# Efficiency of Conventional versus Islamic Banks: International Evidence using the Stochastic Frontier Approach (SFA)

Shamsher Mohamad [1]
Taufiq Hassan [2]
Mohamed Khaled I. Bader [3]

**Abstract**

*This paper measures and compares the cost and profit efficiency of 80 banks in 21 of Organisation of Islamic Conference (OIC) countries: comprising of 37 conventional banks and 43 Islamic banks, using the Stochastic Frontier Approach (SFA). In addition, it assesses the efficiency of those banks based on their size, age, and region. The findings suggest that there are no significant differences between the overall efficiency results of conventional versus Islamic banks. However, there is substantial room for improvement in cost minimisation and profit maximisation in both banking systems. Furthermore, the findings show no significance difference in average efficiency scores between big versus small and new versus old banks in both banking streams. This implies that size and age did not affect the performance of banks in both streams. Overall, the results are in favour of the more recent Islamic banking system.*

JEL Classification: G21, C14

Key words: Conventional Banks, Islamic banks, Efficiency, Data Envelopment Analysis (DEA).

## 1. Introduction

The most well-known approaches to explain banking function process are the production and intermediation approaches. In the *production approach***,** banking activities are described as the production of services to depositors and borrowers. Traditional production factors, land, labour and capital, are used as inputs to produce desired outputs. The production approach views banks as producers of loan and deposit services using capital and labour. However, majority of the recent empirical research of banking efficiency are based on the intermediation approach. *The intermediation approach* was suggested by Sealey and Lindley (1977), in fact

[1] Professor in Finance, Graduate School of Management, University Putra Malaysia. Email: shamsher57@yahoo.com
[2] Associate Professor in Finance, Faculty of Economics and Business, University Putra Malaysia. Email: taufiq@econ.upm.edu.my / tauufik@yahoo.com
[3] Lecturer at the AL-QUDS University in Jerusalam, E-mail: mk.bader@yahoo.com

complements the production approach. It views bank as an intermediator of financial services and assumes that banks collect funds (deposits and purchased funds with the assistance of labour and capital) and transform these into loans and other assets. The deposits are treated as inputs along with capital and labour and the volumes of earning assets are defined as measures of output. The intermediation approach may be more appropriate for evaluating entire financial institutions because this approach is inclusive of interest and/or funding expenses, which often account for between one-half and two-thirds of total costs. Moreover, the intermediation approach may be superior for evaluating the importance of frontier efficiency for the profitability of financial institutions, since the minimisation of total costs, and not just production costs, is needed to maximise profits (Iqbal and Molyneux, 2005).

The conventional banking theories assume that banks earn profits by purchasing deposits from the depositors at a low interest rate, then reselling those funds to the borrowers at higher interest rate, based on its competitive advantage at gathering information and underwriting risk (Santos, 2000). Therefore, conventional banks make profits from the spread between the interest rate received from borrowers and the interest rate paid to depositors.

Islamic banking performs the same intermediary function but does not receive a pre-determined interest from borrowers and does not pay a predetermined interest to the depositors; the amount of profits is based on the profit sharing agreements with the depositors and also with the borrowers. In addition, there are fee-based banking services that are similar to the conventional banks as long as there is no pre-determined interest payment/receipt in the transaction. Thus, Islamic banking is considered as a *different* banking stream as it prohibits interest and replaces with (a) profit share and (b) the profit share depends on the extent of the risk participation of the parties. The absence of pre-determined rewards is based on Qu*ranic* commands and as interpreted using *Shari'ah* principles (Ariff, 2006).

In this respect, Berger, Hunter, and Timme (1993) noted that if banks are efficient, then we might expect improved profitability, greater amounts of funds intermediated, better prices and service quality for consumers, and greater safety and soundness if some of the efficiency savings are applied towards improving capital buffers that absorb risk. However, the converse applies to inefficient intermediaries, with the additional danger of taxpayer-financed industry bailouts if substantial losses are sustained. Consequently, efficiency of banks improves the overall economy which affects the welfare of the society as a whole. The efficiency of banks is influenced by different factors in the environment in which production takes place *e.g.* size, age, region, competition, input and output quality, network characteristics, ownership form, regulations and changes in regulation, and management characteristics.

Carvallo and Kasman (2005) noted that, the liberalisation of financial markets at a global scale, the increasing use of advanced technology, and the information

revolution have put competitive pressure on banking firms both domestically and internationally. This competitive pressure is particularly important for banks in the emerging markets as they constitute the main financial intermediaries to channel savings and investment. In this content, the competitive advantage is enhanced if banks can function efficiently.

In this regard, conventional banks enjoy several advantages over Islamic banks. For example, conventional banks have very long history and experience, accept interest which is a major source of bank revenues, do not share loss with clients and ask for guaranteed collaterals in most transactions, enjoy very huge capital, spread very widely, have much more developed technologies, can enter Islamic banking market (*e.g.* Citibank, Bank of America, Deutche Bank, ABN, AMRO, USB, HSBC, and ANZ Grindlays) and proved to benefit from theoretical and empirical research. In light of the above advantages, it is interesting to examine efficiency of both banking streams. Further, some important, both positive and negative, changes had taken place in the recent years. For example, many large international conventional banks have started to compete by offering Islamic banking services, and the number of Islamic banks has increased causing competition among Islamic banks themselves. Knowledge and practice of Islamic banking is spreading quickly and as more Islamic banking entities are established, new regulations, policies, and accounting standards are designed to accommodate these changes.

Despite the above discussed advantages and challenges, the literature (*e.g*. Hassan and Bashir, 2003; Sarker, 1999; Bashir, 1999; Samad and Hassan, 1999; Yudistira, 2004; and Hussien, 2004) suggests that Islamic banks are more efficient than conventional banks. However, there is no conclusive evidence in this regard. To further substantiate on this controversial issue, this study uses a new set of international data over the period 1990-2005 and applies the Stochastic Frontier Approach (SFA) to test the comparative cost and profit efficiency of the conventional and Islamic banks.

This paper is structured as follows: Section 2 reviews the relevant literature, section 3 explains objectives of the research, section 4 elaborates on the data and methods applied to analyze the data, section 5 discuss the findings and section 6 concludes the paper.

## 2. Literature Review

Existing studies in this area are classified into two groups. The first group includes studies that assess the performance of Islamic banks using traditional financial ratios (*e.g*. Samad, 1999; Bashir, 1999; Hassan and Bashir, 2003; Bader, Ariff, and Shamsher, 2007). Some of those studies compared their results with conventional banks. The second group of studies focus on banks' efficiency and utilise frontier

analysis approaches rather than traditional financial ratios. Studies in this group can be divided into three folds: i) studies that evaluate efficiency of Islamic banks (*e.g.* Yudistira, 2004; Brown and Skully, 2005; Hassan, 2005; Bader, Ariff, and Taufiq, 2007), ii) studies that assess conventional banks' efficiency (*e.g.* Weill, 2004; Bos and Kool, 2006; and Bader, 2007), and iii) studies that compare the efficiency of Islamic with conventional banks (*e.g.* Al-jarrah and Molyneux, 2003, Al-Shammari, 2003; Hussein, 2004; Bader, Shamsher, and Taufiq, 2007).

Iqbal and Molyneux (2005) find that frontier approaches are considered to be superior to standard financial ratios analysis because they use programming or statistical techniques that remove the effects of differences in input and output prices and other exogenous market factors affecting the standard performance of firms. This provides more accurate estimates of the underlying performance of firms and their managers. Therefore, frontier efficiency has been used extensively in the extant banking literature to measure the effects of mergers and acquisitions, capital regulation, deregulation of deposit rates, removal of geographic restrictions on branching and holding company acquisitions, and on financial institution performance in general.

Overall, the use of frontier efficiency techniques yields useful comparative and benchmarking information that can provide impetus for significant improvements and can alert institutions to new business practices. Simple ratio-based analysis that is used for benchmarking can provide important insights but may be limited in scope because they take a one-dimensional view of a service, product, or process and ignore any interactions, substitutions, or trade-offs between key variables. Thus, a more inclusive multiple-input, multiple-output framework for evaluating productive efficiency, that provides benchmarking information on how to become a well-managed bank, seems essential to improve decision making processes (Iqbal and Molyneux, 2005).

In this regard, *cost efficiency*[4] gives a measure of how close a bank's cost is to what a best-practice bank's cost would be for producing the same bundle of output under the same conditions. *Profit efficiency* indicates how well a bank is predicted to perform in terms of profit relative to other banks in the same period for producing the same set of outputs.

Most of the studies over the 1990s have concentrated mainly on estimates of cost efficiency (*e. g*. Berger, Hunter and Timme, 1993; Resti, 1997). Subsequently, bank efficiency studies have been criticised for ignoring the revenue and profit side of banks' operations. Indeed, banks that show the highest inefficiencies and incur the highest costs might be able to generate greater profits than more cost efficient banks

[4] Sources for definitions of efficiency concepts include: Coelli *et al*. (1998), and Thanassoulis (2001).

(*e.g*. Berger and Humphrey, 1997; Berger and Mester, 1997). The few available studies that estimate profit frontier functions report efficiency levels that are much lower than cost efficiency levels, implying that the most important inefficiencies are on the revenue side (Maudos *et al.,* 2002).

Whereas Islamic banking literature represents studies from emerging markets and less developed countries, conventional banking literature includes studies from both developed and less developed countries. However, few studies cover the whole banking industry in many countries perhaps due to the limitations that are associated with information accessibility and other limitations of comprehensive studies.

In conventional banking literature, researchers had linked efficiency to different factors. Even though many researchers focus on two or more of these factors, literature can be reviewed from different aspects based the following criteria: First, some studies focus on cross-country comparisons of conventional banks efficiency (*e.g.* Bonin *et al*., 2005), other studies consider country-specific environmental conditions (*e.g.* Bos and Kool, 2006). Second, some studies have compared efficiency scores of foreign-owned banks with domestic-owned banks (*e.g.* Isik and Hassan, 2002b). Third, other studies have focused on the efficiency of conventional banks based on their nature (kind) whether is large or small, specialised or diversified, retail or wholesale banks (*e.g*. Kwan, 2006). Fourth, other studies focused their efficiency analysis on the government ownership versus private ownership (*e.g.* Cornett *et al*., 2000). Fifth, some studies focused on the concept of new bank versus old bank efficiency (*e.g.* Fries and Taci, 2005). Sixth, a number of studies tackled banks' performance after merger and acquisition as (*e.g.* Hughes *et al*., 1999). Seventh, many researchers were interested to examine the performance and efficiency of banking industry post financial crisis like Asian 1997 crisis (*e.g.* Chen, 2004). Eighth, the last classification, are studies that assess the effect of deregulation and liberalisation on banks' efficiency (*e.g.* Chen *et al*. 2005).

So far, there is quite fair number of researches that studied banking efficiency in less developed countries. For example: Malaysia (Sufian and Ibrahim, 2005), Pakistan (Limi, 2004), Bangladesh (Sarker, 1999), Turkey (Isik and Hassan, 2002a and b), Jordan (Isik *et al*., 2005), Bahrain (Hassan *et al.*, 2003), Saudi (Al-Faraj *et al*., 1993), Kuwait (Limam, 2002), and U.A.E. (Rao, 2005).

There are some documented studies that compare the performance of Islamic banks with their conventional counterparts. However, the focus of the majority of those studies is on comparing performance, especially profitability, with the help of financial ratios and constrained by the time span and the number of Islamic banks (*e.g.* Samad and Hassan, 1999; Iqbal 2001). Other relevant studies that have utilised the frontier approaches the studies by Al-Jarrah and Molyneux, 2003; Hussein, 2004; Brown and Skully, 2005; and Bader, Ariff, and Shamsher, 2007.

Al-Jarrah and Molyneux (2003) investigate the efficiency of the banking system in Jordan, Egypt, Saudi Arabia and Bahrain. Their sample comprises 82 banks over the period 1992-2000. They use the (SFA) and Fourier-Flexible (FF) form, based on intermediation approach to estimate cost and profit efficiency levels in the countries

under investigation. In particular, their paper evaluates whether factors such as asset quality, capital level, and environmental variables such as bank size, market characteristics, geographic position, and liquidity ratios influence banks' efficiency levels. In addition to input and output variables, the study employs three control variables including size of the loan loss reserves as a percent of bank's credit portfolio, the capital adequacy ratio, and a time trend.

Their results show that larger banks seem to be more profit efficient in general. The results show that the efficiency scores ranged from 56 percent for investment banks to 75 percent for Islamic banks. In addition, large banks seem to be more profit efficient. In their analysis, Bahrain was the most cost efficient while Jordan was the least. Indeed, based on specialisation, Islamic banks are the most profit efficient while investment banks are the least efficient. In sum, profit efficiency of Arabic banking system not only has not witnessed significant changes over 1993-1999 but also has experienced a fall in profit efficiency in 2000.

Hussein (2004) examined the performance of Bahrain as a leading financial centre in the Gulf region. He estimated how close Bahrain banks are from their potential profits that a best-practice bank can earn and compare the profit efficiency of Islamic versus conventional banks. He employed the Fourier's flexible functional model to estimate the profit efficiency index. His findings show that the profit efficiency of Bahrain banks over 1985-2001 is relatively stable and in line with the Organisation for Economic Co-operation and Development (OECD) banks. He found that, in general, there is not much difference in profit efficiency between Islamic and conventional investment banks, despite the fact that many Islamic banks are small and act as venture capital. In contrast, the only Islamic commercial bank in his sample outperforms the conventional counterparts. This was due to lack of competition whereby the Islamic commercial bank was able to reduce inputs' costs and charge higher mark-up.

## 3. Objectives

This paper assumes that both conventional and Islamic banks are cost minimisers, and revenue and profit maximisers. Hence, both conventional and Islamic banks try to maximise profits by raising revenues and reducing costs. On this basis, this paper investigates the differences in mean cost and profit efficiency scores of conventional versus Islamic banks. The effect of size, age and location on cost and profit efficiency of those banks is examined.

## 4. Data and Methodology

### *Data*

This study used a sample of 80 banks in 21 of Organisation of Islamic Conference (OIC) countries: comprising of 37 conventional banks and 43 Islamic banks,

collected from the BankScope database over the period 1990-2005[5]. To mitigate biasness in the findings, only banks in Islamic countries are selected and conventional banks in these countries that offer Islamic banking products are also excluded from the sample. The analysis is based on average efficiency scores of the sampled conventional and Islamic banks that are classified based on the total sample, and samples based on differences in size (measured by total assets), age (measured by date of establishment) and geographical location to account for different levels of economic development and market microstructure. To ascertain the robustness of the findings based on average scores, the analysis is repeated based on individual countries.

***Methodology***

The Stochastic Frontier Approach (SFA) is used to analyze the efficiencies of the sampled banks. This methodology is well documented in the literature (Carvallo and Kasman, 2005; and Beccalli *et al*., 2006) and is only briefly explained below.

***The Stochastic Frontier Approach (SFA)***

SFA has been widely used by a considerable number of studies in evaluating banking efficiency (Kumbhakar *et al*., 2001; Berger and Mester, 2003; Bikker and Bos, 2004; Koetter, 2005), and specifically both profit and cost efficiency (Kraft and Tirtiroglu, 1998; Hassan and Marton, 2003; Bonin *et al*., 2005; Fries and Taci, 2005; Bos and Kool, 2006; and Kwan, 2006). Decisive virtues of SFA are that it covers both the random noises, *e.g.* due to well-known measurement problems, and systematic differences between banks in the sample due to heterogeneity across banks (Kumbhakar and Lovell, 2000). These features allow a relative comparison of markedly different banks, for example large commercial versus small cooperative or savings banks or conventional versus Islamic banks, thus explicitly allowing for both environmental factors and random errors.

The SFA starts with a standard cost or profit function and estimates the minimum cost or maximum profit frontier for the entire sample from balance sheet data. The efficiency measure for a specific bank observation is its distance from the frontier. For the estimation of the cost and profit frontier functions this study follows the standard literature and uses the translog functional form (see Bos and Kolari, 2005). In a three-input, three-output translog setting, assume that the deterministic kernel $c\left(y_i, w_i; \beta\right)$ of the multiple-output cost frontier takes the log-quadratic translog functional form, and then the stochastic cost frontier model can be written as[6]:

[5] However, not all banks have 16-years history, especially the new banks category which makes it difficult to use time dummies to investigate different time periods.

[6] For a theoretical framework for the SFA models used here, see Kumbhakar and Lovell (2000).

$$\ln E_i \geq \beta_0 + \sum_m \alpha_m \ln y_{mi} + \sum_n \beta_n \ln w_{ni} + \frac{1}{2}\sum_m \sum_j \alpha_{mj} \ln y_{mi} \ln y_{ji}$$

$$+\frac{1}{2}\sum_n \sum_k \beta_{nk} \ln w_{ni} \ln w_{ki} + \sum_n \sum_m \gamma_{nm} \ln w_{ni} \ln y_{mi} + v_i$$

$$= \beta_0 + \sum_m \alpha_m \ln \mathrm{y}_{\mathrm{mi}} + \sum_n \beta_n \ln w_{ni} + \frac{1}{2}\sum_m \sum_j \alpha_{mj} \ln \mathrm{y}_{\mathrm{mi}} \ln y_{ji}$$

$$+\frac{1}{2}\sum_n \sum_k \beta_{nk} \ln w_{ni} \ln w_{ki} + \sum_n \sum_m \gamma_{nm} \ln w_{ni} \ln y_{mi} + v_i + u_i, \qquad (7)$$

where

| | |
|---|---|
| $E_i = w_i^T x_i = \sum_n w_{ni} x_{ni}$ | is the expenditure incurred by producer i, |
| $y_i = (y_{1i}, \ldots, y_{Mi}) \geq 0$ | is a vector of output produced by producer |
| $i, w_i = (w_{1i}, \ldots, w_{Ni}) > 0$ | is a vector of input prices faced by producer |
| $i, c(y_i, w_i; \beta)$ | is the cost frontier common to the all producers, |
| $\beta$ | is a vector of technology parameters to be estimated, |
| $v_i$ | is the two-sided random-noise component, and |
| $u_i$ | is the nonnegative cost inefficiency component of the composed error term $\varepsilon_i = v_i + u_i$. |

$k = 1, \ldots\ldots, N$

Rather than utilising standard profit function, this study follows Berger and Mester (1997) by employing alternative profit function. Humphrey and Pulley (1997) have introduced the alternative profit frontier to bridge the gap between a cost frontier and a profit frontier. An alternative profit frontier is defined as:

$$\pi^A(y, w; \beta, \delta) = \max_{p,x} \{p^T y - w^T x : g(p, y, w; \delta) = 0,\ D_0(x, y; \beta) \leq 1\}, \qquad (8)$$

where the endogenous variables are $(p, x)$ and the exogenous variables are $(y, w)$, $D_0(x, y; \beta)$ is the output distance function characterising the structure production technology, and $g(p, y, w; \delta)$ represents the producer's "pricing opportunity set" which captures the producer's ability to transform exogenous $(y, w)$ into endogenous product prices $p$.

Following Coelli *et al.* (1998) and Bos and Kolari (2005), linear homogeneity was imposed in input prices by normalising the dependant variables and input price variables (W) before taking logarithms. Cost efficiency for bank *k* at time *t* is:

$$CE_{kt} = \left\{E\left[\exp\left(u_{KT}\right)\right] \middle| \varepsilon_{KT}\right\}^{-1} \qquad (9)$$

This measure takes on a value between 0 (fully inefficient) and 1 (fully efficient) and indicates how close a bank's costs are to the costs of a fully efficient bank under the same conditions based on its inputs, outputs, prices, and controlling variables. Profit efficiency also takes on a value between 0 and 1 and its definition is:

$$PE_{kt} = E\left[\exp\left(-u_{KT}\right)\right] \mid \varepsilon_{KT}\right] \tag{10}$$

***Definition of Variables***

Berger and Humphrey (1997) explain the difficulty of variable selection in performance appraisal of banks. They argue that there is 'no perfect approach' on the explicit definition and measurement of banks' input and output. In variables selection, there are some restrictions on the type of variables since there is a need for comparable data and to minimise possible bias due to different accounting practices as, even in the same country, different banks might use different accounting standards. In this respect, selection of variables clearly affects the results of efficiency scores.

Based on documented literature (Isik and Hassan, 2002; Hassan, 2005)[7], the input vector consists of the following three variables: (i) labour; (ii) fixed assets (fixed capital); and (iii) total funds. The quantity of labour is measured by the staff costs, fixed capital by the book value of premises and fixed assets, and total funds by the sum of deposit (demand and time) and non-deposit funds as of the end of the respective year. Hence, the total banking costs include both interest expense and operating costs and are surrogated by the sum of labour, capital, and total funds expenditures. All variables are measured in millions of U.S. dollars. All banks, within the intermediation framework are modelled as multi-product firms, producing three outputs employing three inputs.

All input prices are surrogated as flows over the year divided by these stocks: (i) price of labour: total expenditures on employees such as salaries, employee benefits, and reserves for retirement pay (personal expenses), divided by the total funds, (ii) price of fixed assets: total expenditures on premises and fixed assets (depreciation) divided by the book value of premises and fixed assets, and (iii) price of total funds: total interest expenses on deposit and non-deposit funds plus other operating expenses divided by the total funds[8].

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[7] In this regard, Isik and Hassan (2002) assessed cost and profit efficiency for banks in Turkey. They selected three inputs- three output approach. Hassan (2005a) examined cost, profit and X-efficiency in Islamic banks and he followed the same approach.

[8] Other operating expenses, similar to interest expenses, are involved here as it could be argued that these expenses are among the costs that banks paid on their funds. These expenses include: other general and administrative expenses, marketing expenses, and other operating expenses.

The output vector includes the following three outputs: (i) total loans; (ii) other earning assets such as investment securities, specialised and directed loans, and inter-bank loans; (iii) off-balance sheet items. The total revenue created by these outputs is the dependent variable in the revenue function. Whereas, the revenues created by these outputs, after accounting for the expenses in their production, make up the dependent variable in the profit function. Therefore, the net income (interest and non-interest income) is used as a proxy for the regressing in the revenue equation, while the operating expenses (interest and non-interest expense) and taxes deducted from the net income before it is used as a proxy for the profit equation.

## 5. Results

The results for overall cost and profit efficiency of all banks and conventional versus Islamic banks, using Stochastic Frontier Approach (SFA) is documented in Table 1.

***Overall Cost and Profit Efficiency of Conventional, Islamic and All Banks***

The information in Table 1 shows that the average cost and profit efficiency scores for all banks are 30.6 and 75.3 percent respectively; implying banks are more profit efficient. The one sample T-tests confirms that there is significant difference between cost and profit efficiency scores in all banks.

Table 1: Cost and Profit Efficiency of Conventional, Islamic, and All Banks

| Banks Category | Descriptive Statistics | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| **All Banks** | N | 80 | 80 |
| | **Mean** | **0.306** | **0.753** |
| | Standard Deviation | 0.114 | 0.026 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.131 | 0.726 |
| **One Sample T-Test** | **Sig. (2-tailed)*** | **0.00** | **0.00** |
| **CBs** | N | 37 | 37 |
| | **Mean** | **0.293** | **0.754** |
| | Standard Deviation | 0.095 | 0.027 |
| | Maximum | 0.653 | 0.861 |
| | Minimum | 0.166 | 0.726 |
| **IBs** | N | 43 | 43 |
| | **Mean** | **0.318** | **0.751** |
| | Standard Deviation | 0.128 | 0.026 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.131 | 0.732 |

| | | | |
|---|---|---|---|
| **Independent Sample T-Test Sig. (2-tailed)**** | Equal Variance Assumed | **0.34** | **0.68** |
| | E. V. not Assumed | **0.33** | **0.68** |

* Significant at 5 percent level.

** No Significance differences between means of conventional versus Islamic banks at 5 percent level.

Similar trend is observed for cost and profit efficiency of conventional and Islamic banks, that is banks in both banking streams are more profit efficient and less cost efficient. The average cost and profit efficiency for conventional banks are 29.3 and 75.4 percent, respectively, where as Islamic banks scored 31.8 and 75.1 percent, respectively. Though the scores indicate that Islamic banks are slightly better cost efficient and as profit efficient as the conventional banks, the differences are not statistically different[9]. This implies that both banking streams have similar level of cost and profit efficiency. This result is a new contribution to the literature because, except for Hassan (2005a), there is no documentation of a comparative analysis of cost and profit of both banking streams using SFA.

## Efficiency of Big versus Small Banks

### *Cost and Profit Efficiency of All Banks based on their Size*

Information in Table 2 on the average cost and profit efficiency scores of big, small, and all banks, shows that these banks are more efficient in generating profits compared to controlling costs. The same trend is observed for big and small banks. Cost and profit efficiency mean scores for big banks are 29.4 and 76.1 percent, whereas small banks scores are 31.8 and 74.5, respectively. The findings show no significant difference in the mean cost scores between big and small banks, inconsistent with the expectation that big banks are more cost efficient than small banks (Bos and Kolari, 2005, and Isik and Hassan, 2003).

However, big banks are more profit efficient than small banks, and the difference is statistically significant. Since there is no difference in cost efficiency between big and small banks, this implies that big banks are better in generating more revenue. This evidence suggests that size of banks does affect their profit efficiency but not the cost efficiency.

[9] The SFA results must be interpreted cautiously as the panel frontier calculation do not account for differences in the banking infrastructure and the level of financial market development between countries.

Table 2: Cost and Profit Efficiency of Big versus Small Banks

| Banks Category | Descriptive Statistics | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| **All Banks** | N | 80 | 80 |
| | **Mean** | **0.306** | **0.753** |
| | Standard Deviation | 0.114 | 0.026 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.131 | 0.726 |
| **Big Banks** | N | 38 | 38 |
| | **Mean** | **0.294** | **0.761** |
| | Standard Deviation | 0.093 | 0.034 |
| | Maximum | 0.640 | 0.879 |
| | Minimum | 0.156 | 0.726 |
| **Small Banks** | N | 42 | 42 |
| | **Mean** | **0.318** | **0.745** |
| | Standard Deviation | 0.130 | 0.012 |
| | Maximum | 0.667 | 0.798 |
| | Minimum | 0.131 | 0.727 |
| **Independent Sample T-Test Sig. (2-tailed)*** | Equal Variance Assumed | **0.36** | **0.004** |
| | E. V. not Assumed | **0.35** | **0.006** |

* No significant differences between big and small banks at 5 percent level.

Information in Table 3 shows that there are no significant differences between cost and profit efficiency of banks with different assets size and banking streams. This is inconsistent with the notion that big (small) conventional banks are more cost and profit efficient compared to big (small) Islamic banks.

Table 3: Cost and Profit Efficiency of Conventional versus Islamic Banks Based on their Size

| Banks Category | Descriptive Statistics | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| **BCBs** | N | 18 | 18 |
| | **Mean** | **0.276** | **0.766** |
| | Standard Deviation | 0.059 | 0.034 |
| | Maximum | 0.427 | 0.861 |
| | Minimum | 0.201 | 0.726 |
| **BIBs** | N | 20 | 20 |
| | **Mean** | **0.310** | **0.757** |
| | Standard Deviation | 0.115 | 0.034 |

| | | | |
|---|---|---|---|
| | Maximum | 0.640 | 0.879 |
| | Minimum | 0.156 | 0.732 |
| **Independent Sample T-Test Sig. (2-tailed)*** | Equal Variance Assumed | **0.26** | **0.45** |
| | E. V. not Assumed | **0.25** | **0.45** |
| **SCBs** | N | 19 | 19 |
| | **Mean** | **0.309** | **0.743** |
| | Standard Deviation | 0.120 | 0.011 |
| | Maximum | 0.653 | 0.768 |
| | Minimum | 0.166 | 0.727 |
| **SIBs** | N | 23 | 23 |
| | **Mean** | **0.324** | **0.746** |
| | Standard Deviation | 0.140 | 0.014 |
| | Maximum | 0.667 | 0.798 |
| | Minimum | 0.131 | 0.734 |
| **Independent Sample T-Test Sig. (2-tailed)*** | Equal Variance Assumed | **0.72** | **0.35** |
| | E. V. not Assumed | **0.71** | **0.33** |

* Differences are significant at 5 percent level.

These findings imply that small banks are doing as well as the big banks despite their fewer assets. However, there are slight differences between the four groups: Big Islamic banks are slightly more cost efficient than big conventional banks, whereas big conventional banks are more profit efficient. Meanwhile, small Islamic banks scored slightly higher cost and profit efficiency than small conventional banks. The differences are however not statistically different.

***Efficiency of Old versus New Banks***

Information on the effect of age, as measured by date of establishment, on both cost and profit efficiency of both old and new banks is summarized in Table 4. The new banks are more cost efficient than the old banks and the difference is significant at 10 percent level. The cost efficiency scores for the old and new banks are 29 percent and 33 percent respectively. Both old and new banks had no significant differences in their profit efficiency scores of 75 and 74 percent respectively. This finding suggests that new banks had better cost efficiency but similar profit efficiency with the old banks. This could be due to either the shortened learning curve for the new banks as they learned from the experiences of the old banks and/or attempts by the new banks to compete for the clients of old banks by offering higher interest rates.

Table 4: Cost and Profit Efficiency of Old versus New Banks

| Banks Category | Descriptive Statistics | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| **All Banks** | N | 80 | 80 |
| | **Mean** | **0.306** | **0.753** |
| | Standard Deviation | 0.114 | 0.026 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.131 | 0.726 |
| **OBs** | N | 49 | 49 |
| | **Mean** | **0.290** | **0.755** |
| | Standard Deviation | 0.102 | 0.031 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.156 | 0.726 |
| **NBs** | N | 31 | 31 |
| | **Mean** | **0.333** | **0.749** |
| | Standard Deviation | 0.128 | 0.015 |
| | Maximum | 0.640 | 0.821 |
| | Minimum | 0.131 | 0.733 |
| **Independent Sample T-Test Sig. (2-tailed)*** | Equal Variance Assumed | **0.10** | **0.31** |
| | E. V. not Assumed | **0.12** | **0.24** |

* No significant differences between old and new banks at 5 percent level.

***Average Efficiency of Old versus New Conventional and Islamic Banks***

Information summarized in Table 5 on the cost and profit efficiency of old and new conventional and Islamic banks suggests no significant differences in cost and profit efficiency scores of between the groups of different banking streams. The findings suggest that age of banks does not affect the cost and profit efficiency scores in both banking streams. The results, however, favour new banks probably due to their shortened learning curves.

Table 5: Cost and Profit Efficiency of Conventional versus Islamic Banks Based on their Age

| Banks Category | Descriptive Statistics | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| **OCBs** | N | 27 | 27 |
| | **Mean** | **0.280** | **0.757** |
| | Standard Deviation | 0.094 | 0.031 |
| | Maximum | 0.653 | 0.861 |

| | | | |
|---|---|---|---|
| | Minimum | 0.166 | 0.726 |
| **OIBs** | N | 22 | 22 |
| | **Mean** | **0.301** | **0.752** |
| | Standard Deviation | 0.113 | 0.032 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.156 | 0.732 |
| **Independent Sample T-Test Sig. (2-tailed)*** | Equal Variance Assumed | **0.47** | **0.62** |
| | E. V. not Assumed | **0.48** | **0.63** |
| **NCBs** | N | 10 | 10 |
| | **Mean** | **0.328** | **0.746** |
| | Standard Deviation | 0.095 | 0.008 |
| | Maximum | 0.510 | 0.763 |
| | Minimum | 0.226 | 0.733 |
| **NIBs** | N | 21 | 21 |
| | **Mean** | **0.336** | **0.750** |
| | Standard Deviation | 0.143 | 0.018 |
| | Maximum | 0.640 | 0.821 |
| | Minimum | 0.131 | 0.734 |
| **Independent Sample T-Test Sig. (2-tailed)*** | Equal Variance Assumed | **0.90** | **0.43** |
| | E. V. not Assumed | **0.88** | **0.32** |

* No Significance differences between means of banks based on their age and type at 5 percent level.

***Cost and Profit Efficiency of All Banks Based on Regions***

The scores for the impact of geographical location on the cost and profit efficiency on all banks in the three designated regions; Africa, Asia, and Middle East and Turkey are summarized in Table 6. Slight differences in cost and profit efficiency scores between banks in these regions are observed, though not statistically significant. On average, banks in the Middle East and Turkey scored the highest cost efficiency while banks in Africa scored the lowest cost and profit efficiency. Meanwhile, the highest profit efficiency was reported by Asian banks.

Table 6: Cost and Profit Efficiency Scores of Banks in the Selected Regions

| Region | Statistics | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| **Africa** | N | 21 | 21 |
| | **Mean** | **0.281** | **0.749** |
| | Standard Deviation | 0.081 | 0.027 |
| | Maximum | 0.510 | 0.861 |
| | Minimum | 0.133 | 0.726 |
| **Asia** | N | 19 | 19 |
| | **Mean** | **0.283** | **0.755** |
| | Standard Deviation | 0.114 | 0.028 |
| | Maximum | 0.583 | 0.821 |
| | Minimum | 0.142 | 0.733 |
| **Middle East and Turkey** | N | 40 | 40 |
| | **Mean** | **0.331** | **0.753** |
| | Standard Deviation | 0.125 | 0.025 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.131 | 0.729 |
| **All Banks** | N | 80 | 80 |
| | **Mean** | **0.306** | **0.753** |
| | Standard Deviation | 0.114 | 0.026 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.131 | 0.726 |
| **Oneway ANOVA Sig.*** | Between Groups | **0.16** | **0.76** |

* There are no significant differences between banks in these regions at the 5 percent level.

### *Cost and Profit Efficiency of Conventional versus Islamic Banks in Different Regions*

The scores for the impact of geographical location on the cost and profit efficiency of conventional, Islamic, and all banks in the three designated regions; Africa, Asia, and Middle East and Turkey are summarized in Table 7. The summary information in Table 7 shows no significant differences in cost and profit efficiencies between banks of both streams in the designated regions. Implying that geographical location does not differentiate the cost and profit efficiency between conventional versus Islamic banks.

However the scores indicate that Islamic banks in the Middle East and Turkey were more cost efficient than the other groups of banks while African Islamic banks scored the lowest mean cost efficiency. However, the profit efficiency scores in these groups

of banks are very close which indicates that profit efficiency has not been influenced by geographical locations.

Table 7: Cost and Profit Average Efficiency Scores of Conventional versus Islamic Banks in the Selected Regions

| Region Category | Descriptive Statistics | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| **African CBs** | N | 10 | 10 |
| | **Mean** | **0.317** | **0.756** |
| | Standard Deviation | 0.089 | 0.039 |
| | Maximum | 0.510 | 0.861 |
| | Minimum | 0.201 | 0.726 |
| **African IBs** | N | 11 | 11 |
| | **Mean** | **0.249** | **0.743** |
| | Standard Deviation | 0.062 | 0.009 |
| | Maximum | 0.343 | 0.761 |
| | Minimum | 0.133 | 0.732 |
| **Asian CBs** | N | 9 | 9 |
| | **Mean** | **0.252** | **0.756** |
| | Standard Deviation | 0.061 | 0.032 |
| | Maximum | 0.377 | 0.816 |
| | Minimum | ,1657 | ,7333 |
| **Asian IBs** | N | 10 | 10 |
| | **Mean** | **0.311** | **0.754** |
| | Standard Deviation | 0.145 | 0.025 |
| | Maximum | 0.583 | 0.821 |
| | Minimum | 0.142 | 0.736 |
| **Middle East and Turkey CBs** | N | 18 | 18 |
| | **Mean** | **0.301** | **0.752** |
| | Standard Deviation | 0.110 | 0.016 |
| | Maximum | 0.653 | 0.783 |
| | Minimum | 0.203 | 0.729 |
| **Middle East and Turkey IBs** | N | 22 | 22 |
| | **Mean** | **0.355** | **0.755** |
| | Standard Deviation | 0.134 | 0.031 |
| | Maximum | 0.667 | 0.879 |
| | Minimum | 0.131 | 0.734 |
| **Oneway ANOVA Sig.*** | Between Groups | **0.10** | **0.85** |

* No significance differences at 5 percent level between conventional and Islamic banks in these regions.

In summary, there are significant differences in cost and profit efficiency scores between individual banks. With respect to groups of banks, except profit efficiency between big and small banks, the evidence shows no significant differences between the cost and profit efficiency scores in these groups of banks. Though slight differences between the cost, and profit efficiencies between these groups are observed, the differences are not statistically significant. In particular, there are no significant differences between conventional and Islamic banks based on size, age, and region.

Table 8: Summary of Average Cost and Profit Average Efficiency Scores using Stochastic Frontier Approach

| No. | Bank Category | Cost Efficiency | Profit Efficiency |
|---|---|---|---|
| 1 | All Banks | **0.306** | **0.753** |
| 2 | Conventional Banks (CBs) | **0.293** | **0.754** |
| 3 | Islamic Banks (IBs) | **0.318** | **0.751** |
| 4 | Big Banks | **0.294** | **0.761** |
| 5 | Small Banks | **0.318** | **0.745** |
| 6 | Big CBs | **0.276** | **0.766** |
| 7 | Big IBs | **0.310** | **0.757** |
| 8 | Small CBs | **0.309** | **0.743** |
| 9 | Small IBs | **0.324** | **0.746** |
| 10 | Old Banks | **0.290** | **0.755** |
| 11 | New Banks | **0.333** | **0.749** |
| 12 | Old CBs | **0.280** | **0.757** |
| 13 | Old IBs | **0.301** | **0.752** |
| 14 | New CBs | **0.328** | **0.746** |
| 15 | New IBs | **0.336** | **0.750** |
| 16 | African Banks | **0.281** | **0.749** |
| 17 | Asian Banks | **0.283** | **0.755** |
| 18 | Middle East and Turkey Banks (ME&T) | **0.331** | **0.753** |
| 19 | African CBs | **0.317** | **0.756** |
| 20 | African IBs | **0.249** | **0.743** |
| 21 | Asian CBs | **0.252** | **0.756** |
| 22 | Asian IBs | **0.311** | **0.754** |
| 23 | ME&T CBs | **0.301** | **0.752** |
| 24 | ME&T IBs | **0.355** | **0.755** |

Information in Table 8 shows that on average, Islamic banks in the Middle East and Turkey scored the highest cost efficiency while African Islamic banks scored the lowest cost efficiency. Meanwhile, big conventional banks scored the highest profit efficiency and small conventional banks and African conventional banks scored the lowest profit efficiency. The results on the cost and profit efficiency of conventional versus Islamic banks are generally consistent with the documented literature.

## Conclusion

The results based on the SFA approach indicate that there is a slack in the usage of resources across all banks. Therefore, there is substantial room for improvements in the cost and profit efficiency in both banking streams to sustain their competitive edge in the banking industry. The overall efficiency results of all banks show that the average bank is better in generating profits than utilising its resources. The findings also show that profit efficiency is more stable than cost efficiency over the years. However, for the overall sample, there is no significant difference between cost and profit efficiency of conventional versus Islamic banks, irrespective of size, age and location of banks in both streams. Overall, Islamic banks in the Middle East and Turkey scored the highest cost efficiency while African Islamic banks scored the lowest cost efficiency. Meanwhile, big conventional banks scored the highest profit efficiency and small conventional banks and African conventional banks scored the lowest profit efficiency.

Since bank efficiencies are greatly affected by internal and external factors that are always evolving, these conclusions are valid only for the selected sample and time period of study. Therefore the differences between the results of this study and those documented in the literature are possibly due to different sample size, period and countries.

## Implications

Bank efficiency studies are of crucial importance for operational and academic proposes (Berger *et al.*, 1997). In this regard, managers, regulators, investors, borrowers, and depositors find the efficiency studies helpful in evaluating bank performance. Equally, this study offers certain benefits to these banks' stakeholders. For example, managers can determine the outcomes of the previous management decisions and bank regulators are concerned about the safety and soundness of the banking system and preserving the public confidence in the banking systems. These findings could help them review their policies on the financial system. Further, efficiency evaluation is useful for individual investment or loan decisions. In addition, creditors and investors use such efficiency evaluations to judge past performance and current position of banks. Second, to judge future potential and the risk connected with that potential. Consequently, drawing efficiency results of banks can help improve their overall investment performance.

These findings contribute to the government's policy reviewing the performance of the banks in different systems and on licensing new conventional and Islamic banks in the economy. Similarly, recent drive among banks towards downsizing, rightsizing and rationalisation has direct implications on the issue of banks' cost and profit

efficiency[10]. The analysis period 1996-2005 had significant changes occurred in the banking systems, and the findings on the changes of efficiency in the banking system over this period and efficiency analysis between different sizes, ages and regions provides an important input for revising guidelines making the banking industry globally competitive.

Finally, the findings provide a guide for bankers to evaluate their cost, revenue, and profit performance and hence chart their milestones in achieving the desired level of performance over a designated period of time. Thus, the information generated from the analysis could be used to improve managerial performance, identify the strength and weaknesses of the banks and strategise to improve their competitiveness.

[10] See Berger and Humphrey, 1997; and Akhtar, 2002.

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