MEASUREMENT AND SOURCES OF TECHNICAL INEFFICIENCY: SOME EVIDENCE FROM THE SUDANESE ISLAMIC BANKS

NAZIRUDDIN ABDULLAH
ABD ELRHMAN ELZAHI SAAID
Kulliyyah of Economics and Management Sciences,
International Islamic University, Malaysia

ABSTRACT

The establishment of Islamic banks that started in many parts of the Muslim countries some years ago has become a fact. However, this phenomenon needs to be justified empirically. Sudan has adopted Islamic principles for its entire banking industry. This has put the spotlight on the performance of the Islamic banks in the Sudan. In this paper the stochastic cost frontier function with a time series of cross-section data on Sudanese Islamic banks is used. The error terms are decomposed into \( v \) and \( u \), which represent random noise and technical inefficiency, respectively. The banks in the sample have been divided into three categories, namely national banks, private domestic banks, and foreign joint venture banks. The technical efficiency was measured and the sources of inefficiency were investigated. The results showed that all banks in these groups were technically inefficient. The results also reveal that the national banks and private domestic banks were more technically inefficient than the foreign joint venture banks. The sources of inefficiency are attributed to the ownership, lack of banking technologies, severe economic sanctions and the lack of managing the high risk of the Islamic financing modes. This result has very good policy implications for the recent Sudanese government privatization policy regarding its national banks.

ABSTRAK

and inputs-mixed. In another study, Abdullah and Elzahi (2003) used the same data to measure the Sudanese Islamic banks’ TFP growth, scale efficiency and technological change using translog cost function. They found that, on average, the productivity growth of the Sudanese Islamic banks was 1.61%, of which 2.26% was contributed by the scale effect and the remaining (-) 0.65% was contributed by the technological change effect. Their empirical results point to the fact that the production technology of the Sudanese Islamic banks during the survey period was bound by increasing returns to scale, while the technological change effect contributed negatively to the TFP growth.

In the present study we concentrate on measuring and identifying the sources of technical inefficiency of 13 Sudanese Islamic banks for the period between 1991 and 1998. We note in passing that this study is distinctly different from Elzahi (2002) in that it divided the Sudanese Islamic bank into three discernible categories, namely, public banks, private banks, and foreign joint venture banks. All banks in the sample subscribed to Islamic banking practices.

Since, to date, no empirical studies using a translog cost function have been carried out to measure the technical inefficiency of the Sudanese Islamic banks owned by different groups, the present study offers a procedure to measure it using the said function. This function is preferred to the Cobb-Douglas function because its assumptions are less restrictive.

TYPES OF EFFICIENCY IN BANKING INDUSTRY:
A SURVEY OF THE LITERATURE

Scale

Economies of scale are associated with firm size. Firms in an industry realize economies of scale if technology allows production costs to rise proportionately less than output when output increases. That is to say, economies of scale exist if per unit or average production costs decline as output rises. Conversely, if average costs rise with output, diseconomies of scale are present\(^1\). The earliest literature on scale efficiency suggests that medium-sized firms are slightly more scale efficient than either very large or very small firms\(^2\). In relation to this, Benston et al. (1982a, 1982b) and Allen and David (1993)\(^3\) have conducted in-depth studies on how costs changed with size. They concluded that, ceteris paribus, if banks doubled in their size they would
X-efficiency is widely used to describe all technical (the use of inputs) and allocative (mix of inputs) efficiencies of the firm(s). The concept of the TE, AE, OE and X-efficiency is illustrated in Figure 1. Specifically, Figure 1 represents a firm that employed two factors of production, capital (K) and labor (L), in production of a single output, Y. For simplicity, constant returns to scale are assumed in order to avoid frontiers at each level of output. The isoquant QQ' shows the possible combinations of factor inputs the firm can produce if it is perfectly efficient. The slope DW represents the prices of inputs. If the firm's production is efficient, it should occur at point F, which indicates cost minimization. This point referred to as the optimal point or overall efficiency (OE) is measured by the ratio of OA/OC. Farrell suggested that OE could be separated into technical efficiency (TE) and allocative efficiency (AE). If the firm is not producing on the isoquant, it is technically inefficient, which is calculated as OB/OC. Likewise, producing at point C also indicates that the firm has made an incorrect choice in combining its factor inputs at the given prices and thus incurs more cost than if it had produced at point F. This incorrect input choice is called allocative inefficiency and is measured by OA/OB. Thus, OE is the multiplication of TE by AE or mathematically:

\[ OE = TE \times AE = \left( \frac{OB}{OC} \right) \times \left( \frac{OA}{OB} \right) \]

Figure 1
Farrell Measure of Efficiency
banking industry\textsuperscript{17}. His results showed that technical efficiency of labor and capital inputs decrease over time. Labor input was used more inefficiently than capital input.

In summary, the literature cited above points to the fact that frontier analyses have been widely used to analyze and measure conventional financial industry performance, notably efficiency. This approach, however, has not been applied to the Islamic banks. All studies that have been undertaken to measure the Islamic banks' performance have instead used either financial ratios or descriptive analysis. Therefore, a study that can make full use of available tools to investigate Islamic banking efficiency, of which frontier analysis is one, is badly needed. The lack of studies conducted to measure the performance of the Islamic banking sector using recently established methods has motivated us to undertake such study. Perhaps, by so doing some light on how the Islamic banks fared compared with their counterparts, the conventional banks can be shed.

It is also worth mentioning at this juncture that the latest methods are considered best because they permit individuals with very little institutional knowledge or experience in firms to select the most efficient firms in the industry, assign numerical efficiency values and identify the areas of input overuse and/or output underproduction. At the same time, for those who are well-versed in this area, frontier analysis permits management to identify the areas of best practice within complex services operations, which is not always possible using the traditional benchmarking techniques due to lack of a powerful optimizing methodology\textsuperscript{18}.

**SOURCES OF INEFFICIENCY: THE CASE OF THE SUDANESE ISLAMIC BANKS**

This paper intends to measure the technical inefficiency of 13 Sudanese Islamic banks. This is actually in line with the interest of policymakers and firms managers whose main task is to distinguish between efficient and inefficient firms. In fact, this exercise is also very helpful for those who are interested in determining whether inefficient banks shared among themselves a similar set of characteristics. In order to explicitly show and evaluate the sources of inefficiency among the Sudanese Islamic banks we divide the banks into three categories, namely: national banks, domestic private banks and foreign joint venture banks.
determination of input and output variables. They are the production
approach and the intermediate approach (Allen & David, 1997).

The production approach considers banks as users of physical inputs
such as labor and capital from which deposits and other types of bank
assets are produced. It defines the total cost as the cost of purchased
inputs only\textsuperscript{21}. This approach is appropriate for evaluating the efficiency
of the branches of financial institutions for the simple reason that
branches initially process customer services for the whole institution
and branch managers have little influence over the bank's funding
and investment decisions.

The intermediate approach, on other hand, views banks as using
deposits together with physical inputs to produce various types of bank
assets as measured by their currency value. In the case of conventional
banks, total cost is defined as the interest expense of deposits plus the
expense of physical inputs. Following Islamic principles, we note,
however, that the Islamic banking system is expected to replace interest
with return on deposits.

As pointed out by Allen and David (1997) and owing to the
inclusiveness of the interest (or return on deposits as in Islamic banks)
expenses, which is almost one-half to two thirds of the total costs in
conventional financial institutions, the present paper will employ the
intermediate approach to evaluate Sudanese Islamic banks. The
transcendental logarithmic (or translog) cost function is used to
measure the technical efficiency of the said banks. The advantage of
this function compared to the Cobb-Douglas function is that it allows
homogeneity of degree one via sample parameter restriction.
Furthermore, it does not have a finite representation if one or more
sample banks only produce a subset of the output vector, i.e., if any
output has a zero value\textsuperscript{22}.

We note here that the present study uses one output variable and three-
variable inputs to measure the three categories of Sudanese Islamic
bank technical efficiency, namely, public banks, private banks and
foreign joint venture banks. Since our sample represents purely Islamic
banks in which interest bearing loans were forbidden as all bank
practices conformed to Islamic principles, the only output used in this
investigation is total investments ($Y$). Meanwhile, labor ($X_1$), fixed
assets ($X_2$) and core deposits ($X_3$) are factor inputs, and salaries and
wages divided by number of employees ($W_1$), total expenses on
furniture, equipment and premises divided by their book value ($W_2$),
and rate of return on deposits divided by the total deposits ($W_3$) are
the prices of $X_1$, $X_2$ and $X_3$ respectively.
below its frontier. Any such deviation is the result of factors under the firm’s control such as technical inefficiency.

The technical efficiency will be estimated by decomposing the error term based on the random effects model so that its estimation by generalized least squares (GLS) is possible. GLS is consistent with the model as \( N \rightarrow \infty \) without the assumption of normality of the \( \varepsilon_i \) and without the assumption of a specific distribution for the \( \mu_i \). In this approach, one-sided random deviations are allowed in order to characterize inefficiencies. The estimated efficiency can be obtained directly if the following procedures are pursued.

To begin with, let \( \varepsilon_i = \sum \varepsilon_i \), where \( \varepsilon_i \) the obtained residual from equation (1) (see Simar, 1991 for details). Then we define \( \zeta_i = \max \varepsilon_i - \varepsilon_i \), where the maximum is introduced in order to provide positive value of the estimation of the \( \zeta_i \)'s. Hence the estimation of the efficiency of the bank is given by:

\[
TE = \text{eff}_i = \exp(-\zeta_i)
\]

(3)

Sudanese Islamic banks are assumed to be technically efficient if \( \exp(-\zeta_i) = 1 \). Thus the optimal value of \( \exp(-\zeta_i) \) provides a measure of technical efficiency (TE). If \( \exp(-\zeta_i) \) is positive but less than 1, it implies that the production unit under investigation is technically inefficient or not efficient at the 100 per cent level.

**ECONOMETRICS SPECIFICATION**

The following translog cost function is used to estimate equation (1)

\[
\ln TC = \alpha_0 + \sum_{i=1}^{3} \alpha_i \ln w_i + 1/2 \sum_{i=1}^{3} \sum_{j=i}^{3} \gamma_{ij} \ln w_i \ln w_j + \sum_{i=1}^{3} \delta_i \ln w_i \ln y + \beta_i \ln y + 1/2 \beta_{yy} (\ln y)^2 + \varepsilon
\]

Where,

- \( TC \) = total cost
- \( y \) = investment assets
- \( w_i \) = price of labor
- \( w_2 \) = price of fixed capital
- \( w_3 \) = price of deposits

We note that the dual condition that must be satisfied by the cost function implies that it must be concave in input prices and monotonically non-decreasing in input prices and outputs (Jagtiani et al., 1995).
Investments ($Y$), Capital ($X_1$), Labour ($X_2$), Deposits ($X_3$), Price of capital ($W_1$), Price of labor ($W_2$), Price of deposits ($W_3$), ($S_1$) share of capital, ($S_2$) share of labor, ($S_3$) share of deposits. All variables are measured in thousands Sudanese pounds except $X_2$, which is in terms of number of employees. The numbers of the cross sections are 13 banks. $TC =$ total cost of the three inputs.

Table 2
GLS Parameter Estimates for Cross-section of Sudanese Banks

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Estimate</th>
<th>t-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.14</td>
<td>16.8</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>0.04</td>
<td>5.14</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>0.36*</td>
<td>5.90</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\alpha_3$</td>
<td>0.60</td>
<td>5.10</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\beta_y$</td>
<td>0.80</td>
<td>3.40</td>
<td>0.0011</td>
</tr>
<tr>
<td>$\beta_{yy}$</td>
<td>0.18</td>
<td>-3.89</td>
<td>0.0002</td>
</tr>
<tr>
<td>$\gamma_{w12}$</td>
<td>0.06</td>
<td>-0.11</td>
<td>0.9095</td>
</tr>
<tr>
<td>$\gamma_{w13}$</td>
<td>0.79</td>
<td>4.73</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\gamma_{w23}$</td>
<td>0.24</td>
<td>-2.87</td>
<td>0.0051</td>
</tr>
<tr>
<td>$\delta_{w1y}$</td>
<td>0.26</td>
<td>5.30</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\delta_{w2y}$</td>
<td>-0.19</td>
<td>-6.50</td>
<td>0.0000</td>
</tr>
<tr>
<td>$\delta_{w3y}$</td>
<td>-0.21</td>
<td>-6.70</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

$F = 5632$  
S.E = 1.532  
$R^2 = 0.99$

Method General Lest Squares (GLS): Total Panel Observations are 104.

*Note: Coefficient for labor was obtained using parameter restrictions of linear homogeneity.

The present study also estimates the technical efficiency of the 13 Sudanese Islamic banks. This is consistent with traditional cost regressions that are normally interpreted on the hypothesis that all banks operate at the minimum frontier of the cost function. This behavior, however, is not found in practice because the banks, which incur higher costs than the minimum at a given scale and scope due to the technical inefficiency are behaving less efficiently than theoretically assumed. In this study, the stochastic econometrics cost frontier approach is used to evaluate the Sudanese Islamic bank technical efficiency.
CONCLUSION

In this paper, the stochastic cost frontier function with a time series of cross-sections data on Sudanese Islamic banks is used. The error terms are decomposed into $v$ and $u$, which represent the random noise and technical inefficiency, respectively. The banks in the sample have been divided into three categories, the national banks, private domestic banks and foreign joint venture banks. The empirical results showed that all banks in our groups were technically inefficient with a mean level of efficiency less than one. Specifically, the average technical efficiency for national banks, private domestic banks, and foreign joint venture banks were 65%, 71.3% and 79% respectively for the period 1991 to 1998. Since national banks and private domestics banks were more technically inefficient than foreign joint venture banks, ownership could be one of the sources of inefficiency in the Sudanese banking industry. Other sources of inefficiency may be the lack of banking technologies, which forced Islamic banks in Sudan to follow labour-intensive techniques at the expense of technical efficiency. Finally, due to an unfavourable environment and the economics sanctions that were imposed on Sudan during the 1990s, coupled with the Sudanese government's agriculture financing policy to attain self-sufficiency in foodstuffs, the banks were exposed to high risks. Preoccupied with these problems, the Islamic banks management in Sudan had very little choice but to concentrate on minimizing the risks rather than optimizing their physical inputs. The results of this study provide a good reason for the Sudanese government to undertake a privatization policy, that is, to privatize its national banks.

ENDNOTES


23. The symmetry and linear homogeneity conditions imposed are \( \sum_{i=1}^{3} \alpha_i = 1, \sum_{i=1}^{3} \gamma_i = 0, \sum_{i=1}^{3} \beta_i = 0 \)

24. Applying Shephard's lemma to (6) \( \sum_{i=1}^{3} \frac{\partial \ln C}{\partial \ln x_i} = \frac{\sum_{i=1}^{3} x_i w_i}{C} \sum_{i=1}^{3} S_i = \frac{w_i x_i}{TC} \) Where \( i = 1,2,3 \)


REFERENCES


Samad, A. (1999). Comparative efficiency of Islamic banks vs