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Efficiency analysis of UAE banks using data envelopment analysis

Tamer Mohamed Shahwan and Yousef Mohammed Hassan
Department of Accounting, Finance and Banking,
Al Ain University of Science and Technology, Al Ain, United Arab Emirates

Abstract

Purpose – The current study aims to explore and measure the profitability, marketability, and social disclosure efficiency of UAE banks using a nonparametric frontier method – data envelopment analysis (DEA).

Design/methodology/approach – In order to estimate the relative efficiency of the Emirati banks based on three different dimensions: profitability, marketability and social disclosure, a sample of 20 listed Emirati banks in 2009 is first selected. Second, a disclosure index to measure the extent of their social disclosure is developed and utilized. Third, the input-oriented version of DEA model is deployed to estimate their technical and scale efficiency.

Findings – Based on nonparametric Wilcoxon signed rank test, paired-difference *t* test and sign test, this study reports significant evidence that the UAE banks are performing much better in profitability and social disclosure activities than marketability activities. The results also provide additional evidence regarding the positive relation observed between the performance of social disclosure and profitability performance.

Research limitations/implications – The sample is small, although it includes all relevant Emirati banks. Moreover, follow-up research using panel data derived from the UAE banking sector are required to test and generalize the current results.

Originality/value – The paper is original in its approach by introducing social disclosure as a new empirical dimension to the literatures of banking efficiency analysis using DEA.

Keywords Bank efficiency, Profitability efficiency, Marketability efficiency,
Social disclosure efficiency, DEA, Process efficiency, Banks, Data analysis

Paper type Research paper

Introduction

The financial services sector, particularly, the banking system is one of the most complex industries in the world. It plays a vital role in the economic development by diversifying growth's elements of any country. In 2009, the contribution of the financial services and insurance sector to the UAE GDP is 5.8 percent (Statistics Centre-Abu Dhabi (SCAD), 2010). Over the last years, many of significant challenges faced both global and UAE banking sector, especially in the wake of the credit crunch of 2007. These challenges include deregulation concerning the establishment, operation, and supervision of credit institutions; the accelerating improvements in computer and telecommunication technologies; and growing competition from both global and domestic banks. According to KAMCO Research & UAE National Bureau of Statistics (2011), the financial services sector contributions to the UAE GDP fell down from 7.1 percent in 2007 to 6.7 percent in 2008 as a result of the recent financial crisis where profitability level and credit conditions shrunk considerably. Moreover, the future expansion within the UAE banking sector due to the government's demonstrated commitment to implement its strategy, namely known as Abu Dhabi Economic Vision 2030 will pose further opportunities and threats to the UAE banks regarding the improvement of their efficiencies.

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Measuring the efficiency of banking industry has attracted considerable attention by academics, policymakers, and other market participants all over the world (e.g. Yue, 1992; Tahir *et al.*, 2009). However, these studies ignored several areas related to banking efficiency analysis. First of all, very few studies (e.g. Al Tamimi and Lootah, 2007; Avkiran, 2009) have only addressed the operational and profitability efficiency of the UAE banks and ignored the other indicators of the efficiency such as marketability and social disclosure efficiencies. Seiford and Zhu (1999) and Luo (2003) show that marketability efficiency is a vital indicator as well as the profitability efficiency since the real value of a bank should be defined by the current stock market. Second, greater disclosure enhances stock market liquidity thereby reducing cost of equity capital through reducing information asymmetry between management and fund providers (Botosan, 1997; Christensen *et al.*, 2008; Francis *et al.*, 2008; Gao, 2008). In this context, the second stream of environmental disclosure research suggests that a significantly negative association between disclosure and cost of equity capital may be extended to corporate voluntary social reporting. Disclosing information to show socially responsible behaviors can help companies avoid government regulation, gain legitimacy, and reduce compliance costs (Dhaliwal *et al.*, 2009). Furthermore, consumers and investors who care about social and environmental issues prefer socially responsible corporations thereby improving their sales level and financial performance (Lev *et al.*, 2010; Richardson and Welker, 2001). Accordingly, this study contributes to this literature by extending the efficiency analysis of the UAE banks based on the following three dimensions: profitability, marketability, and social disclosure efficiencies. The remainder of this paper proceeds as follows: the following briefly reviews the literature on data envelopment analysis (DEA) used in banking efficiency analysis. Third section describes procedures used to estimate the level of the UAE banks' social disclosure. Fourth section presents the DEA that is applied in this study. Fifth section discuses the data and empirical results; and the final section summarizes the study's conclusions, implications, and suggestions for future research.

DEA in banking efficiency analysis

As financial managers scramble to compete in highly chaotic environment, they must do so by achieving good performance which is a cornerstone for the survival of any organization (March and Sutton, 1997; Amado *et al.*, 2012). Since a good performance is concerned with high efficiency and effectiveness, much effort has been devoted over the past decades among researchers to estimate the level of efficiency with which banks work to their competitors. Most of this work has focussed on the USA and the UK. The literatures of the bank efficiency measurement can be classified into different categories based on the method of analysis, the level of data, and the dimensions of performance (Johnes, 2006; Paradi *et al.*, 2011). Regarding the method of analysis, there are numerous techniques used to measure bank operational efficiency such as ratios (Heizer and Render, 2006; Schweser and Temte, 2002) and regression analysis (Hensel, 2003). However, those traditional techniques have become unsatisfactory analysis methods due to the following inherent limitations. First of all, regression analysis compares efficiency with average performance rather than with the best performance (Colbert *et al.*, 2000). Second, regression analysis as a parametric approach which requires the prespecification of a production function restricts the usefulness of this model in capturing real function (Sexton, 1986). Additionally, under the financial ratio analysis, it is impossible to determine a single performance score of different multiple ratios objectively (Colbert *et al.*, 2000). In recent years, two competing frontier efficiency approaches – the stochastic frontier approach (SFA) and DEA – have been proposed as alternative

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techniques for measuring the relative efficiency of any financial institution against the group's observed best practice. A review of the SFA applications in the banking industry can be found in Kumbhakar and Lovell (2000).

DEA as a non-parametric technique was first put forward by Charnes, Cooper, and Rhodes in 1978. DEA computes a comparative ratio of weighted outputs to weighted inputs for each decision-making unit (DMU) using linear programming. The popularity of DEA in measuring the relative efficiency is due to several distinguishing features that make them a valuable and attractive tool for performance analysis. First, DEA is a methodology directed to frontiers rather than central tendencies (Cooper *et al.*, 2000). Second, DEA as a non-parametric technique does not need to make distributional assumptions regarding the residuals (Abbott and Doucouliagos, 2003). Thus, DEA rather than regression analysis is the ideal tool to fit the data. Second, multiple inputs and outputs can be used in the DEA model without any concern regarding the relative importance of each input and output (Colbert *et al.*, 2000). Third, in comparison to traditional methods based on predefined model structures such as the SFA, DEA has the advantage in avoiding the need to make prior assumptions regarding the functional form of the best practice frontier (Cooper *et al.*, 2000). Ruggiero (2007) shows that the SFA model does not produce better results than DEA.

There are ample DEA studies in exploring banking efficiency (e.g. Seiford and Zhu, 1999; Chen *et al.*, 2008). For instance, Luo (2003) evaluates both the commercial banks' marketability and profitability efficiency. He measured profitability efficiency based on three inputs (employee, total assets, and equity) and two outputs (revenue and profits), while the marketability is based on two inputs (revenue and profits) and three outputs (market value, stock price, and earnings per share (EPS)). Based upon a sample of 245 large banks, Luo concludes that 14 percent of banks with higher level of profitability performance have lower level of marketability performance. Tahir *et al.* (2009) use DEA to estimate the overall, pure technical and scale efficiencies for 22 Malaysian commercial banks. The results suggest that domestic banks are relatively more efficient than foreign banks. Moreover, inefficiency of domestic banks is attributed to pure technical inefficiency rather than scale inefficiency. On the other hand, inefficiency of foreign banks is attributed to scale inefficiency rather than pure technical inefficiency. Additionally, the technical efficiency of the Japanese banks from 2000 to 2007 based on both of desirable and undesirable output is analyzed. The results indicate that non-performing loans as undesirable output remain a significant burden for banks' performance (Barros *et al.*, 2012).

The voluntary social disclosure index

The corporate social and environmental reporting is one of the main areas that witnessed an increasing attention from accounting researchers. Although this sort of disclosure has been regulated and has become compulsory in some countries, especially the developed nations (e.g. UK, France, and Denmark), disclosing this kind of information is still not required from firms in other countries and reporting on these themes depends on management decision.

The investigation of the related voluntary social disclosure literature shows that there is no one generally accepted definition for the concept of corporate social reporting provided by researchers and organizations (e.g. Gray *et al.*, 1988; Mathews and Perera, 1991; European Commission, 2001). Despite the different definitions offered by different authors and organizations for the corporate social disclosure concept, the

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information included in this type of disclosure may be divided into five main themes: environment, energy, community involvement, human resources, and product- and consumer-related information (Epstein and Freedman, 1994; Hackston and Milne, 1996; Williams and Pei, 1999; Deegan, 2002).

To measure the efficiency of Emirati banks based on their social disclosure, there is a need to develop a suitable social and environmental disclosure index. In the current section we describe the construction of our social disclosure index and the scoring procedures of the Emirati banks' social disclosure level. Since there is no agreement regarding the appropriate items that have to be included in a social disclosure index, an extensive review of prior studies in emerging economies in general (e.g. Gao *et al.*, 2005; Haniffa and Cooke, 2005) and within the context of Arab countries (e.g. Naser *et al.*, 2006; Rizk *et al.*, 2008; Menassa, 2010) in particular is conducted to develop a list of social and environmental items that can be included in a disclosure index. This review of the relevant corporate social disclosure literature had led to the development of a 38 item that may be voluntary disclosed by Emirati listed banks. For the assessment of the designed index validity, the index is tested by the researchers on a number of listed Emirati banks' annual reports. Moreover, it is also assessed by an external accounting professor with special interest in corporate social practices in the Arab countries. In light of the researchers' test and the expert's assessment, some of the 38 items are excluded as they either are not disclosed by any of the banks or irrelevant. Accordingly, the constructed disclosure index for the current study is adjusted to include 26 items. These items include information about environment, energy, human resources, product and customer, community, and other social and environmental disclosure (e.g. zakatable amount and/or beneficiaries, employee communication, and expenditure on research and development). Moreover, the Cronbach's coefficient α is estimated to assess the internal consistency of the selected items in our disclosure index. The value of α varies between 0 and 1. The higher the coefficient is, the more reliable the measure is. Nunnaly (1978) shows that 0.7 can be considered an acceptable reliability coefficient. In the current study, the coefficient α is found to be 0.73 for all categories which indicates a reasonable degree of internal consistency among the selected items in our designed index. Table I summarizes the elements of the social disclosure index. Regarding the scoring scheme implemented in the constructed social and environmental disclosure index, there are typically two basic approaches: the weighted vs the unweighted disclosure index. Many existing empirical research (e.g. Wallace *et al.*, 1994; Chen and Jaggi, 2000; Archambault and Archambault, 2003) tend to support the use of unweighted index approach. Moreover, the studies done by Wallace and Naser (1995) and Coombs and Tayib (1998) show that only little difference has been found under both unweighted and weighted indices. Accordingly, the unweighted disclosure index approach is adopted to measure the extent of the social and environmental disclosure by Emirati listed banks. Under the unweighted social disclosure method, each item is considered as a dichotomous variable. If an information item has been disclosed in the bank's annual report, then "1" will be assigned, otherwise, it will be "0." Accordingly, the total social disclosure (*TSD*) score for a bank (j) is measured as follows:

$$TSD_j = \frac{\sum_{i=1}^{n} Score_{ij}}{\sum_{i=1}^{n} \max Score_i} \quad (1)$$

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(A) Environmental information
1. Environmental policies
2. Environmental protection and pollution prevention
3. Efforts to reduce gas emissions
4. Conservation of natural resources
5. Recycling plant of waste products
6. Environment's awards or certificates (e.g. ISOs 14000)
(B) Energy
1. Conservation of energy
2. Energy efficiency of products
(C) Human resources
1. Number of employees
2. Management relationships with employees to improve job satisfaction
3. Training and development
4. Commitment to emiratization strategy
5. Working conditions
6. Health and safety arrangements
(D) Product and customers
1. Product (service) quality information
2. Product safety information
3. Customer satisfaction
4. Quality's reward (e.g. ISO 9000, prizes and awards received)
(E) Community-related disclosures
1. Donations and charity contributions
2. Community relations
3. Seminars, conferences, and educational institutions
4. Support and sponsorship programs
5. Humanitarian aid programs
6. Preservation national culture and tradition
7. Support for people with special needs
(F) Other social and environmental disclosure

Table I.
Social disclosure index

where max $Score_i$ is the maximum score awarded to any bank for all categories ($i = 1, \ldots, 6$). $Score_{ij}$ reflects the total items a bank actually disclosed.

The DEA methodology

Specification of DEA models

DEA assigns a score of 1 to an efficiently unit when they are compared with other relevant units. A score <1 imply that a linear combination of other units from the sample could produce the same vector of outputs using a smaller vector of inputs. The efficiency can be measured as follows (Cooper *et al.*, 2011):

$$\begin{aligned} &Max\, h_0(u,v) = \sum_r u_r y_{r0} / \sum_i v_i x_{i0} && \text{Subject to} \\ &\sum_r u_r y_{rj} / \sum_i v_i x_{ij} \leqslant 1 && \text{for } j = 1, \ldots, n, \\ &u_r, v_i \geqslant 0 && \text{for all } i \text{ and } r \end{aligned} \tag{2}$$

where the u_r's and v_i's are the variables of the problem. The y_{r0}'s and x_{i0}'s are the observed output and input values. To solve this model, we opt to the equivalent linear programming transformation as illustrated in the following equations:

$$\begin{aligned} &Min\ \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \quad \text{Subject to} \\ &\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = \theta x_{i0} \qquad i = 1, 2, \ldots, m; \\ &\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+ = y_{r0} \qquad r = 1, 2, \ldots, s; \\ &\lambda_j \geqslant 0 \qquad j = 1, 2, \ldots, n \end{aligned} \tag{3}$$

where θ is efficiency score. It reflects the radial distance from the estimated production frontier to the DMU under consideration. The value of this score is between 0 and 1. λ_j are the optimal weights of referenced units for unit j; x_{ij} is the value of the ith input to unit j; y_{rj} is the value of the rth output from unit j; s_r^+ and s_i^- are output and input slacks, respectively, and ε is non-archimedean element that is smaller than any positive number and >0. The DEA model illustrated in Equation (3) is referred to CCR[1] model in the form of input-oriented version. In this context, the CRS can be converted into BCC[2] model if the constraint $\Sigma_{j=1}^{n}\lambda_j = 1$ is adjoined. BCC model can then be written as follows (Cooper *et al.*, 2011):

$$\begin{aligned} &Min\ \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \quad \text{Subject to} \\ &\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = \theta x_{i0} \qquad i = 1, 2, \ldots, m; \\ &\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+ = y_{r0} \qquad r = 1, 2, \ldots, s; \\ &\lambda_j \geqslant 0 \qquad j = 1, 2, \ldots, n \\ &\sum \lambda_j = 1 \end{aligned} \tag{4}$$

Specification of DEA inputs and outputs

The selection of appropriate inputs and outputs is the most important step in measuring the relative efficiency of banks using DEA (Yue, 1992). Till today, there is no clear agreement over the appropriate inputs and outputs for measuring banks' efficiency (Avkiran, 2011). Generally, there are two different perspectives for specifying the proper inputs and outputs: the production approach and the intermediation approach (e.g. Yue, 1992; Sathye, 2001; Luo, 2003; Avkiran, 2011). Under the production approach, banks can be defined as producers of services by processing deposits and loans (Seiford and Zhu, 1999). On the other hand, the intermediation approach views

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banks as financial intermediaries that focus on borrowing funds from depositors and lending those funds to deficit units (Tahir *et al.*, 2009). In order to improve the evaluation of Emirati banking performance we design a performance criterion that will enable banks' managers to determine where improvements can be made. The study of Luo (2003) serves as the basis for our design approach. Specifically, we adapt the production approach in defining inputs and outputs for banks. Figure 1 depicts the three dimensions of the UAE banking efficiency model.

The first dimension is concerned with measuring the profitability efficiency based on three inputs (total deposits, total operating expenses, and leverage) and two outputs (return on assets (ROA) and return on equity (ROE)). For measuring the marketability efficiency, there are two inputs (ROA and ROE) and three outputs (price/earnings (P/E) ratio and EPS). In order to measure social disclosure efficiency, six inputs are used. The first input is the existence of audit committee. The extent of corporate social responsibility (CSR) disclosure is expected to be higher for firms that have an audit committee. The existence of an audit committee might be seen as a monitoring mechanism that improves the quality of corporate reporting (McMullen, 1996; Barako *et al.*, 2006), reduces the information asymmetry (Chung *et al.*, 2004), and reduces irregularities and unreliable disclosure (McMullen, 1996). The second input is the proportion of Sheikhs[3] on corporate board. Following Graham (1991) and Spears (2010) who argued that "servant leader" recognizes his social responsibility to serve his followers, it is reasonable to expect that the existence of a Sheikh as a "servant leader" in the Emirati banks' board of directors will emphasize a company's social and charitable role and promote the culture of donation and the concept of CSR toward the community. The third input is the institutional ownership[4]. That is, corporations with high percentage of shares held by institutional investors, who have strong incentives to monitor these companies' disclosure practices, are more likely to voluntarily disclose information to assure those investors and meet their expectations, and thus, reduce agency costs (Barako *et al.*, 2006; Naser *et al.*, 2006). The fourth input is the government ownership[5] which has a vital impact on the corporation's social disclosure, particularly in the absence of labor unions in the UAE. Naser *et al.* (2006) argues that corporations with high proportion of shares held by government are expected to offer welfare and training programs and pension plans to enhance its employees' working conditions. Moreover, such companies are more likely to observe environmental issues

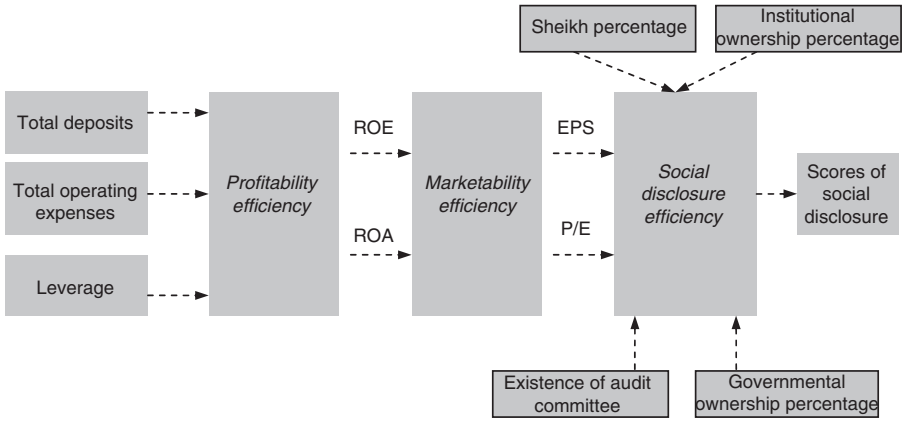

Figure 1.
Banking profitability, marketability, and social disclosure efficiencies model

in its annual reports to reflect its role in the society and to present itself as a good example for other firms in the country. Finally, most of the recent quantitative studies (e.g. Knoepfel, 2001; Ruf *et al.*, 2001; Van de Velde *et al.*, 2005) support the existence of positive relationship between corporate social performance and corporate financial performance. Hence, EPS and P/E ratios are selected as proxies of the bank financial performance and to be used as inputs to measure the bank's social disclosure, while the output of the banks' social disclosure model is the computed social disclosure scores of each bank which previously illustrated in "The voluntary social disclosure index".

Data and empirical analysis

To compute the social disclosure scores and evaluate the relative efficiency of Emirati banks using DEA, data set including all of the 2009 listed Emirati banks' annual reports is used[6]. It consists of 20 out of 23 listed banks in UAE as banks with negative values are ignored[7]. Table II represents the computed social disclosure score for each of the Emirate banks where the lowest score is obtained by the Commercial Bank International (CBI). However, the highest social disclosure score is obtained by National Bank of Abu Dhabi (NBAD) followed by Abu Dhabi Islamic Bank (ADIB), United Arab Bank (UAB), and so on. Back to the DEA analysis of the data set, the efficiency analysis of the selected banks is conducted by using a computer program DEAP where both of CCR and BCC models are used to evaluate the performance of the UAE banks from three different dimensions: profitability, marketability, and social disclosure. The input-oriented version of DEA model is selected in the current study as the Emirati banks are governed under the direct supervision of the UAE central bank according to the Union Law No. 10 of 1980. This implies that the differences in product offerings between the competing banks are often limited. Table III reports the descriptive statistics of the inputs and outputs in each stage of DEA analysis. Most of variables' scores varied as indicated by the minimum and maximum values. This

Bank	Total social disclosure score (*TSD*)
Abu Dhabi Islamic Bank (ADIB)	0.62
Bank of Sharjah (BOS)	0.08
Commercial Bank International (CBI)	0.04
First Gulf Bank (FGB)	0.35
Finance House (FH)	0.31
Invest Bank (INVSTB)	0.27
National Bank of Abu Dhabi (NBAD)	0.77
National Bank of Fujairah (NBF)	0.42
National Bank of Um Al-Qaiwain (NBQ)	0.23
National Bank of Ras Al Khaimah (RAKBANK)	0.15
Sharjah Islamic Bank (SIB)	0.08
United Arab Bank (UAB)	0.54
Union National Bank (UNB)	0.31
Arab Emirates Investment Bank (EIBANK)	0.12
Ajman Bank (AJMANBANK)	0.1
Commercial Bank of Dubai (CBD)	0.45
Dubai Islamic Bank (DIB)	0.24
Emirates Islamic Bank (EIB)	0.24
Emirates NBD (EMIRATES NBD)	0.48
Mashreq (MASQ)	0.23

Table II.
Social disclosure score of the Emirati banks

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Table III.
Descriptive statistics of variables used to measure the efficiency of Emirati banks

Variable(s)	Mean	SD	Minimum	Maximum
TSD score	0.3015	0.196	0.04	0.77
ROA	0.0189	0.0131	0.0006	0.0424
ROE	0.1129	0.0662	0.0011	0.2596
EPS	0.7125	1.386934	0	6.21
P/E	96.936	234.16	4.91	817.41
Total deposits	39,295,657,350	52,785,198,299	518,248,000	2.11157E + 11
Operating expenses	1,043,340,066	1,642,713,528	18,562,313	7,249,776,000
Leverage	0.821	0.094751753	0.48	0.9
Institutional ownership	0.31	0.252476362	0.0564	0.9985
Governmental ownership	0.237	0.235910331	0	0.71
Sheikh percentage	0.135965	0.144465903	0	0.4286
Audit committee	0.35	0.489360485	0	1

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grants credibility to the findings of the study as it covers all the banks listed in Emirati stock markets with different features. The table reveals that the mean of *TSD* score is only 30 percent of the standard social disclosure items that formed the index. It ranges between 4 and 77 percent of the expected number of items that formed the index. Over the full sample, ROA ranged from 0.006 to 4.24 percent, with a mean of 1.89 percent. Moreover, the mean of ROE is about 11.3 percent, ranging from a high of nearly 26 percent to a low of 6.6 percent. The statistics on marketability measures, namely EPS and P/E, also showed a considerable dispersion in the scores. While the EPS ranged from 0 to 6.21, with a mean of 0.7, the P/E ratio varied from 4.9 to 817.4 percent with an average of 96.94 percent. With respect to leverage, it ranged from 0.48 to 0.90, with a mean of 0.821. This result is expected as long-term debt is usually a significant portion of the capital structure of banks. In 2009, the operating expenses of Emirati banks ranged from 18,562,313 to 7,249,776,000 Emirati Dirhams. Concerning corporate governance variables, Table III shows that the existence of corporate audit committee variable ranged from 0 to 1, where 1 indicates that the company has audit committee, 0 means that the audit committee does not exist. The mean of existence of audit committee is only about 0.35 revealing that the most of the Emirati banks are still with no audit committees. The ratio of Sheikh on Emirati companies' boards ranged from 0 to 0.4286, with a mean of 0.1359 for the whole population.

Turning to ownership structure variables, Table III also indicates that while governmental ownership ranged from 0 to 0.71, with a mean of 0.237 for the whole population, the proportion of institutional ownership also ranged from 0.0564 to 0.9985, with a mean of 0.31. This mean might reflect the existence of a number of investment companies which have substantial ownership in listed banks.

Back to the DEA analysis of our data set where the overall, pure technical efficiency and scale efficiency scores achieved by Emirati banks along with the direction of return to scale are shown in Table IV. The approach taken was to consider banks efficient if their relative efficiency ratios equaled 1 and regarded as inefficient if they obtained a relative efficiency ratio <1. At the first stage of our analysis, bank profitability efficiency is measured. Our results indicate that five banks are deemed as efficient while 15 banks are rated as inefficient. The results also indicate that the average pure technical efficiency score for the banks is 81.8 percent under the assumption of VRS, which is higher than the average efficiency score of overall technical efficiency under the CRS assumption. On the other hand, the average score of

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Table IV. Technical and scale efficiency scores for Emirati banks

	Profitability efficiency				Marketability efficiency				Social disclosure efficiency			
Bank	OE	PTE	SE	Return to scale	OE	PTE	SE	Return to scale	OE	PTE	SE	Return to scale
ADIB	0.04	0.555	0.072	irs	0.122	0.663	0.185	irs	1	1	1	–
BOS	0.73	0.902	0.809	irs	0.026	0.035	0.767	irs	0.268	1	0.268	irs
CBI	0.143	0.616	0.233	irs	0.02	0.138	0.145	irs	0.361	1	0.361	irs
FGB	0.623	0.839	0.742	irs	0.209	0.214	0.976	irs	1	1	1	–
FH	1	1	1	–	0.047	0.053	0.88	irs	1	1	1	–
INVESTB	0.81	0.913	0.888	irs	0.023	0.034	0.693	irs	1	1	1	–
NBAD	0.723	0.843	0.858	irs	0.138	0.166	0.832	irs	1	1	1	–
NBF	0.309	0.684	0.452	irs	0.022	0.085	0.265	irs	1	1	1	–
NBQ	0.639	0.869	0.735	irs	0.03	0.04	0.747	irs	0.553	0.982	0.563	irs
RAKBANK	1	1	1	–	0.041	0.045	0.918	irs	0.302	0.912	0.331	irs
SIB	0.41	0.806	0.509	irs	0.027	0.048	0.555	irs	0.491	1	0.491	irs
UAB	1	1	1	–	0.022	0.027	0.799	irs	1	1	1	–
UNB	0.541	0.756	0.716	irs	0.063	0.098	0.64	irs	0.624	0.888	0.703	irs
EIBANK	1	1	1	–	0.055	1	0.055	drs	0.598	1	0.598	irs
AJMANBANK	0.028	1	0.028	irs	1	1	1	–	1	1	1	–
CBD	0.663	0.826	0.802	irs	0.037	0.058	0.642	irs	1	1	1	–
DIB	0.489	0.748	0.654	irs	0.04	0.079	0.502	irs	0.71	1	0.71	irs
EIB	0.206	0.617	0.334	irs	0.022	0.134	0.163	irs	1	1	1	–
EMIRATESNBD	0.381	0.702	0.543	irs	0.086	0.132	0.656	irs	1	1	1	–
MASQ	0.326	0.684	0.477	irs	1	1	1	–	1	1	1	–
Mean	0.553	0.818	0.643	–	0.152	0.252	0.621	–	0.795	0.989	0.80	–
SD	0.319	0.144	0.304	–	0.294	0.350	0.30618	–	0.2753	0.031	0.27	–
Minimum	0.028	0.555	0.028	–	0.02	0.027	0.055	–	0.268	0.888	0.27	–

Notes: OE, overall efficiency based on CRS; PTE, pure technical efficiency based on VRS; SE, scale efficiency (SE = OE/PTE); irs, increasing return to scale; drs, decreasing return to scale

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scale efficiency is 64.3 percent which means that bank profitability inefficiency is attributed to scale inefficiency. In a similar way, for bank marketability efficiency, the average pure technical efficiency score for banks is 25.2 percent which is less than the average score of scale efficiency 62.1 percent. This implies that bank marketability inefficiency is attributed to pure technical inefficiency rather than scale inefficiency. Furthermore, the results suggest that the average of profitability efficiency is higher than the average of marketability efficiency based on all mentioned indices. At the last stage of the analysis, DEA is conducted on the entire pool of Emirati banks to measure their social disclosure efficiency. As seen in Table IV, the average pure technical efficiency score for banks 98.9 percent is higher than the average score of scale efficiency 80.1 percent. So, the social disclosure inefficiencies are attributed to scale inefficiency rather than pure technical inefficiency. The distribution of the pure technical efficiency scores related to profitability, marketability, and social disclosure of Emirati banks is illustrated in Table V within different score interval. As seen in Table V, our findings obviously indicate that a majority of Emirati banks are efficient regarding the profitability and social disclosure rather than marketability. Our results also turn out that "good" environmental performance can be associated with "good" profitability performance. These findings are consistent with the results of Hossain *et al.* (2006) that there is significantly positive relation between profitability and environmental social disclosure. Having discussed the profitability, marketability, and social disclosure efficiency results, attention should now be turned to determine whether there is significant difference between scores of technical and scale efficiency across the three DEA stages. The results of Wilcoxon signed-rank test, sign test, and *t*-test are shown in Table VI. These results further provide statistically significant evidence of the low level of marketability efficiency inside Emirati banks compared to profitability and social disclosure efficiencies.

Conclusions

In this study we explore the usefulness of DEA to evaluate the relative efficiency of UAE banks using three different dimensions (profitability, marketability, and social disclosure). Hence, this study introduces new empirical dimension to the literatures of evaluating the banking efficiency. In contrast to studies that only measure the efficiency of banks based on profitability and marketability performance, this study adopts additional dimension: the social disclosure performance. Six categories of social disclosure information, referring to environmental issues, energy-related issues, human resources issues, products and customers issues, community-related disclosure, and other social items are analyzed. Our primary findings imply that the majority of Emirati banks obtain high level of profitability and social disclosure efficiency.

Table V. Distribution of pure technical efficiency scores, Emirati banks

Bank's efficiency interval	Banks (%) based on profitability efficiency	Banks (%) based on marketability efficiency	Banks (%) based on social disclosure efficiency
0 < 0.6	0.05	0.8	0
0.6 < 0.8	0.35	0.05	0
0.8 < 0.85	0.15	0	0
0.85 < 0.90	0.1	0	0.05
0.90 < 0.95	0.1	0	0.05
0.95-1	0.25	0.15	0.9

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Efficiency dimensions		Wilcoxon test		Sign test		*t*-test	
		Z-statistic	*p*-value	*t*-statistic	*p*-value	*t*-statistic	*p*-value
Profitability efficiency (OE_1, PTE_1, and SE_1); marketability efficiency (OE_2, PTE_2, and SE_2); and social disclosure efficiency (OE_3, PTE_3, and SE_3)	OE_1 vs OE_2	−2.688	0.007*	2.907	0.0036*	3.485	0.0025*
	OE_1 vs OE_3	−2.025	0.043*	2.121	0.0339*	−2.365	0.0287*
	OE_2 vs OE_3	−3.725	0.000*	4.006	0.000*	−8.592	0.000*
	PTE_1 vs PTE_2	−3.593	0.000*	3.064	0.002*	6.697	0.000*
	PTE_1 vs PTE_3	−3.413	0.000*	3.25	0.001*	−5.070	0.000*
	PTE_2 vs PTE_3	−3.622	0.000*	3.881	0.000*	−9.540	0.000*
	SE_1 vs SE_2	−1.045	0.294	1.118	0.264	0.252	0.804
	SE_1 vs SE_3	−1.594	0.112	1.179	0.239	−1.622	0.121
	SE_2 vs SE_3	−2.112	0.035*	2.121	0.034*	−2.116	0.048*

Note: *Significance change in the efficiency at the 5 percent significance level

Table VI.
Test results of the difference between technical and scale efficiency across the three DEA stages, Emirati banks

However, these banks are inefficient in performing marketability-related activities. These results will attract the attention of the policymakers in Emirati banks to enhance their activities for generating more market value. This study also indicates that the majority of banks with high profitability efficiency tend to have high disclosure efficiency. However, it is not clear why some banks with low profitability efficiency level tend to adequately disclose social information. Therefore, a comprehensive study is needed to further investigate the relation between profitability and social disclosure efficiency.

As a suggestion for further improvement in the evaluation of banking efficiency, it is worthwhile to extend the presented model by applying it overtime using DEA window analysis. Moreover, a sensitivity analysis can also be performed in order to determine the causes of inefficiency in the Emirati banks.

Notes

1. The CCR model is referred to the constant returns to scale (CRS) model which has been developed by Charnes *et al.* (1978).
2. The BCC model is also known as the variable return to scale (VRS) model which has been developed by Banker *et al.* (1984).
3. A "Sheikh" is an Arabic title of respect and honor which is commonly used to designate a tribal leader, an Islamic scholar, or sometimes to a person who has financial or political influence.
4. The institutional ownership is measured by the percentage of common shares held by institutional investors.
5. The government ownership of the firm is measured as a percentage of common shares owned by government.
6. The annual balance sheets and income statements are obtained from Abu Dhabi Securities Exchange and Dubai Financial Market.
7. Abu Dhabi Commercial Bank, Amlak Finance, and Tamweel are excluded from our data set due to the negative values of their ROE, ROA, and EPS in 2009.

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About the authors

Tamer Mohamed Shahwan is an Assistant Professor in Finance and Banking. He got his PhD from Humboldt University of Berlin, Germany (2006). His dissertation is concerned with "Forecasting commodity prices using artificial neural networks." His research interests are in the areas of investment and financial engineering. This involves research into stocks, financial risks, financial forecasting and market efficiency. Most of his research involves the use of intelligent systems and mathematical models such as neural networks, fuzzy logic, hybrid systems and evolutionary algorithms. Tamer Mohamed Shahwan is the corresponding author and can be contacted at: Tamer.Shahwan@aau.ac.ae

Yousef Mohammed Hassan is based in the Department of Accounting, Finance and Banking, Al Ain University of Science and Technology, Al Ain, United Arab Emirates.

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