article on the efficiency of the banks in the United Arab Emirates using both of Data Envelopment Analysis and traditional ratio analysis. His main concern was a comparison between the national and non national banks over the years of 1997-2001. The main conclusions of this study were that banks were generally inefficient and had a low utilization of resources. This was shown through both the data envelopment analysis methods and the traditional ratio analysis. Finally he mentions that the differences in results of using different methods were consistent with previous studies of the comparison of these traditional and non-traditional approaches to efficiency analysis in banking.

In 2010 Khaddaj studied the Syrian banking industry using the operating approach previous used by all of Berg, Noulas and Tamimi to analyze the recent privatization of Syrian banks and the effects of such on the efficiencies. Khaddaj further goes to criticize Tamimi's approach whereby "the comparison used would have been further elaborated by adding the Data Envelopment Analysis Intermediation approach used paper's since the latest two ratios used by Al-Tamimi Loans To Assets and Loans To Deposits represents the intermediation approach more than the operating approach" (Khaddaj, 2010) Therefore, in this study I took Khaddaj's opinion in to consideration and applied the recommendations set forth by him to see if any further elaboration could be observed.

In 2002, Jemric and Vujcic studied the Croatian banking industry and included some very important points in their study. They stressed on the importance of efficiency analysis for policy makers and highlight the key differences between Data Envelopment Analysis and regression models and why Data Envelopment Analysis is more relevant to this industry. Finally, they concluded that age played an important role in the efficiency of banks and that older banks were seen to be more efficient. This point was also observed by Khaddaj. However; in this study age was seen to be irrelevant. This is probably due to the large concentration and competition among banks forcing all the banks to be at similar efficiency levels.

FURTHER STRENGTHS AND LIMITATIONS OF DATA ENVELOPMENT ANALYSIS

Moffat and Valadkhani provide some key supporting information on the strengths and limitations of the Data Envelopment Analysis approach when used. These points were essential in the selection of the Data Envelopment Analysis model for my study over some of the more traditional parametric approaches available. Due to the relatively small sample size in the study they mention that the nature of Data Envelopment Analysis can overcome this problem Furthermore, they mention that compares to regression analysis, Data Envelopment Analysis each unit separately and provides unique 'best practice' scenarios whereby regression analysis does not. They also highlight the key disadvantage of the Data Envelopment Analysis model where the efficiency frontiers suffers high

sensitivity to extreme observations and errors of measurement as a key assumption in the Data Envelopment model is the lack of random errors of measurement and the consideration of all units under the frontier as inefficient.

OTHER SOURCES USED

The Emirates Bankers Association annually produces an annual report where they provide all the key figures relating to the finance and banking industry in the United Arab Emirates. These figures cover national banks and foreign banks (when data provision allows). The data from this report mainly revolved around the size and number of banks and their respective branches as well as the net loans, assets and deposits of the banks in the United Arab Emirates. The facts and figures from the 2011 annual report were used to compare the banking industry from the time of this study to the previous study done by Tamimi in 2004 and highlight the large growth that the country has experienced in the banking industry which validated the need to compare the current efficiency analysis of banks in the recent years to the study previously done.

The World Economic Report provided by the International Monetary Fund website was another key source of key micro and macro-economic information that also further showed the large growth of the United Arab Emirates Economy from the 1997-2001 periods to the period of this study. The information provided here was less directly from the banking industry and more general economic data such as Gross GDP of the United Arab Emirates and where it fits in among its neighboring countries in the GCC.

An article found on Zawya.com, which are the comments by Fitch on the UAE banking industry for 2009, also provided key insight on activity in the industry that may have contributed to the reasons for fluctuations in results for that year.

2.2 COMMENTS AND CRITICISMS

The literature selection used provides a in depth look into the models used in this study from the initial founders of the model and several further studies where the same model has been used. They highlight the key strengths, weaknesses and recommendations for use of the model in relation to other models available and highlight why the selection was made for the model that would be used.

The key inconsistency found between this study and those of previous was the difference when factoring age of the bank into the efficiency equation. In the studies of Khaddaj and Jermic it was found that age and efficiency were positively correlated and in this study it was found to have little or no effect. However; this inconsistency had little effect on my study as this factor was only related to one research question and differences may have been due to the different structures in the different countries banking industries.

These strengths, weaknesses and recommendations were all taken in to consideration throughout this study and have shown further consistency in results to the original study and the supporting studies that followed. All together, the literature provided me the foundation and confidence in which to base my study upon and to set this study as a base for further supportive and complimentary research in the field or other related fields.

3. RESEARCH METHODOLOGY

As previously specified, this study compares and analyses the relative efficiency through the CCR model of data envelopment analysis of the national banks in the United Arab Emirates over the period of 2008 to 2012. The methodology will include the rationale behind my selection of sample, data collection methods, Data Envelopment Analysis approaches used and the rationale behind the different inputs and outputs used in each approach.

3.1 DATA SAMPLE

For this study I selected 15 out of the 23 banks. The list of banks included in the study is the following:

#	Bank Name	Established
1	Emirates NBD	1963
2	United Arab Bank	1975
3	National Bank of Abu Dhabi	1968
4	Commercial Bank of Dubai	1969
5	Abu Dhabi Commercial Bank	1985
6	First gulf Bank	1979
7	National Bank of Umm Al Quwain	1982
8	Invest Bank	1975
9	RAK Bank	1976
10	National Bank of Fujairah	1982
11	Dubai Islamic Bank	1975
12	Sharjah Islamic Bank	1975
13	Commercial Bank International	1991
14	Union National Bank	1982
15	Abu Dhabi Islamic Bank	1997

Foreign banks operating in the United Arab Emirates were excluded as even though they share a significant market share in the United Arab Emirates, they have no publicly available financial statements for the region. Thus; meaning that collecting sufficient information to include them in the study was not possible.

In this study Islamic banks and the Islamic divisions of conventional banks were included in the calculations of inputs and outputs. The profits earned of distributed to investors for the different Islamic banking products and services was used in replacement of the interest income or expense due to the same nature and role in the financials of the Decision Making Unit when calculating the end of year balance sheet and income statement.

Out of the national banks, 8 banks were excluded for the following reasons:

- Hilal Bank, Bank of Sharjah, ARBIFT for lack of 2012 data
- Ajman Bank due to lack of information as it was established in 2008
- Dubai Bank and Emirates Islamic Bank due to them being subsidiaries of ENBD group and not all information is publicly available.
- Mashreq Bank and Noor Bank due to their private nature and lack of detailed public financials.

A year by year analysis of the yearend financial data provided from the Bank Scope Database was used to calculate the different inputs and outputs of the four different approaches used in the CCR Data Envelopment Analysis model.

3.2 INTRODUCTION TO D.E.A. APPROACHES

The four different approaches used are the following and will be explained in more depth later on in the paper.

- I. Time Based Operational Approach - An approach measuring the operational efficiency of the DMU with consideration of its age.
- II. Traditional Operational Approach - An approach measuring the operational efficiency of the DMU without consideration of its age.
- III. Time Based Intermediary Approach - An approach measuring the efficiency of the DMU as a financial intermediary with consideration of its age.
- IV. Traditional Intermediary Approach - An approach measuring the efficiency of the DMU as a financial intermediary without consideration of its age.

When it came to the accounting for age, in terms of years in operation, of the institution in the time based models the key aim was to analyze if the presence of a learning curve was observable whereby the newer banks would be generally less efficient than the older banks. This was tested through the research questions using the two time based DEA approaches.

In order to run the model and calculate the results the freely available software 'MAX DEA V5.2' which was developed by Cheng Gang from the China Centre for Health Development Studies, Peking University and Qian Zhenhua from School of Science, University of Science and Technology, Beijing.

3.3 D.E.A. APPROACHES USED (IN DEPTH)

In this study, four different data envelopment analysis approaches were used. Each approach includes its own set of inputs and outputs that were inputted into the software in order to test the different variables that may affect the efficiency of the banks. Each approach contains a brief description of the approach and the reasoning behind it followed by a more detailed list of inputs and outputs. The results of each approach are discussed further on in the paper.

3.2.1 TRADITIONAL OPERATING APPROACH

The Traditional Operating Approach measures the relative efficiency of the different DMUs by comparing the costs and revenues of the DMU without consideration for the years in operation. This approach, compared to the time based approach, will enable us to see the relative efficiencies of the banks and compare these relative efficiencies to the time based method.

INPUTS

I.	[IE]	Interest Expense	(AED '000,000)
II.	[NE]	Non Interest Expense	(AED '000,000)

OUTPUTS

I.	[IR]	Interest Revenue	(AED '000,000)
II.	[NR]	Non Interest Revenue	(AED '000,000)

3.2.2 TIME BASED OPERATING APPROACH

The Time Based Operating Approach measures the relative efficiency of the different DMUs by comparing the costs and revenues of the DMU with consideration for the years in operation. The time factor is present here to evaluate whether or not the age of the bank has any relation to the relative efficiency of the bank to its peers.

INPUTS

I.	[YO]	Years of Operation	(Number of Years) – Uncontrolled
II.	[IE]	Interest Expense	(AED '000,000)
III.	[NE]	Non Interest Expense	(AED '000,000)

OUTPUTS

I.	[IR]	Interest Revenue	(AED '000,000)
II.	[NR]	Non Interest Revenue	(AED '000,000)

3.2.4 TRADITIONAL INTERMEDIARY APPROACH

The Traditional Intermediary Approach measures the relative efficiency of the different DMUs by comparing the costs and available deposits and funds with the outputs of loans and net investments by the bank. This approach seeks to evaluate the efficient use of its inputs to provide financial services and investments for its relevant clients and returns for shareholders without considering the experience gained through years of operation. This approach, compared to the time based approach, will enable us to see the relative efficiencies of the banks and compare these relative efficiencies to the time based method.

INPUTS

I.	[IE]	Interest Expense	(AED '000,000)
II.	[NE]	Non Interest Expense	(AED '000,000)
III.	[DP]	Deposits/Funds Available for Investments	(AED '000,000)

OUTPUTS

I.	[LA]	Loans and Advances	(AED '000,000)
II.	[NI]	Net Investments	(AED '000,000)

3.2.3 TIME BASED INTERMEDIARY APPROACH

The Time Based Intermediary Approach measures the relative efficiency of the different DMUs by comparing the costs and available deposits and funds with the outputs of loans and net investments by the bank. This approach seeks to evaluate the efficient use of its inputs to provide financial services and investments for its relevant clients and returns for shareholders while considering the experience gained through years of operation. The time factor is present here to evaluate whether or not the age of the bank has any relation to the relative efficiency of the bank to its peers.

INPUTS

I.	[YO]	Years of Operation	(Number of Years) – Uncontrolled
II.	[IE]	Interest Expense	(AED '000,000)
III.	[NE]	Non Interest Expense	(AED '000,000)
IV.	[DP]	Deposits/Funds Available for Investments	(AED '000,000)

OUTPUTS

I.	[LA]	Loans and Advances	(AED '000,000)
II.	[NI]	Net Investments	(AED '000,000)

3.3 DATA CALCULATION ASSUMPTIONS

INPUTS/OUTPUTS

In order to calculate the different inputs and outputs the below figures from the financial statements were captured along with the reasoning for each

INPUTS

- ❖ [YO] Years In Operation : *The Number of years from establishment to the year of the reported financials being used*
- ❖ [IE] Interest Expense
 - *The interest paid on customer deposits*
 - *The amount of interest paid on other interest bearing deposit, borrowings or securities*
- ❖ [NE] Non Interest Expense
 - *Staff costs*
 - *Other operational expenditure*
- ❖ [DP] Deposits/Funds Available for Investments
 - *Total Deposits, Money market and short term borrowing*
 - *Long term funding*
 - *Derivatives*

OUTPUTS

- ❖ [IR] Interest Revenue
 - *Interest income on loans*
 - *Other interest income*
- ❖ [NR] Non Interest Revenue
 - *Net Gains/Losses on trading, derivatives and other securities*
 - *Net fees and commissions*
 - *Other operating income*
- ❖ [LA] Loans and Advancements
 - *Gross Loans which includes Residential/mortgage, consumer, corporate and other loans.*
 - *Gross loans excludes impaired and non-performing loans*

- ❖ [NI] Net Investments
 - *Loans and Advanced to other banks*
 - *Total Securities (derivatives and securities for trading, held to maturity and for sale)*
 - *Investments in property*

GENERAL ASSUMPTIONS

The below assumptions were used when calculating the different inputs and outputs used for the above approaches and clarify the reasoning behind the different inputs in an attempt to ensure a standard approach when running the models.

- ❖ In the case of Institutions with Islamic subsidiaries that are consolidated within the parent bank's financial statements, profits from Islamic finance were considered under the IE figure due to the nature of the expense and its similar function.
- ❖ In the case of Institutions with Islamic subsidiaries that are consolidated within the parent bank's financial statements, profits distributed to depositors were considered under the IR figure due to the nature of the expense and its similar function.
- ❖ Years of Operation used are the number of years from year of study since the year of establishment.
- ❖ All non operational expenses/losses/gains were not included such as the following:
 - FX devaluation on non-tradable or balance sheet assets
 - Credit devaluation
 - Net provisions/re attained provisions
 - 'Other revenues' due to non recurring nature
- ❖ Revenue generating deposits in other financial institutions were considered as investments.
- ❖ Deposits from other financial institutions in the bank were considered as deposits available for investment

4. RESULTS AND DISCUSSION

In this section I will discuss the main results found for each approach and include any major observations or findings that I have come across. Observations and findings will also be compared to the observations and findings of similar studies in the past using the same or similar methods.

TRADITIONAL OPERATING APPROACH

BANK	2012	2011	2010	2009	2008	Mean	St. Dev.
ADCB	77.78%	69.51%	75.92%	75.48%	80.22%	75.78%	3.55%
ADIB	73.41%	78.71%	80.46%	78.57%	89.00%	80.03%	5.07%
CBD	100.00%	94.17%	91.91%	81.56%	100.00%	93.53%	6.78%
CBI	67.52%	57.48%	59.37%	53.33%	67.45%	61.03%	5.62%
DIB	70.82%	68.60%	68.89%	68.13%	79.10%	71.11%	4.10%
ENBD	83.02%	88.01%	74.56%	73.05%	77.87%	79.30%	5.54%
FGB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
INVEST	96.52%	98.14%	100.00%	100.00%	100.00%	98.93%	1.41%
NBAD	94.05%	83.01%	88.19%	86.61%	91.61%	88.69%	3.85%
NBF	89.79%	88.20%	79.22%	67.76%	78.74%	80.74%	7.90%
NBQ	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
RAK	100.00%	100.00%	82.96%	97.86%	100.00%	96.16%	6.65%
SIB	60.36%	60.41%	62.89%	59.47%	76.50%	63.93%	6.39%
UArB	97.24%	100.00%	100.00%	100.00%	100.00%	99.45%	1.11%
UNB	94.21%	91.56%	89.21%	97.06%	93.55%	93.12%	2.63%
Mean	86.98%	85.19%	83.57%	82.59%	88.94%		
St. Dev.	13.21%	14.45%	13.16%	15.60%	10.89%		

As mentioned earlier the traditional approach is the same approach used by Tamimi (Tamimi, 2004) in his earlier study and here I will first discuss the results I found among the different years and the compare these observations to his while keeping in consideration that his study included both foreign and national commercial banks and this study only counts for national banks.

2008

In 2008 we can see that there were six efficient banks on the efficient frontier and all with an efficiency score of 100% (40% of banks). These banks are Commercial Bank of Dubai, First Gulf Bank, Invest Bank, National Bank of Umm Al Quwain, The National Bank of Ras Al Khaima (RAK Bank) and United Arab Bank. This means that for these six national commercial banks the proportion of outputs to inputs and utilization of resources have been the highest relative to the less efficient banks. For the banks that did not achieve the 100% efficiency score, we can observe that the same level of output can be achieved by reducing the level of inputs required or that an

increase of outputs can be achieved using the same level of inputs. For the nine banks that received efficiency score lower than 100% an increase of outputs equal to the difference between the 100% efficient score and the score they received while keeping inputs constant is needed in order for them to reach the efficient frontier. For example, in 2008, the National Bank of Abu Dhabi received an efficiency score of 91.61% meaning that an increase in outputs of 8.39% is required to reach the efficiency level of the efficient commercial banks. However; with all this in mind we can also see a mean efficiency score of 88.94% among the rest of the national commercial banks which means that there is a generally high level of efficiency among the competitors. This may be due to the large concentration of commercial banks that are all providing very similar products with similar profit margins to a limited customer base.

2009

In 2009 it can be observed that there was a decline in the number of efficient banks to 4 banks (27% of banks). In this year both of the Commercial Bank of Dubai and RAK Bank left the list of efficient banks with the Commercial Bank of Dubai dropping to 81.56%. Overall we also see a drop in the average efficiency score from 88.94% to 82.59% showing a general decrease in the efficiency of resource utilization across the board. This could be due to the general slowdown in the banking industry where all banks suffered from the amassed bad debt in their books caused by loans affected by the real estate crisis as well as the large amount of government lending that worldwide investors were worried might result with a default. Banks interest margins also suffered with a total net profit decline of over 19% in 2009. (Zawya.com, 2009)

2010-2012

In the years of 2010-2012 we can see steady growth in the mean efficiency score where it gradually grows close to its 2008 number with a score of 83.57 in 2010, 85.19 in 2011 and 86.98 in 2012. Over the three years the number of efficient banks was constant at four banks with First Gulf Bank and the National Bank of Umm Al Quwain on the efficient frontier throughout the whole five year period. The remaining efficient banks that moved on and off the frontier curve were all from the original six efficient banks in the year of 2008. This information is positive as it shows a general return to efficiency for the national commercial banks of the United Arab Emirates and that if growth in efficiency is constant that within the next couple of years they should have reached or passed the 2008 figure.

Comparison to Tamimi's study

In Al Tamimi's study over the years of 1997 to the year of 2001 and using the same inputs and outputs as this study of national and foreign commercial banks in the United Arab Emirates he showed that national commercial banks had efficiency scores varying from 74.5% in 1998 to 89.9% in 2001 and numbers in between for the other years. He also mentioned that in general commercial banks in the United Arab Emirates and especially the national banks were generally efficient compared when compared to each other; however, the year on year change was much larger than the period examined here. (Tamimi, 2004) This shows a relatively higher instability in achieving constant levels of efficiency. This wide variance compared to the smooth and steady changes in the mean efficiency score in this study, even considering the huge shock the banking sector took in

2009, shows that in general the national commercial banks in the United Arab Emirates are much more in control and able to utilize their resources to the highest possible levels of efficiency.

TIME BASED OPERATING APPROACH

BANK	2012	2011	2010	2009	2008	Mean	St. Dev
ADCB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
ADIB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
CBD	100.00%	100.00%	96.50%	88.34%	100.00%	96.97%	4.52%
CBI	68.35%	58.90%	61.15%	63.01%	72.59%	64.80%	4.99%
DIB	75.85%	75.33%	76.38%	80.46%	87.59%	79.12%	4.61%
ENBD	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
FGB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
INVEST	96.52%	98.14%	100.00%	100.00%	100.00%	98.93%	1.41%
NBAD	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
NBF	89.79%	89.38%	79.22%	68.41%	83.34%	82.03%	7.87%
NBQ	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
RAK	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
SIB	60.36%	60.74%	64.87%	62.05%	77.40%	65.09%	6.36%
UArB	97.24%	100.00%	100.00%	100.00%	100.00%	99.45%	1.11%
UNB	94.21%	91.56%	90.24%	97.06%	100.00%	94.61%	3.57%
Mean	92.15%	91.60%	91.22%	90.62%	94.73%		
St Dev	12.62%	14.07%	13.38%	14.17%	9.23%		

In the time based operating approach all inputs and outputs were kept constant except for the addition of the number of years since inception in an attempt to see if the age of the bank had any effect on the efficiency of the bank. Two main expectations or theories were present. The first was that banks would show a positive relationship between efficiency and age whereby as a bank grows and learns it is now more able to manage the efficient utilization of resources. The second possible expectation would be that newer banks with fresh and experienced minds would be able to identify the areas of inefficiency in the older banks and thus avoid them occurring in the new banks that were trying to correct and streamline these areas of inefficiency that may be present in their organizations.

However; in this particular study adding the number of years resulted in a general and overall increase in the mean efficiency scores of the banks in the study and that eleven out of the fifteen banks were now efficient in 2008. When looking at the trends over the years and comparing bank to bank numbers we can see that the general trend in efficiency is the same with a high in 2008 followed by a severe drop in 2009 and steady growth after that where the efficiency score is approaching the 2008 high in 2012. Bank to bank comparisons show that for the banks that suffered the worst efficiency scores in the traditional operating approach are also the least

relatively efficient banks in the time based approach as well. These banks are Sharjah Islamic Bank, Commercial Bank International and Dubai Islamic Bank.

To conclude, adding the number of years to the study is inconclusive and seems only to distort the results by over inflating efficiency scores and compressing the results so less efficient banks appear to be on the efficient frontier. This means that it is difficult to differentiate between the relatively efficient and inefficient banks. This difference Khaddaj's study of Syrian banks could be the fact that the general age difference of the commercial banks in the United Arab Emirates is much higher where the United Arab Emirates bank's ages ranged from 16 to 40 years of age and the banks studies in Khaddaj's study had an age range of 4 to 6 years of age. (Khaddaj, 2010)

TRADITIONAL INTERMEDIARY APPROACH

Bank	2012	2011	2010	2009	2008	Mean	St. Dev
ADCB	92.90%	91.80%	94.55%	96.22%	95.46%	94.18%	1.63%
ADIB	78.60%	84.82%	82.73%	87.81%	73.00%	81.39%	5.16%
CBD	100.00%	100.00%	97.86%	100.00%	93.29%	98.23%	2.61%
CBI	98.63%	90.47%	93.66%	100.00%	98.60%	96.27%	3.61%
DIB	73.81%	73.72%	83.92%	74.83%	68.77%	75.01%	4.93%
ENBD	100.00%	99.87%	89.76%	96.44%	86.97%	94.61%	5.33%
FGB	100.00%	100.00%	100.00%	100.00%	96.23%	99.25%	1.51%
INVEST	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
NBAD	100.00%	100.00%	100.00%	100.00%	95.16%	99.03%	1.94%
NBF	91.42%	93.63%	92.78%	90.41%	82.56%	90.16%	3.96%
NBQ	100.00%	100.00%	93.95%	100.00%	100.00%	98.79%	2.42%
RAK	98.93%	95.35%	96.37%	100.00%	90.15%	96.16%	3.44%
SIB	83.08%	82.69%	81.98%	92.81%	87.24%	85.56%	4.06%
UArB	95.97%	100.00%	100.00%	100.00%	100.00%	99.19%	1.61%
UNB	95.45%	97.20%	93.80%	95.02%	100.00%	96.29%	2.15%
Mean	93.92%	93.97%	93.42%	95.57%	91.16%		
St Dev	8.32%	7.76%	6.07%	6.75%	9.56%		

The key purpose of the traditional intermediary approach was to define and identify efficiency criteria and levels of the different national commercial banks in the United Arab Emirates as the role of financial intermediaries in the economy and their efficiency in utilizing the resources of interest expense, non interest expense and the additional input of deposits and funds available to the banks for investments and loans. The banks with the highest relative levels of loans and investments issued were the banks seen as most efficient in providing the financial intermediary role in the economy. This is different to the operating approach where we were comparing the relative efficiency of generating interest and non interest income from the efficient utilization of interest and non interest expense.

2008

In 2008 we can see that there were four efficient banks (26% of banks) on the efficient frontier and all with an efficiency score of 100%. These banks are Invest Bank, National Bank of Umm Al Quwain, United Arab Bank and Union National Bank. This means that these four banks showed the highest level of efficiency in their role as financial intermediaries in the economy and the highest level of utilization of available funds in their investments and loans provided. The banks that did not achieve the 100% efficiency score it can be observed that for the same level of funds available to them a higher amount of investments and providing of loans can be achieved or that with the same level of loans and investments that they could reduce the amount of funds that they hold and possibly reduce the amount of unnecessary cost of holding these funds.

For the eleven banks that have efficiency scores lower than the 100% efficient frontier score, an increase of loans and investments is possible by the difference between the 100% efficient score and the score they received while keeping the amount of funds available to them constant. By doing this they will be able to reach the efficient frontier. For example, Dubai Islamic Bank achieved a traditional intermediary approach efficiency score of 75.01% which means that they can enjoy a proportionate increase in investments and loans of 24.99% while keeping available funds constant to achieve the efficient frontier status. We can also see an overall mean efficiency score of 91.16% among the national commercial banks in the United Arab Emirates which shows a generally high level of intermediary role efficiency in the United Arab Emirates banking sector. This high level of efficiency shows consistency in the industry and may be the cause of the general high level of competitiveness and relatively limited market size available to the banks making efficiency extremely important in order to survive in the market.

2009

In 2009 we can see a rise an increase in the number of efficient banks from four to eight banks (53%). In this year we can observe the exit of Union National bank from the list and the addition of Commercial Bank of Dubai, Commercial Bank International, First Gulf Bank, The National Bank of Abu Dhabi and RAK Bank. We also can observe a rise in the mean efficiency score of the banks from 91.16% to 95.57% showing the presence of a general increase of intermediary role efficiency among the United Arab Emirates Banking sector. This year was a key year in the worldwide banking sector and especially in the United Arab Emirates with huge pressure from regulators to control lending. According to Fitch Ratings Agency mentions a lowering of capital ratios by the United Arab Emirates Central Bank after the Ministry of Finance stipulated higher capital requirements at the end of 2008 (Zawya.com, 2009). These adjustments along with continued adjustments to regulations over the year would have a big effect on the banks policies with regards to deposit and funds utilization and affect their relative intermediary role efficiency.

2010-2012

In the years of 2010-2012 we can see a drop in the efficiency score from 2009 of 95.57% down to 93.42% in 2010 followed by a constant level of 93.97% and 93.92% in the remaining years of 2011 and 2012 respectively. With regards to number of efficient banks we can see that the number of efficient banks dropped to four banks in 2010 with a rise to six banks in each of 2011 and 2012. This year to year fluctuation on number of efficient banks can be observed through the relatively high

standard deviation among the banks. The average standard deviation is 3% however we have some banks with standard deviations of their efficiency score of 0% and some with standard deviations as high as 5.3%. The major top three fluctuating banks are Emirates NBD (standard deviation of 5.33), Abu Dhabi Islamic Bank (standard deviation of 5.16) and Dubai Islamic Bank (standard deviation of 4.93). These banks contribute to the misleading appearance of a constant efficiency score over this period where in reality we can observe large fluctuations in the individual banks efficiency scores and the number of efficient banks. The main causes of these fluctuations and high standard deviations could be caused by the banks attempting to adjust their internal lending and investment policies to the pressures by the regulators in 2009 that were discussed earlier.

General observations

In the traditional intermediary approach and considering the large fluctuation showed by fluctuation observed with some of the banks we are still able to point out the major market leaders or efficiency 'role models' in the financial intermediary role of banks in the United Arab Emirates Economy. These leading banks are Invest Bank which has had an efficiency score of 100% in all 5 years; National Bank of Abu Dhabi and First Gulf Bank with efficiency scores in all years from 2009 onwards; National Bank of Um Al Quwain who only had a below efficient score in 2010 and lastly United Arab Bank that was efficient in all years but 2012. This observation shows that the United Arab Emirates banking industry has a few key banks that can be used as benchmarks in their methods of providing the intermediary service in the country.

TIME BASED INTERMEDIARY APPROACH

Bank	2012	2011	2010	2009	2008	Mean	St. Dev
ADCB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
ADIB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
CBD	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
CBI	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
DIB	78.48%	79.32%	91.27%	79.15%	82.81%	82.20%	4.78%
ENBD	100.00%	100.00%	95.42%	100.00%	100.00%	99.08%	1.83%
FGB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
INVEST	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
NBAD	100.00%	100.00%	100.00%	100.00%	99.18%	99.84%	0.33%
NBF	94.95%	97.45%	98.18%	90.41%	92.75%	94.75%	2.90%
NBQ	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
RAK	100.00%	100.00%	100.00%	100.00%	90.19%	98.04%	3.92%
SIB	83.86%	85.96%	86.53%	92.95%	87.24%	87.31%	3.04%
UArB	95.97%	100.00%	100.00%	100.00%	100.00%	99.19%	1.61%
UNB	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%
Mean	96.88%	97.52%	98.09%	97.50%	96.81%		
St Dev	6.43%	5.99%	3.89%	5.67%	5.51%		

As with the time based operating approach, in the time based intermediary approach all inputs and outputs were kept constant except for the addition of the number of years since inception in an attempt to see if the age of the bank had any effect on the efficiency of the bank. Two main expectations or theories were present. The first was that banks would show a positive relationship between efficiency and age whereby as a bank grows and learns it is now more able to manage the efficient utilization of resources. The Second possible expectation would be that newer banks with fresh and experienced minds would be able identify the areas of inefficiency in the older banks and thus avoid them occurring in the new banks that were trying to correct and streamline these areas of inefficiency that may be present in their organizations.

To further support the inconclusiveness of the time based operating approach and adding of the years since inception as a variable, the time based intermediary approach resulted in a general and overall increase in the mean efficiency scores of the banks in the study and that ten out of the fifteen banks were now efficient in 2008. On top of that a repeat of the results of the time based operating approach, bank to bank comparisons show that for the banks that suffered the worst efficiency scores in the traditional operating approach are also the least relatively efficient banks in the time based approach as well. These banks are Sharjah Islamic Bank and Dubai Islamic Bank.

Comparison to time based operating approach

One difference to the time based operating approach results was that when looking at the trends over the years and comparing bank to bank numbers, instead of the repeat of the general trend in efficiency is the same with sudden rise in mean efficiency from 2008 to 2009 followed by a drop to midway between the 2008 and 2009 figures with a constant efficiency after that from 2010 to 2012, we can see a different trend forming where we see the same initial rise but then followed by a further rise in 2010 followed by a steady drop back to 2008 levels in the year of 2012. However, due to the inflated nature of the results and the resulting appearance of extremely high efficiency levels it is extremely difficult to make logical and practical comparisons in the change of scores over the period of time.

To conclude, as seen in the previous time based approach, adding the number of years to the study is inconclusive and seems only to distort the results by over inflating efficiency scores and compressing the results so less efficient banks appear to be on the efficient frontier. This means that it is difficult to differentiate between the relatively efficient and inefficient banks. This difference Khaddaj's study of Syrian banks could be the fact that the general age difference of the commercial banks in the United Arab Emirates is much higher where the United Arab Emirates bank's ages ranged from 16 to 40 years of age and the banks studies in Khaddaj's study had an age range of 4 to 6 years of age. (Khaddaj, 2010)

COMPARATIVE OBSERVATIONS

When comparing the two different approaches of operating efficiency and intermediary role efficiency we can see that both First Gulf Bank, The National bank of Um Al Quwain and United Arab Bank all stand out as benchmark banks in terms of efficiency compared to the other commercial banks in the United Arab Emirates. With regards to the other banks we do see a general higher level of year on year differences in net increases and decreases of efficiency where in the intermediary approach we can observe a more unstable level of efficiencies. This is observed most in Emirates NBD and Dubai Islamic bank which are both major banks in Dubai which is the emirate that was affected greater by the economic crisis due to their large exposures to Dubai government debt.

Over all, we can notice a general high level of industry wide efficiency in both approaches which is probably due to the high levels of competition in the market. However; the key difference between the two is that the economic crisis of 2007 – 2008 along with the relative regulation changes had different effects on the results of the two approaches. In the operating approach the crisis caused a drop in the efficiency levels with a steady upwards movement afterwards, where on the intermediary role approach the regulations seemed to cause a disruption among the banks where bank managements are struggling to adjust to the economic situation and regulations and stabilize their intermediary role efficiency levels.

In both approaches and for reasons mentioned previously, the effect of years of operation had little or no effect on the data and resulted in a distorted and less realistic picture.

5. CONCLUSION

This paper is a Data Envelopment Analysis of the national commercial banks in the United Arab Emirates. It uses the CCR model and four main approaches which were the operating approach, which measured the operating efficiency of the banks, and the intermediary approach, which measured the efficiency of the banks as financial intermediaries in the United Arab Emirates Economy. For each of these approaches another approach was used with the number of years in operation as an additional uncontrolled input to the model in order to evaluate the effect that the age of the bank had on its efficiency level.

The main aim of the study was to identify the relatively high efficient banks and the relatively less efficient banks and analyze the general level of efficiency across the banking industry and any effects the recent economic activity may have had on banking efficiency levels.

The main findings of this paper are (i) that when using the traditional operating efficiency approach we can see a general level of high efficiency and that we can identify two to three major banks that are the leaders in operating efficiency. With regard to operating efficiency that the banks in general move in a correlated manner relative to market conditions. (ii) When using the intermediary approach we see less correlation between banks; however we can identify the market leaders with constant efficient levels. In this approach a general high level of efficiency was also noted among banks. (iii) The number of years in operation had little or no effect to either of the models. It provided little or no useful information and resulted in all banks having a higher efficiency score meaning less efficient banks seeming more efficient in relation. (iv) Compared to previous studies

in the 1997-2001 era there has been a raise in the general efficiency levels of the national banks in an operating perspective (no previous data on intermediary approach).

To conclude, the high level of competition among the United Arab Emirates national commercial banks has resulted in an improving and high level of operational efficiency among them. This tight competition may mean that marginal differences in efficiency may be important factors in resulting in a higher profitability and through this study we were also able to identify the banks that can be used as benchmarks and leaders of efficiency in the United Arab Emirates banking industry.

6. FURTHER RESEARCH

This paper provides a first step to all stakeholders in being able to make better judgments. For the Government further research into the field along with links to the economic situation and comparison to foreign banks that do not provide public information could allow them to better adjust their policies to be in line with the ideas and goals of the United Arab Emirates Government. For bank management a further in depth, internal or even department-wise Data Envelopment Analysis study may be the key to finding the major inefficiencies within their respective organizations and being able to raise the benchmark and themselves become the relatively efficient banks. Finally, for investors who are interested in picking individual companies or industries to invest in, similar studies can be done on other organizations and respective industries to identify the most relatively efficient industries in order to allow them to diversify their risk more efficiently.

Finally, a follow up study should also be considered after information of the omitted banks becomes publicly available to bring light to any changes in results that may occur with their inclusion. This goes for both the omitted national banks and the foreign banks.

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