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DATA ENVELOPMENT ANALYSIS OF UAE COMMERCIAL BANKS

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Key Words

Bank performance; UAE Banks; DEA analysis; Financial Ratios; JEL Classification: G2.

Abstract

The analysis of bank performance is important for depositors, creditors as well as the government. The present paper aims at identifying the relatively best-performing banks and the relatively worst performing banks in the United Arab Emirates. It also seeks to identify banks' ranking according to their level of efficiency. The study's main findings can be summed up as follows: (i) most of the UAE commercial banks appear inefficient according to Data Envelopment Analysis and traditional measures; (ii) national banks are relatively more efficient than foreign banks; (iii) two traditional ratios, loans to deposits and loans to total assets indicate that the UAE commercial banks did not use the available resources properly, and (iv) the results obtained from the application of the DEA model and the traditional ratios are different, which is consistent with previous studies.

Introduction

The UAE is among the strongest economies in the Gulf region with high GDP- per capita and a surplus balance of payments position throughout the last decade. A strong economy has a direct effect on the financial position of the UAE commercial banks. For example, the average capital adequacy increased from 24% in 1997 to 28.5% in 2001, which is more than the required 8% ratio by Basel Accord. The average liquidity ratio measured by total loans to total deposits was 68% during the period 1991-2001, whereas the UAE Central Bank determines this ratio to be 100%. That is to say, the UAE commercial banks did not use 32% of the available resources. These two ratios indicate that the UAE commercial banks have an excess liquidity which

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can mean that some resources of these banks are not efficiently used.

The total assets of the national banks increased from AED 86,448 in 1987 (about US$ 23,539 billion) to AED 233,189.5 billion (about US$ 71,667.5 billion) in 2003. The total assets of foreign banks increased from AED 22,261 in 1987 (about US$ 6,062 billion) to AED 89,932.7 billion (about US$ 24,489 billion) in 2003 (Emirates Banks Association,2004).

Bank performance has been an important issue particularly in developing countries. This is due to the vital role played by commercial banks, being dominant financial institutions and representing the major source of financial intermediation. Berger and Humphrey (1991) have concluded that differences in bank performance of U.S. banks are far more important sources of competitive advantage than scale and/ or scope economies.

The banking sector in the UAE is the backbone of the country's financial sector, and is one of the most developed and least monopolized in the region. In 2004, there were 21 UAE-owned banks with 377 branches in the UAE and abroad; 25 foreign banks with 112 branches, two investment banks, and 48 representative offices (Dubai Chamber of Commerce and Industry, 2005). It should be noted that the UAE Central Bank regulations place a maximum of eight branches on foreign banks. Accordingly, the number of branches of national banks is much higher than that of foreign banks.

With this number of banks chasing a population of about 3.4 million, the UAE banking sector is by far the most over-banked in the region (Dean, 2003). This opinion is supported by various local, regional, and international bankers who are familiar with the UAE financial sector (Al Mazroui, 2001, Kardouche, 2001, Van den Bosch, 2003, and Kumar, 2004).

The large number of commercial banks, the high branch density, the rapid technological change, and increased competition which characterize the banking sector in the UAE, have put more presure on commercial banks. In addition, there are two other factors, namely the GATS (The General Agreement of Trade in Services) requirements, and FTA (Free Trade Agreement) with the United States, which are also expected to put more presure on these banks. For GATS implementation, the UAE commercial banks require to improve their performance in order to compete internationally (Al-Tamimi, 2000).

The UAE's banking industry has to prepare itself to enter a new era of liberalization and foreign competition (Kawach, 2003). The UAE banks

should also be looking ahead and adapt themselves to the challenges of tomorrow, particularly those raised by WTO and Free Trade Agreement with the United States (Saleh 2005).

The objective of this paper is to measure and compare the performance of the UAE commercial banks during the period 1997-2001. The study aims at identifying UAE's most efficient banks and relatively the less efficient banks. It also aims to identify banks' efficiency scores and ranks. This is intended to help the UAE commercial banks assess and improve their performance in order to meet the challenges mentioned above, which reflects the actual motivation of this study. The study utilizes the Data Envelopment Analysis (DEA) method along with some traditional ratios to provide a more comprehensive picture of the UAE commercial banks' performance.

In evaluating bank performance, traditionally two ratios are used, namely, the profitability ratio ROE (return on equity) and ROA (return on assets). These two ratios are considered by Sinkey (2002) as the best measures of a bank's overall performance. However, other researchers, Barnes, (1987); Vassiloglou and Giokas (1990); Fernadez - Castro and Smith (1994); and Tarim and Karan (2001) consider the financial ratios insufficient measures of bank performance. These ratios are also considered as a short run analysis that may be inappropriate for describing the actual efficiency of a bank in the long-run, thus failing to consider the value of management actions and investment decisions which might affect future performance. Furthermore, commonly used performance ratios fail to consider multiple outputs provided with multiple inputs. All of the above shortages have prompted researchers to new ways of measuring efficiency in the banking sector which complements financial ratio analysis method in order to have a more comprehensive picture of a bank's performance. Data envelopment analysis (DEA) is used as an alternative and complement to the traditional measures of bank performance. DEA, occasionally called frontier analysis, was used initially by Charnes, Cooper and Rhodes (1978). In DEA, the relative efficiency of a decision-making unit (DMU) is defined as the ratio of the total weighted output to the total weighted input

Literature Review

Data Envelopment Analysis(-DEA) has been used successfully in measuring the efficiency of commercial banks. Numerous applications of DEA have appeared in the bank performance literature. Miller and Nou-

las (1996) studied the technical efficiency of large bank production. With the use of Data Envelopment Analysis (DEA), the authors considered the relative technical efficiency of 201 large banks from 1984 to 1990. Bank technical inefficiency averages 5 percent, lower than found in existing estimates. Larger and more profitable banks have higher levels of technical efficiency. They also concluded that larger banks are more likely to operate under decreasing returns to scale. Resti (1997), on the other hand, examined the cost efficiency of the Italian banking system. He concluded that efficiency scores showed a high variance and that the efficiency of Italian banks did not increase over the period 1988-1992.

Berger and Humphrey(1997) provided a review of 130 efficiency studies of financial institutions including commercial banks. Chen and Yeh (1998) examined the efficiency of Taiwan's banks. using DEA to calculate the operating efficiencies of 34 commercial banks. The input variables include staff employed and interest expense; and the output variables include loans, investment interest revenue,non-interest revenue and bank assets. They also used seven financial indicators in evaluating bank performance: security measures (the ratios of loan to assets, and loan to deposits), profit measures (interest expense to revenue, net interest to assets and revenues to assets) and cost measures (the ratio of personnel expense to loan and personnel expense to revenue). They found that 15 commercial banks were relatively efficient; and the overall efficiency rather high, besides the fact that the publicly-owned banks seemed to manage their resources more poorly than the privately-owned ones. Chen and Yeh(1998) also compared the data envelopment analysis results with the financial ratios but found different results.

Ayadi (1998) examined bank performance in Nigeria by using DEA. The input variables used were the interest paid on deposits, as well as expenses on personnel, administration, and total deposits; while output variables were defined as total loans, interest income and non-interest income. He concluded that the weakness of Nigerian banks is attributed mainly to poor management which manifests in excessive credit and liquidity risk, poor loan quality and sluggish ability to generate capital internally. He also found that those Nigerian banks classified as relatively efficient are those that have been in existence for a long period of time.

Al-Shammari and Salimi(1998) examined the comparative operating efficiency of Jordanian commercial banks between 1991-1994 by using a

modified version of DEA in which no inputs are specified. The only variables considered were financial ratios; return on investment, return on equity, earnings per share, credit to total assets, credit to deposits and cash and portfolio investments to deposits. The results obtained suggest that the majority of banks were fairly inefficient. The study results also revealed the composite reference set and their shadow prices, major determinants of banks' relative performance, and the target financial ratios.

Avkiran (1999) examined operating efficiencies, employee productivity, profit performance and average relative efficiency for Australian trading banks 1986 - 1995. He used two DEA models. In the first, the input variables include interest expense and non-interest expense, whereas the output variables included net interest income and noninterest income. In the second, he used deposits and staff numbers as input variables and net loans and non-interest income as output variables. He concluded that changes in a bank's market share of deposits is a determinant in the extent to which efficiency gains are passed on to the public. In general, efficiencies arose in the post-deregulation period. Evidence from the merger cases studied supports the reports of others that acquiring banks are more efficient than target banks. However, the acquiring bank does not always maintain its pre-merger efficiency. Decision-makers ought to be more cautious in promoting mergers as a means to enjoying efficiency gains. There is mixed evidence on the extent to which the benefits of efficiency gains are passed on to the public.

Noulas (2001) studied the effect of banking deregulation on private and publicly-owned banks by using a DEA model and the traditional approach. The DEA was run with interest expense and non-interest expense as the two input variables, and interest revenue and non-interest revenue as the two output variables. The reported results showed that the private banks were more efficient than the publicly-owned banks, although the gap in the efficiency levels between the two groups is not statistically significant.

Barr et al.(2002) evaluated the productive efficiency of US commercial banks from 1984-1998. They used five input variables, namely, salary expense, premises and fixed assets; other noninterest expense, interest expense and purchased funds. The output variables include earnings assets, interst income and noninterest income. They found that there were strong and consistent relationships between efficiency and independent measures of performance including

confidential ratings made by bank examiners. Morover, they found that the impact of varying economic conditions was mediated to some extent by the relative efficiencies of banks operating in these conditions. Finally, they found a close relationship between efficiency and soundness as determined by bank examiner ratings.

Mukerjee et al.(2002) explored the linkage between performance benchmarking and strategic homogeneity of Indian commercial banks. They used five parameters as output variables in the DEA model, namely, deposits, net profits, advances, non-interest income, and interest spread. The input parameters included bank net worth, bank borrowings, operating expenses, number of employees and number of bank branches in the country. They found that the public sector banks generally outperform the private and foreign banks.

Jemric (2002) investigated the efficiency of banks in Croatia by using two DEA models: the CCR-model and BCC-model. Different sets of input and output were used for each. For the CCR model the inputs include interest and related costs,commissions for services and related costs, labor- related administrative costs (gross wages) and capital related administrative costs. The outputs include interest and related revenues and interest revenues. For the BCC model, three input variables were used, namely, fixed assets and software, number of employees and total deposits received. The output variables include total loans extended and short term securities issued by official sectors. The main results reported in this study showed that foreign owned banks were on average more efficient, and new banks were more efficient than the older ones. Moreover, smaller banks were globally efficient.

Darrat et al.(2002) investigated the efficiency of banks in Kuwait over a four-year period (1994-1997). They employed three inputs (labor,capital,and deposits), and two outputs (loans and investments). The results indicate that cost efficiency of Kuwaiti banks averages about 68%, implying that about 32% of banks' resources in Kuwaiti were not optimally processed. The results also suggest that Kuwaiti banks did not use the proper input mix.

Yildirim (2002) examined the efficiency performance of the Turkish banking sector between 1988 and 1999. The technical and scale efficiencies of Turkish commercial banks are measured with the use of nonparametric Data Envelopment Analysis. The empirical results suggest that over the sample period both pure technical

and scale efficiency measures show a great variation and the sector did not achieve sustained efficiency gains. It is also reported that the sector suffers mainly from scale inefficiency, which in turn, is due to decreasing returns to scale. There were also reported diffencies in the efficiency performance of commercial banks with different ownership status. In addition, the relationships between profitability, asset quality, size and the two definitions of efficiency and scale inefficiency are positively related to size. The trend in the performance levels over the period suggests that macroeconomic condition had a profound influence on the efficiency measures.

Krishnasamy et al., (2003), analysed the nature and extent of productivity change of ten commercial banks in Malaysia over the period 2000-2001. Utilising non-parametric methodology, Data Envelopment Analysis (DEA) and Malmquist total factor productivity index (MPI), individual bank efficiency and productivity changes that took place is estimated within this period. The MPI calculated within the framework of DEA further decompose productivity growth into technical efficiency change and technological change. The results of this study indicate that total factor productivity increased in all eight banks except for EON, which remain the same while PBB, recorded a decrease in productivity. AFB recorded the highest growth in total factor productivity. The growth in productivity was attributed to technological change rather than technical efficiency change.

Leong et al.(2003) investigated the technical efficiency of banks in Singapore for the period 1993-99. They concluded that the derived efficiency scores were reasonably consistent with competitive industry conditions in identifying best practice banks and across alternative DEA specifications.

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA), occasionally called frontier analysis, was first introduced by Charnes, et al. in 1978. It is a performance measurement technique which, can be used for evaluating the relative efficiency of decision-making units (DMU's) in organizations. Examples of such units to which DEA has been applied are: banks, police stations, hospitals, government departments, prisons, defense bases (army, navy, and air force), schools, and university departments. Note here that one advantage of DEA is that it can be applied also to non-profit making organizations.

The efficiency of a bank refers to the ability of the bank's production

function to produce the maximum possible output from given quantities of inputs. A common measure for relative efficiency is:

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{\text{Weighted sum of inputs}}$$

DEA is a novel approach to relative efficiency measurement where there are multiple incommensurate inputs and outputs. If a suitable set of measures can be defined, DEA provides an efficiency measure not relying on the application of a common weighting of the inputs and outputs. DEA is a nonparametric mathematical programming model used to evauate the relative efficiency of decision- making units in their use of multiple inputs to produce multiple outputs. The unit being evaluated can be judged to be relatively efficient if the composite unit requirs less input to obtain the output achieved by the unit being evaluated. The DEA efficiency score for a specific firm is not defined by an absolute standard, rather it is defined relative to another unit (banks in our study) under consideration. DEA establishes ''benchmark'' efficiency score of unity that no individual bank's score can exceed. Consequently, efficient banks receive efficiency scores of unity, while inefficient firms receive DEA scores of less than unity

DEA as a performance measurement technique has been applied over a wide range of cases. It employs linear programming techniques to measure the relative efficiency of comparable entities called Decision Making Units. The model states that a given decision-making unit (DMU) is inefficient (efficiency < 1) if some other DMU, or some combination of DMUs, can produce at least the same amount of all outputs with less of some resource input and not more of any other resource. In other words, DEA can measure the slack in each of the input and output variables and also derive a reference group of efficient units with direct comparison (Cooper, et al. 2000). Conversely, a DMU is considered efficient when no other DMU can produce more output of an equal or lesser amount of input. DEA is mostly used to measure efficiency in situations where multi-input and multi-output cannot be transformed into an aggregate input or aggregate output (virtual input/output). DEA provides the user with information about the efficient and inefficient units, as well as the efficiency scores and reference sets for inefficient units.

Following the framework adopted by Noulas (2001) which is based on Berg et al.(1991) the output-oriented (CCR) DEA model is employed to measure bank performance.

Charnes et al. (1978) formulate the following fractional programming model:

max

$$h_k = \frac{\sum_{r=1}^{s} u_{rk} Y_{rk}}{\sum_{i=1}^{m} v_{ik} X_{ik}}$$

s.t

$$\frac{\sum_{r=1}^{s} u_{rk} Y_{rj}}{\sum_{i=1}^{m} v_{ik} X_{ij}} \leq 1; j = 1, \ldots, n$$

$$u_{rk} \geq \epsilon; r = 1, \ldots, s$$

$$v_{rk} \geq \epsilon; r = 1, \ldots, m$$

where ϵ is a non- Archimedean constant, y_{rj} represents the output level of bank j, r = 1,2,...,s where, s is the number of outputs, x_{ij} indicates the input level of bank j, i = 1,2,...,m where m is the number of inputs and n represents the total number of banks.

The CCR model assumes constant returns to scale. This allows the comparison between small and large banks which is the case of UAE commercial banks, where different sizes are present. The other DEA model is BCC model which assumes the varying returns to scale. The BCC model was introduced by Banker et al.(1984). The use of the second model according to Noulas(2001), and Berg et al.(1991) raises the possibility that the large banks will appear as being efficient for the simple reason that there are no truly efficient banks.

Research questions

This study seeks to answer the following questions:

(1) What are the most efficient banks among the UAE commercial banks. The reason is to identify the banks that produce the maximum possible output from given quantities of inputs.

(2) Which banks are considered inefficent. The aim is to identify the banks that do not produce the maximum possible output from given quantities of inputs.

(3) What are the bank /banks to be benchmarked. In order to improve performance of the inefficient banks, it is important to identify the leading banks or the benchmarked banks.

(4) How can the inefficient banks improve their performance. The most important issue is estimating how much output could be increased and/or the magnitude of input that could be conserved by inefficient banks. This means that additional decreases in specific input could be achieved for a bank to operate as well as the most efficient banks, and increases in output could be reached at lowered levels of resource input.

Research methodology

This study examines the UAE commercial banks' performance by using two methodologies: Data Envelopment Analysis (DEA), and The traditional measures namely, return on assets (ROA), return on equity (ROE), loans to deposits (LTD), and loans to total assets (LTA). The DEA was run with interest expense and non-interest expense as the two input variables, and interest revenue and non-interest revenue as the two output variables. There are two reasons for the use of the input and output variables; firstly, they represent the most important sources and uses of funds for commercial banks, and secondly, they have been widely used by researchers in the DEA models as we have seen in the literature review section.

Data used in this study are from the annual reports of UAE commercial banks published by the Emirates Banks Association for five years 1997-2001. These annual reports include national and foreign banks. The national banks covered in this study are 18 banks in 1997, and (19) banks for (1998-2001). In 1997, the number of national banks was 19 banks, One bank was excluded from the 1999 population (Dubai Islamic Bank) because of insufficient data. In 1998 to 2001, Abu Dhabi Islamic Bank was added and Dubai Islamic Bank was excluded for the same reason. The number of foreign banks operating in UAE is 27 during 1997-2001. Three were excluded because of a lack of information.

Results

The DEA scores resulting from applying the CCR model are presented in Table1. The table indicates that in 1997 only five commercial banks out of 42 (11.9 percent) are relatively efficient, and their efficiency scores are all equal to 1.00. The efficient national banks are DMU7 (Commercial Bank of Dubai), DMU11 (Middle East Bank), DMU12 (National Bank of Abu Dhabi), DMU16 (National Bank of Sharjah) whereas the only efficient foreign bank is DMU40 (National Bank of Bahrain). This implies that the resource utilization of these particular commercial banks is functioning well.

Thirty seven inefficient banks had efficiency scores less than 1.00. They can improve by decreasing resource input and increasing output. For example, the efficiency score of bank 13, a local bank, is 0.9893, i.e., this bank has attained 98.9 per cent efficiency. In other words this bank needs to increase its outputs by 1.07 percent to become as efficient as its reference subset. The bank has reached 98.93 per cent of the level of output of efficient banks with the same level of input.

Table 1
Relative Efficiency (DEA Results)

1997		1998		1999		2000		2001	
Unit	**Score**	**Unit**	**Score**	**Unit**	**Score**	**Unit**	**Score**	**Unit**	**Score**
40	100.00	20	100.00	16	100.00	11	100.00	9	100.00
16	100.00	33	100.00	19	100.00	27	100.00	33	100.00
11	100.00	2	100.00	11	100.00	13	100.00	40	100.00
7	100.00	5	100.00	2	100.00	9	100.00	20	100.00
12	100.00	12	99.84	40	95.49	2	98.08	1	100.00
13	98.93	39	99.44	43	93.37	17	95.17	5	98.27
17	98.46	13	84.28	20	90.50	28	89.55	6	96.67
39	96.97	30	81.77	15	89.76	19	89.02	13	95.69
21	96.31	31	80.56	32	86.20	37	88.82	11	95.03
15	90.38	19	78.64	38	84.76	31	88.72	18	94.59
25	90.30	1	77.64	26	83.68	44	88.09	12	93.63
19	89.54	10	77.56	17	81.25	21	87.43	14	91.88
9	87.61	9	76.09	13	79.68	15	86.76	16	90.71
24	86.22	22	74.96	21	79.59	26	86.65	15	90.29
43	86.04	27	72.49	44	79.03	20	86.54	8	89.16
1	83.94	23	71.97	5	78.92	18	85.06	19	88.45
3	83.46	4	71.07	31	78.90	43	83.82	21	87.04
31	83.27	36	70.33	35	77.88	29	83.33	4	86.49
6	82.82	14	69.91	7	76.81	35	79.54	26	86.37
34	82.80	28	69.49	10	76.61	39	78.70	22	85.27
18	81.72	32	69.28	9	75.24	34	78.13	39	85.22
35	81.21	18	69.26	25	74.55	10	77.92	38	85.08
28	80.04	38	68.76	27	71.27	40	77.39	30	84.77
42	79.16	26	68.50	6	69.69	6	77.04	36	83.00
26	79.05	6	68.41	1	68.16	14	76.91	42	82.37
10	78.29	3	67.78	22	67.98	38	76.82	35	80.46
38	76.86	44	67.32	14	67.76	12	72.68	29	80.26
27	75.77	7	66.86	29	67.72	16	72.58	41	79.57
37	75.67	43	66.71	3	67.48	30	72.40	31	78.57
23	75.51	35	65.82	36	66.50	24	71.39	34	77.12
41	75.06	29	65.73	18	65.36	1	71.04	25	76.69
5	74.42	41	65.64	37	62.48	23	70.94	10	76.52
33	73.92	34	65.48	41	62.39	4	70.34	17	76.45
32	73.11	25	64.56	42	61.56	41	70.14	37	76.38
4	72.71	42	60.89	28	61.12	8	68.40	2	74.64
14	72.55	15	57.36	30	60.69	25	66.92	28	74.23
44	71.91	37	56.58	4	60.22	36	65.43	24	73.26
36	71.42	17	56.27	24	59.22	22	64.03	27	72.15
29	70.58	24	53.53	23	59.00	5	58.22	3	69.97
22	68.19	40	49.42	34	55.57	3	55.58	44	69.71
30	66.07	16	49.03	12	49.99	42	52.38	23	69.53

The mean overall efficiency score is 0.8240. This implies that UAE commercial banks could have produced the same level of output by using 82.4% of the input actually used. Note that the gap in the efficiency difference among 42 banks is not large; it may be due to the fact that all the UAE commercial banks face high competitive pressures and have already improved their efficiency in the process.

We also separate the 42 banks into national banks and foreign banks when we report the results of efficiency score analysis: 1 to 20 are national and 21 to 44 are foreign. It shows that the mean efficiency score of national banks (0.8665) is higher than that of foreign banks (0.7981). The results also show that 14 of 18 national commercial banks are inefficient, compared with 23 of 24 in the case of foreign banks. This evidence reveals that national banks operations may be relatively more efficient than those of foreign banks.

In 1998 only four commercial banks out of 43 (9.3 percent) are relatively efficient. The efficient national banks are DMU2 (Arab Bank for Investment and Foreign Trade), DMU5 (Mashreq Bank), DMU20 (Abu Dhabi Islamic Bank), whereas the only efficient foreign bank is DMU33 (Credit Agricole Indosuez). The mean overall efficiency score is relatively high (0.714). Commercial banks in UAE could have produced the same level of output by using 71.4 per cent of the input actually used. The gap in the efficiency difference among 43 banks is not large. Table 1 indicates that the mean efficiency score of national banks (0.745) is higher than that of foreign banks (0.689). The results also show that 16 of 19 national commercial banks are inefficient, compared with 23 of 24 in the case of foreign banks. This evidence also reveals that national bank operations may be relatively better than those of foreign banks.

In 1999 only four commercial banks out of 43 (9.3 percent) are relatively efficient, and their efficiency scores are all equal to 1.00. The four efficient banks are national banks, namely DMU2 (Arab Bank for Investment and Foreign Trade), DMU11 (Middle East Bank), DMU16 (National Bank of Sharjah, DMU19 (United Arab Bank). Thirty nine banks had efficiency scores less than 1.00. As to the mean overall efficiency score, the score is also high (0.714). It implies that commercial banks in UAE could have produced the same level of output by using 71.4 per cent of the input actually used. Note that the gap in the efficiency difference among 43 banks is also not large; it may be due to the same reason mentioned previously. The mean effi-

ciency score of national banks (0.788) is higher than that of foreign banks (0.699). The results also show that 15 of 18 national commercial banks are inefficient, compared with all foreign banks being inefficient. This evidence also reveals that national banks operations may be relatively better than those of foreign banks.

In 2000 only four commercial banks out of 43 (9.3 percent) are relatively efficient. The efficient national banks are DMU9 (Middle East Bank), DMU11 (National Bank of Sharjah), DMU13 (United Arab Bank), whereas the only efficient foreign bank is DMU27 (BNP Paribas). As to the mean overall efficiency score, the score is also high (0.779). It implies that commercial banks in UAE could have produced the same level of output by using 77.9 per cent of the input actually used. Note that the gap in the efficiency difference among 43 banks is also not too large. The mean efficiency score of national banks (0.811) is higher than that of foreign banks (0.75.2). The results also show that 16 of 19 national commercial banks are inefficient, compared with 23 of 24 in the case of foreign banks. This evidence also reveals that national banks operations may be relatively better than those of foreign banks.

Finally, in 2001 only five of 43 commercial banks (11.6 percent) are relatively efficient. The efficient national banks are DMU1 (Abu Dhabi Commercial Bank), DMU9 (Middle East Bank), DMU20 (Abu Dhabi Islamic Bank), whereas the efficient foreign banks are DMU33 (Barclays Bank), and DMU 40(National Bank of Bahrain). The mean overall efficiency score is quite high (0.843). It implies that commercial banks in UAE could have produced the same level of output by using 84.3 per cent of the input actually used. Note that the gap in the efficiency difference among 43 banks as in the case of the four previous years is not large. Table 1 shows that the mean efficiency score of national banks (0.899) is higher than that of foreign banks (0.798). The results also show that 16 of 19 national commercial banks are inefficient, whereas 22 foreign banks are inefficient. This evidence also reveals that national banks' operations may be relatively better than those of foreign banks.

Regarding the traditional performance measures, four ratios were used, namely, ROE, ROA, loans to deposits (LTD), and loans to total assets (LTA). They are well known and frequently used as indicators of commercial banks' performance. The Appendix shows that the efficient banks according to DEA did not achieve the best performance based on traditional performance measures

were used. For example, the average ratio of loans to total deposits was 77.6 percent in 1997 and increased to 85.39 percent in 2001, whereas the ratio determined by the UAE Central Bank is 100 percent. To some extent it appears that the UAE commercial banks did not adequately utilize the available resources properly. This also appears to be the case of the ratio of total loans to total assets. Similar to the DEA, the four traditional measures reflect that most of the UAE commercial banks were inefficient. The Appendix also indicates that there were major differences in the performance levels. However, similar to DEA, the national banks were also more efficient than the foreign banks when the traditional measures were used. This conclusion is based on the fact that the average ratios of national banks are higher than those of foreign banks. For example, for the national banks, the average ratio of the four measures in 2001 was ROA (2.4 percent), ROE (31.71 percent), LTD (85.17 percent), and LTA (55.86 percent), compared with 0.28 percent, 22.71 percent, 85.61 percent, and 42.59 respectively of the foreign banks.

Conclusions

The paper analyses the use of the data envelopment analysis (DEA) methodology in the performance measurement of UAE commercial banks along with traditional measures of ROE, ROA, loans to deposits, and loans to total assets during 1997-2001. These two methodologies were used in order to provide a more comprehensive and complete picture of the UAE commercial banks' performance.

The study sought to identify the relatively best-performing banks and relatively worst-performing banks. It also sought to identify banks' efficiency scores and ranks. The study found five main points:

(1) Most of the UAE commercial banks appear inefficient when both the DEA and the traditional measures were used.

(2) The national banks were more efficient than the foreign banks. An application for this might lie in the fact that the ownership of these banks belong to government bodies, therefore, they have more facilities and they face less restrictions in managing their operations.

(3) Two traditional ratios loans to deposits, and loans to total assets, indicate that to some extent the UAE commercial banks did not use the available resources properly. This suggests that there was excess liquidity in the banking system. UAE commercial banks need to develop new strategies in

order to utilise the available resources.

(4) The results obtained from the application of the two methodologies are different, which is consistent with previous studies.

(5) The individual banks can identify competition, benchmark themselves with respect to competition, compete with better performers and seek for improvement.

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Appendix
Financial Performance Indicators(%)

ROA

Bank	1997	1998	1999	2000	2001
1	2.43	2.34	2.39	2.41	2.31
2	3.08	2.85	2.21	1.94	.70
3	3.04	2.05	2.39	1.41	1.88
4	1.54	1.3	1.09	1.67	1.83
5	2.81	2.74	1.75	1.45	1.38
6	3.11	2.56	2.49	2.82	2.95
7	3.46	2.99	2.97	2.78	2.36
8	2.86	0.85	-2.41	2.74	2.93
9	3.07	3.59	2.63	1.59	1.79
10	4.34	2.87	2.98	4.9	3.73
11	1.31	1.14	0.99	2.56	2.60
12	1.67	1.65	1.62	3.82	4.04
13	2.21	0.7	1.27	2.94	3.11
14	2.38	2.51	2.74	2.68	2.49
15	4.9	5.42	5.82	2.53	2.30
16	4.25	3.16	3.27	1.86	2.66
17	2.57	2.4	2.48	3.51	3.45
18	2.55	2.93	3.65	2.1	1.79
			0.69	1.38	1.32
Mean	**2.86**	**2.45**	**2.87**	**2.4**	**2.4**
19	3.29	2.18	3.04	2.15	.55
20	1.09	0.98	1.11	1.62	1.26
21	1.66	1.4	1.37	0	.28
22	3.67	0.3	-10.01	1.32	Ù.46
23	3.57	2.74	2.17	0.94	1.13
24	1.44	3.04	2.81	3	2.48
25	2.29	1.83	2.12	2.23	2.53
26	3.3	2.33	-2.06	0.35	.07
27	0.25	1.24	1.31	2.34	2.31
28	1.51	1.58	1.2	1.93	1.14
29	1.73	1.7	0.54	1.6	.41
30	2.08	0.77	-9.19	1.05	-15.99
31	1.03	0.68	-2.25	0.54	.80
32	2.13	1.41	-1.26	-0.38	.10
33	2.42	22.61	-3.85	1.55	1.58
34	1.39	1.21	1.12	1.67	1.47
35	0.14	-0.98	-0.82	1.93	1.50
36	0.25	0.24	0.33	2.68	1.01
37	1	0.93	0.77	2.23	1.95

Bank	1997	1998	1999	2000	2001
38	1.78	1.84	1.7	-1.04	1.09
39	0.73	0.93	0.7	1.38	1.39
40	1.58	1.58	-0.21	0.55	.40
41	2.74	3.01	2.54	1.2	Ù1.46
42	1.6	-0.81	-0.03	-0.03	.02
Mean	**1.77**	**1.35**	**1.78**	**1.28**	**.286**

ROE

Bank	1997	1998	1999	2000	2001
1	17.75	17.66	17.42	17.35	49.23
2	15.47	13.19	9.62	8.63	7.07
3	19.29	13.97	16.17	17.63	64.54
4	15.22	10.22	9.39	15.87	32.50
5	25.89	21.15	13.82	9.96	52.25
6	13.62	14.21	13.22	17.78	48.00
7	19.3	18.15	17.5	15.11	60.51
8	11.86	2.56	-10.96	10.4	14.49
9	18.7	19.78	15.01	13.72	56.68
10	15.94	11.58	10.89	18.63	21.81
11	17.73	15.85	11.8	14.09	20.91
12	10.58	10.07	9.99	18.21	28.73
13	11.75	3.54	6.81	16.89	24.22
14	11.3	9.13	10.58	10.41	24.10
15	22.96	23.51	20.5	17.18	27.47
16	16.77	14.09	14.71	10.58	21.24
17	1.97	16.75	15.82	14.76	23.63
18	13.14	15.36	17.1	10.62	17.13
			1.64	5.08	8.05
Mean	**15.51**	**13.93**	**15.51**	**13.84**	**31.71**
19	12.62	8.88	11.01	4.84	2.96
20	12.79	14.41	10.24	20.61	34.42
21	20.5	16.92	16.22	0	1.87
22	14.4	1.25	-28.76	9.39	Ù8.00
23	22.04	17.46	14.92	18.41	24.83
24	11.21	22.62	16.69	16.62	34.84
25	19.27	15.94	24.52	15.74	19.40
26	17.09	13.29	-12.17	2.04	.44
27	2.19	11.21	12.24	22.47	193.77
28	16.44	16.61	15.93	5.12	2.69
29	10.95	9.05	2.98	8.11	2.07
30	15.84	5.56	-72.56	4.27	-119.29
31	13.02	9.56	-35.99	9.43	26.86
32	23.51	21.04	-20.88	-5.96	1.52
33	21.39	22.12	-37.98	27.68	79.38

Bank	1997	1998	1999	2000	2001
34	24.76	24.23	24.3	24	57.63
35	1.43	-10.9	-12.18	23.12	92.47
36	1.52	1.42	1.89	26.74	38.72
37	15.11	13.19	9.62	16.67	18.84
38	3.61	3.74	3.84	-11.71	30.02
39	6.61	7.03	4.69	13.12	19.43
40	14.54	22.12	-3.32	6.87	14.42
41	27.2	26.9	22.71	10.83	Ù25.71
42	14.12	-7.47	-0.29	-0.3	.29
Mean	**14.26**	**11.89**	**14.26**	**11.17**	**22.71**

LTD

Bank	1997	1998	1999	2000	2001
1	85.77	98.03	95.28	100.93	92.27
2	86.61	140.08	129.96	128.91	129.07
3	71.51	85.22	93.43	73.87	94.37
4	81.42	86.91	78.17	74.63	72.95
5	81.25	82.93	79.25	32.79	28.60
6	82.67	83.29	75.51	86.37	89.21
7	82.49	88.02	96.5	93.22	104.49
8	66.25	112.7	90.76	78.85	82.22
9	77.68	85.01	83.98	67.14	64.94
10	123.13	115.95	93.2	115.32	118.17
11	62.42	61.34	65.43	74.67	68.54
12	30.57	32.3	36.97	104.93	106.80
13	80.04	87.26	91.3	81.41	85.33
14	58.9	92.55	113.59	110.95	98.11
15	89.48	100.23	126.79	90.97	86.65
16	95.04	90.35	95.44	83.69	85.89
17	90.46	95.89	106.82	96.93	97.74
18	83.82	90.36	113.34	79.77	61.49
			18.17	29.72	51.36
Mean	**79.42**	**90.47**	**79.42**	**84.48**	**85.17**
19	100.17	110.2	106.42	220	125.31
20	96.59	89.34	92.05	68.55	59.74
21	50.18	56.01	63.94	102.21	92.86
22	99.19	106.15	86.29	84.26	78.40
23	40.38	43.58	45.62	61.48	80.20
24	64.44	58.01	58.51	66.48	82.65
25	39.27	57.12	61.06	85	79.01
26	111.57	108.83	94.9	49.39	47.11
27	44.53	44.55	39.36	75.88	77.32
28	73.3	80.71	65.76	56.4	38.18
29	54.18	63.77	60.4	62.07	52.77

Bank	1997	1998	1999	2000	2001
30	95.09	81.78	73.79	81.9	90.28
31	100.66	127.82	142.47	158.94	127.20
32	62.65	79.67	74.06	70.61	62.26
33	92.36	86.53	83.93	31.37	26.43
34	36.97	30.51	32.39	64.51	59.34
35	78.43	72.04	69.63	64.29	53.50
36	82.29	73.94	65.8	74.28	52.90
37	97.21	138.14	100.03	50.84	72.61
38	102.98	148.13	220.71	82.62	58.75
39	82.17	106.94	106.55	36.28	35.75
40	71.09	74.18	69.72	99.79	80.97
41	77.52	80.64	100.26	86.13	59.92
42	87.68	101.43	110.92	110.85	59.35
Mean	**76.70**	**84.16**	**76.70**	**81.01**	**85.61**

LTA

Bank	1997	1998	1999	2000	2001
1	60.21	66.80	64.49	68.26	61.50
2	23.42	23.66	23.47	22.26	22.18
3	56.59	69.83	76.54	53.01	63.06
4	70.04	74.32	66.65	61.5	59.67
5	59.13	58.84	55.85	24.82	22.01
6	60.93	62.08	57.32	65.64	61.88
7	62.37	66.99	73.05	57.41	61.78
8	44.26	66.26	64.01	50.34	48.27
9	61.96	66.2	65.81	48.91	46.09
10	85.79	66.67	59.95	71.66	63.77
11	49.6	49.04	53.48	57.97	53.43
12	23.71	24.53	27.56	73.45	75.31
13	54.8	58.31	57.87	64.31	66.49
14	41.4	59.09	72.82	73.19	72.79
15	65.87	73.06	78.46	73.84	72.03
16	64.29	64.88	68.76	57.99	57.52
17	67.02	68.74	72.23	68.71	67.67
18	62.62	65.32	78.24	58.65	49.78
			10.22	20.12	36.01
Mean	**73.46**	**60.26**	**73.46**	**56.42**	**55.86**
19	69	78.63	74.23	58.04	34.26
20	56.63	53.48	57.48	58.35	51.52
21	42.5	47.38	53.93	76.26	68.42
22	56.88	51.42	33.47	69.62	66.36
23	28.37	28.27	27.22	42.63	58.71
24	51.96	46.98	46.29	52.25	64.24
25	24.74	33.94	27.73	54.51	57.02

Bank	1997	1998	1999	2000	2001
26	81.13	81.34	75.14	19.9	17.68
27	36.89	37.23	33.15	57.29	58.74
28	56.3	64.57	52.11	24.58	18.09
29	43.67	49.25	46.59	47.55	39.06
30	66.91	55.26	52.05	58.96	68.08
31	44.92	37.29	41.94	35.64	30.32
32	36.5	28.97	31.54	50.89	46.08
33	73.76	67.58	66.27	28.32	23.88
34	33.42	27.84	29.16	36.57	35.35
35	53.56	53.63	51.28	31.78	24.95
36	27.03	28.31	25.52	40.86	30.52
37	41.13	41.14	38.16	27.25	42.79
38	48.25	57.79	71.46	62.88	29.64
39	47.1	72.28	75.16	30.62	30.90
40	52.14	40.85	41.61	38.31	41.99
41	56.54	54.88	64.31	55.12	41.76
42	54.32	71.69	62.75	68.21	41.90
Mean	**49.32**	**50.42**	**49.32**	**46.93**	**42.59**

الملخص

تحليل البيانات المغلفة في البنوك التجارية في دولة الإمارات العربية المتحدة

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إن تحليل الأداء للبنوك يعد ذا أهمية كبيرة لكل من المودعين والمقترضين والحكومة. الهدف من البحث هو محاولة تحديد البنك الأفضل أداء والبنك الأقل أداء نسبياً من بين البنوك التجارية في دولة الإمارات العربية المتحدة. البحث أيضاً يهدف إلى ترتيب البنوك حسب درجة الكفاءة. ومن أهم النتائج التي تم التوصل إليها: أن غالبية البنوك التجارية كانت غير كفوءة بموجب نموذج تحليل البيانات المغلفة والمؤشرات التقليدية. كما أن البنوك التجارية الوطنية كانت نسبياً أكثر كفاءة من فروع البنوك التجارية الأجنبية العاملة في البلد. وقد أشار تحليل نسبتين تقليديتين وهما: نسبة القروض إلى الودائع، ونسبة القروض إلى مجموع الأصول بأن البنوك التجارية لم تستخدم الموارد المتاحة بالشكل المطلوب. وتشير النتائج التي تم التوصل إليها باستخدام كل من نموذج تحليل البيانات المغلفة والنسب المالية التقليدية إلى عدم تطابق النتائج وهذا يتوافق مع ما تم التوصل إليه في الدراسات السابقة.

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