Cost efficiency of Yemen Islamic banks: An inefficiency effects approach (2002-2014)

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ABSTRACT

Over the last two decades, Islamic financial institutions have played the main role in financing the agricultural sector in terms of contracts : *Murabaha, Istisna, Ijara, Mudaraba, Musharika, Muzaraa and Al Salam.* Numerous studies have adopted efficiency and productivity techniques to examine and evaluate the overall performance of Islamic banking industries to inform policy effect as well as identify the best practice. According to the importance of the efficiency and productivity of Yemen Islamic banks in the sustainability of financing the agricultural sector, they contribute 15% of their funds annually to finance the agricultural sector. Motivated by the catalytic role that the banking sector could play in the economy, this paper examined the efficiency of Yemen Islamic banks under the intermediation approaches using the Stochastic Frontier method and panel data for four banks during the period 2002-2014. The results indicated that Yemen Islamic banks were moderately efficient. The cost efficiency was estimated at 82%, which was lower than the range of results reported in the literature. Yemen Islamic banks could survive fierce competition only by improving efficiency toward the world best practice frontiers. Efficiency could be improved through a number of measures, including the improvement of productivity through human capital development, the introduction of new technologies and internet banking services (involving automation and computerization) and, most important, through a credible management chosen on the basis of competence and expertise.

INTRODUCTION

Efficient intermediation of funds from savers to borrowers enables the allocation of resources to their most productive uses. The more efficient a financial system is in such resource generation and in its allocation, the greater its contribution to productivity and economic growth (McKinnon, 1997). Hence, an efficient financial intermediation system is a prime requirement for a country's economic development. Consequently, improvement in real returns in the economy may result in higher savings which would presumably, in turn, produce higher resource generation. Thus, development of the financial system is essential for the general enhancement of productivity and economic growth of a country.

The study of efficiency in manufacturing industry in the developing countries has been an important topic in developmental literature (Pitt and Lee, 1981). In the past, the study of efficiency technical and allocative has also been a topic of considerable interest in agriculture. Several authors have conducted numerous studies for estimating technical inefficiencies including (Battese and Coelli, 1988, 1992; Huang and Liu, 1994;Kumbhakar *et al*., 1991; Reifschneider and Stevenson, 1991)who also introduced models for technical inefficiency effects in the stochastic function. The interest in efficiency studies is no longer limited to agriculture and industry as it has been in the past. The interest has now entered into the banking industry.

In recent years, many conventional banks have encountered financial difficulties and failure due to the global financial crisis of 2007–2008. In contrast, Islamic banks have successfully withstood this crisis. In empirical literature, most studies have attributed this success of Islamic banks to their financial regulation guided by *Shariah* principles which prohibits the payment or receipt of interest *(riba*) and encourage risk sharing (Willison, 2009; Hasan and Dridi, 2011). Consequently, the attention of academics, policy makers and investors in Islamic banking has been largely increased in the last few years. Actually, there are more than 300 Islamic financial institutions worldwide including banks, mutual funds and insurance firms. In addition, most western international banks such as Citigroup, HSBC and others have opened Islamic windows. Several factors can explain this rapid growth of interest-free finance, including strong demand for *Shariah*-compliant products, improvement in the legal and regulatory framework for Islamic finance, growing demand from conventional investors for diversification purposes, and the capacity of the industry to innovate and develop a number of financial instruments that meet the needs of investors (Hasan and Dridi, 2011).

Problem statement

Recently, policy makers are focusing on further reforms in the financial services sector. However, there has been no formal evaluation of the outcome of the financial reforms. As stated in the literature, financial reforms target multiple objectives. A comprehensive study leading to an examination of the accomplishments of these objectives is important at this stage. It is worthwhile to examine how the reforms have affected the competition and efficiency gains in Yemen Islamic banks.

Objectives of the study

The main objective of the study is to examine how changes which occurred in the financial services sector during the 13-year period (2002-2014), affected the efficiency of the Islamic banking industry in Yemen. Furthermore, this paper was aimed at achieving the following specific objectives:

- Provide current information on cost or economic efficiency of the Yemen Islamic banking industry.
- Review and evaluate the inter-bank and intra-bank performance for Islamic banking industry over time.
- Identify some critical parameters to improve the economic efficiency and competitiveness of the Islamic banking industry.

This paper examines the cost efficiency of Yemen Islamic banks over the period 2002-2014 by applying the Stochastic Frontier Approach (SFA) under the intermediation frameworks. What are the causes for the inefficiency of banks in Yemen? In addition to the aforementioned reasons of the benefits of efficient banking systems.

METHODOLOGY AND DATA COLLECTION

Methodology

This study applies stochastic frontier approach to measure cost efficiency of four Yemen Islamic banks, *Tadhamon* Islamic Bank (TIB), Yemen Islamic Bank (YIB), Saba Islamic Bank (SIB), and *Al-Shamel* Yemen Bahrain Bank (SBB).(Schmidt and Lovell, 1979) reported that the log likelihood of the cost frontier is the same as that of the production frontier, except for a few sign changes. The log-likelihood functions for the cost function analogues of the (Battese and Coelli, 1995) models were also found to be obtained by making a few simple sign changes, hence referring to frontier production function, the cost model can be defined:

$$\text{Ln } C_i = x_i\beta + U_i, \qquad i = 1,\ldots, N \qquad \ldots\ldots\ldots \qquad (1)$$

where ln (C_i) is the logarithm of the cost for the i-th firm; $\boldsymbol{x_i}$ is a (K+1) vector of the input prices and output of the i-th firm. $\beta = (\beta_0, \beta_1, \ldots, \beta_k)$ is a (K+1) column vector of unknown parameters to be estimated, U_i is a non-negative random variable, which are assumed to account for the cost of inefficiency in production. The ratio of the observed cost for the i-th firm, relative to the potential cost, defined by the frontier function, given the output vector, x_i is used to define the cost efficiency of the i-th firm:

$$CE_i = \frac{C_i^*}{C_i} = \frac{\exp(x_i\beta)}{\exp(x_i\beta+u_i)} = \exp(-u_i) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (2)$$

where $\boldsymbol{C_i^*}$ is minimum cost and $\boldsymbol{C_i}$ is actual cost. The equation (2) is a measurement of cost efficiency, of which the value is equal or less than one. Based on (Battese and Coelli, 1992), these equations of frontier cost function can be changed:

$$C_{it} = X_{it}\,\beta + (V_{it} + U_{it}), \quad i = 1,\ldots, N, \qquad t = 1,\ldots,T \qquad \ldots\ldots (3)$$

$U_{it} = \left(U_i\, e^{-\eta(t-T)}\right), i = 1,2,\dots,N; t = 1,2,\dots,T$ … ..... (4)

$CE_{it} = (e^{-U_{it}}), i = 1,2,\dots,N; t = 1,2,\dots,T$ ……..... …. … (5)

U_{it} is a non-negative variable. According CE_{it}=exp $(-U_{it})$ to account cost efficiency. Assuming U_{it} = (μ, σ_u^2), where η is estimated parameter, T is basic year. When η ≠ 0, it means that equation (3) is a time-varying inefficiency model. If η = 0, equation (3) is changed into the time-invariant model. If η > 0, cost inefficiency decreases with time change, and *vice versa*.

Using maximum-likelihood estimation to calculate $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \frac{\sigma_u^2}{\sigma_v^2 + \sigma_u^2}$ γ has a value between zero and one. If γ = 0, it means that U_{it} can be deleted from the frontier cost model. In other words, γ = 0 means that cost inefficiency does not exist and the difference between the real value and optimal value is caused by $\boldsymbol{V_{it}}$. So the function can use OLS to estimate in this case. The general form of translog frontier analysis is shown as equation (6):

$$\ln(C) = \beta_0 + \frac{1}{2}\sum \beta_i (\ln(Y_i))^2 + \frac{1}{2}\sum \beta_j (\ln(W_j))^2 + \sum\sum \beta_{ij} \ln(Y_i)\ln(W_j) + V_i + U_i \quad \textit{... (6)}$$

where Y_i is output variables

W_j is input price

V_i is random error

U_i is cost inefficiency error and it is to be i.i.d.

In addition, it is necessary to perform a likelihood ratio test to examine whether the regression results are efficient or not. In the analysis of the stochastic frontier, null hypothesis can assume γ = 0, namely, σ_u^2= 0. If the null hypothesis is accepted, U_{it} can be eliminated. U_{it}=0 means that cost inefficiency does not exist in the model. In other words, we do not need to use MLE, but OLS regression. When alternative hypothesis is γ ≠ 0, cost inefficiency exists in the model. When γ = 1, inefficiency is totally the result of cost inefficiency. However, the test of γ is a one-side test, so γ must be positive. The LR test statistic is calculated as:

LR=-2{ln[L(H^0)]-ln[L(H_1)]}……..…….…… (7)

where L (H_0) and L (H_1) are the values of the likelihood function under the null and alterative hypothesis, H0 and H1, respectively. This model was applied by(Bushara and Mohayidin, 2008; Bushara and Abuagla, 2016).

Determinants of efficiency

This study also explores some internal factors that may explain bank inefficiency rather than estimating the cost efficiency scores. In order to identify factors that are correlated with bank inefficiency, the model of (Battese and Coelli, 1995) had been used which permits in a single step to calculate individual Bank efficiency score (Eq. translog(6) and to investigate the determinants of inefficiency (Eq.Z(8). Specifically, u is assumed to be a function of a set of bank-specific characteristics. The following auxiliary model is used:

$u_{ilt} = \psi Z_{ijt} + W_{ijt}$ …… …….. (8)

Where Z is a vector bank specific determinant, W represents a random variable which has a truncated normal distribution, and ψ is a vector of unknown parameters to be estimated. Following previous studies(Weill, 2004; Pasiouras, 2008) , they included the cost function; ten bank-specific variables : Loans, earning assets, non-interest income, capital adequacy, asset quality, management quality , earning ability (profitability), liquidity and time were used.

Data collection

For the definition of inputs and outputs, the paper followed the intermediation approach proposed by (Sealey and Lindley, 1977). Total cost is defined as the sum of interest expenses and overheads (personnel and operating expenses). Three outputs were specified, total loans, other earning assets, and non-interest income. Financial capital, physical capital and Labor are the inputs. The price of labor is defined as the annual salary payment/amount of labours; the price of physical capital is defined as the ratio of operating expenses over the fixed assets. Whereas, the price of funds is calculated as the ratio of profit rate expenses to deposits and short term liabilities. Total cost (TC): Included the costs of borrowed funds, deposits and wages, salaries and other operating expenses. The panel data were provided by Yemen Central Bank.

Variable definitions and notation

Outputs variables

1- Total loans: Which include (*Murabaha, Qard Hasan, and Istisna).*
2- Earning assets: Are comprised of due from banks and financial institutions, restricted investment, investment in Islamic *sukuk*, available for sale investment, investment in associates.
3- Non-interest income: Are comprised of net fees and commissions, gains on foreign exchange transactions, gains on investment and other operating income.

Input prices variables

1- Price of fund (PF)): Total profits margin expenses divided by deposits and short-term funds.
2- Price of physical capital(PK): Other operating expenses divided by fixed assets.
4- Price of labor (PL): Annual salary payment/amount of labors.

RESULTS AND DISCUSSION

Estimation of cost function

Table (1) shows that the parameter estimates of output quantities and input price terms are positive and highly significantly different from zero across model specifications. Therefore, the domain of applicability for the estimated parameters is at least congruent with the data points. In addition, the value of the log-likelihood function of cost estimate and the sigma squared were high enough and fit the statistical significance. Similarly, the parameter γ was significant. This means that some residual estimates consist of bank specific inefficiency

Table 1. Maximum likelihood parameter estimates for stochastic frontier cost functions.

Variables	Coefficient	Standard Error	t- ratio
Constant	-15.36***	0.997	**-15.41**
LnQ_1	0.106**	0.214	**02.149**
LnQ_2	0.16**	0.392	**2.450**
LnQ_3	-0.092	0.0993	**-1.104**
LnW_1	-0.04576***	0.0279	**-6.110**
LnW_2	-0.04151***	0.1586	**-3.823**
LnW_3	0.05975***	0.3774	**6.323**
0.5(LnQ_1*LnQ_1)	0.02726**	0.07754	**2.851**
0.5(LnQ_2*LnQ_2)	-0.92	0.891	**-1.035**
0.5(LnQ_3*LnQ_3)	0.75	0.805	**0.937**
0.5(LnW_1*LnW_1)	-0.39***	0.8009	**-4.821**
0.5(LnW_2*LnW_2)	-0.21	1.240	**-0.166**
0.5(LnW_3*LnW_3)	-0466***	0.220511	**-4.732**
LnQ_1*LnQ_2	0.048	0.0626	**0.761**
LnQ_1*LnQ_3	-0.16	0.0948	**-1.623**
LnQ_1*LnW_1	0.32***	0.0877	**3.688**
LnQ_1*LnW_2	0.44***	0.114	**3.825**
LnQ_1*LnW_3	-0.34**	0.131	**-2.592**
LnQ_2*LnQ_3	0.35	0.0706	**0.496**
LnQ_2*LnW_1	-0.074	0.0783	**-0.940**
LnQ_2*LnW_2	-0.25***	0.0690	**-3.610**
LnQ_2*LnW_3	0.23**	0.108	**2.089**
LnQ_3*LnW_1	-0.28**	0.138	**-2.025**
LnQ_3*LnW_2	-0.21	0.149	**-1.429**
LnQ_3*LnW_3	0.12	0.172	**0.692**
LnW_1*LnW_2	-0.34***	0.0819	**-4.136**
LnW_1*LnW_3	0.37**	0.107	**3.448**
LnW_2*LnW_3	0.39**	0.160	**2.400**
Total loans In Z_1	0.088	0.128	**0.679**
Earning assets InZ_2	0.39	0.321	**1.221**
Non-interest income In Z_3	-0.088	0.110	**-0.789**

Table 1. continued

Capital adequacy Z_4	0-023	0.0122	**1.896**
Asset Quality Z_5	-0.038	0.0637	**-0.601**
Profitability Z_7	0.049	0.0930	**0.534**
Liquidity Z_8	0.26	0.170	**1.538**
Time (t)	-0.64	0.895	**-0.715**
Time (t*t)	-0.16	0.772	**-0.206**
Sigma-squared	0.0032**	0.001	**3.240**
Gamma*(γ)*	0.999***	0.237	**4.211**
Mu	0.00056	0.0904	**0.0062**
Eta	-0.0344	0.345	**-0.0997**
Log Likelihood function	**74.905**		
LR test of the one- side error	**17.938**		

*,**and*** indicate significance at 10%, 5% and 1% respectively.

Table 1 shows the estimation results under the intermediation approach, all other estimated parameters (loans, earning assets, price of labor, price of funds, and price of capital)are significantly different from zero at the ten and five percent significance level. The coefficient estimate of the total loans (Q_1) in the model suggests that, on average, a 5% increase in amount of loans will increase costs by about 0.11%. Similarly, the cost elasticity with respect to other earning assets (Q_2) is 0.16% in the model. Also, it was observed that the magnitude of the coefficient of non-interest income (Q_3) is not significant, implying that the amount of non-interest income does not have a significant impact on total costs. This may be because off-balance activities (represented by non-interest income) accounts for only a small proportion of the output portfolio in the Yemen Islamic banking sector.

The estimated cost elasticity with respect to total labour (W_3) is relatively high when compared to the other two input prices (W_1 and W_2). The results indicate that total costs are very sensitive to the price of labour and suggest that, on average, a 1% increase in the price of labour will raise total costs 5.9% depending on the model.

The coefficient of the price of borrowed funds (W_1) captures the share of costs attributed to physical borrowed funds, which ranges between 1% and 10% depending on the specification adopted. The results indicated the cost inefficiency effects for Yemen Islamic banks: Increased as total loans increased. This result was in agreement with that of Isik and Hassan, (2003)who argued that the positive relationship between loan activity and bank efficiency might be attributed to the ability of the relatively efficient bank to manage operations more productively which increased as earning assets increased. This result is in agreement with the studies of Sufian and Akbar Noor Mohamad

Noor, (2009)who argued that the less efficient banks could have been involved in more risky operations and investment, which decreased as non-interest income increased. This result was in agreement with the study of Sufian and Habibullah, (2010) who suggested that a rising proportion of incomes from non-traditional activities tends to influence the efficiency negatively, which decreased as capital adequacy increased. This result is in agreement with the study of (Tecles and Tabak, 2010) who argued that when a larger ratio of equity-capital is at risk, managers have more incentives to monitor bank efficiency-decreased as assets quality increased which decreased as management quality increased. this result in agreement with that of Kyj and Isik, (2008). Increased as profitability increased. It suggests that banks with high profitability exhibited higher levels of efficiency. A likely reason for this is that banks with higher profitability are able to attract depositors. Besides, the credit worthiness of profitable banks is greater than that of less profitable banks as profitability enhances the confidence of depositors(Sufian and Habibullah, 2010). Which increased as liquidity increased. This result was in agreement with that of Samad and Hassan, (1999)which decreased at first then continued to decline, that means improvement over time.

Cost efficiency of individual banks

Table 2. Cost efficiency scores of individual Islamic banks in Yemen (2002-2014).

Year	*Tadhamon*	*Islami*	*Saba*	*Shamel*	Mean
2002	0.78335	0.73627	0.79081	0.78222	**0.77316**
2003	0.9600	0.66656	0.79535	0.78621	**0.80203**
2004	0.84686	0.79203	0.93549	0.73242	**0.8267**
2005	0.96540	0.83720	0.77961	0.69821	**0.82011**
2006	0.86461	0.92229	0.84107	0.92458	**0.88812**
2007	0.81807	0.85071	0.82739	0.75985	**0.81401**
2008	0.84247	0.94782	0.97480	0.74992	**0.87875**
2009	0.69259	0.76346	0.83748	0.74509	**0.75966**
2010	0.84264	0.91560	0.76352	0.71606	**0.80946**
2011	0.69631	0.85631	0.83789	0.75380	**0.78608**
2012	0.83605	0.88463	0.84515	0.93011	**0.87399**
2013	0.90528	0.87831	0.91902	0.83199	**0.88365**
2014	0.97594	0.99930	0.76018	0.74980	**0.87131**
Mean	**0.84842**	**0.85003**	**0.83905**	**0.78155**	0.82977

Source: Author own calculations based on data.

Generally, the results in Table 2 show the average cost efficiency score for the whole sample (0.82), implying an average inefficiency of about (0.18). This low efficiency (high inefficiency) score is due to high risks compared with conventional banks. The reason is that, in addition to normal credit risks, Islamic banks adopt modes of finance in which banks co-share both profits and losses. For this reason, Islamic banks need greater liquidity compared to conventional banks, to cover themselves against the possibility of huge losses and ensuing great risks such as loss of assets if it does not carefully study the client credit worthiness.

At the level of individual banks, the results in Table 2 reveal that over the sample period Yemen Islamic bank is the most efficient bank with cost efficient score of 0.85 (cost inefficiency score of 0.15), followed by *Tadhamon* bank with cost efficiency score of 0.84 (cost inefficiency score of 0.16). The common characteristics of the most efficient banks are that they have very low level loans of which little is in fixed assets compared to other banks. On the other hand, *Shamel* bank is the most inefficient bank with cost efficiency score of 0.78 (implying inefficiency score of 0.22).

CONCLUSION

Motivated by the catalytic role that the banking sector could play in the economy, this paper assessed the efficiency of four Yemen Islamic banks over the period 2002-2014 using the parametric Stochastic Frontier Approach (SFA) under the intermediation approaches. The results under intermediation approaches indicate that Yemen Islamic banks' are moderately efficient. Efficiency could be improved through a number of measures, including the improvement in productivity through human capital development, investment in research and development application of the research findings and recommendations, specialization of managers in specific tasks, spreading marketing and promotional costs over a wider range of products. The introduction of new technologies and internet banking services (involving automation and computerization) and, most important, through a credible management chosen on the basis of qualification, competence and expertise. Over time, these measures could give rise to substantial gains in terms of economies of scale and efficiency (or lower average cost), and to considerable improvement in the ability to compete and make profits.

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تحليل الكفاءة التكاليفية للبنوك اليمنية الإسلامية:
اسلوب اثار ضعف الكفاءة (2002 -2014)

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الخلاصة

على مدى العقدين الماضيين لعبت المؤسسات المالية الإسلامية الدور الرئيسي في تمويل القطاع الزراعي من حيث عقود المرابحة والإستصناع والإجارة والمضاربة وألمشاركة والمزارعة و السلم. ولقد ساهمت ب15% من حجم التمويل الزراعي. اعتمدت العديد من الدراسات تقنيات الكفاءة والإنتاجية لدراسة وتقييم الأداء العام للمصارف الإسلامية لمعرفة مدى تأثير السياسة العامة وكذلك تحديد أفضل الممارسات. ولكن لا توجد دراسات تقارن بين أساليب قياس الكفاءة للمصارف الإسلامية ولسد هذه الفجوة في ألأدبيات هدفت هذه الورقة إلى تحليل الكفاءة في قطاع المصارف الإسلامية اليمنية باستخدام بيانات جداول متساوية تتكون من اربعة بنوك إسلامية خلال الفترة 2002 إلى 2014. استخدمت الدراسة اسلوب التحليل المعلمي لتحليل الحدود العشوائية تم تطبيق أسلوب التوسط لقياس كفاءة المصارف اليمنية الاسلامية. و تلخصت أهم النتائج بقياس الكفاءة على النحو التالي استنادا إلى طريقة الأسلوب المعلمي(قدرت متوسط الكفاءة للمصارف الاسلامية في اليمن بنحو 0.82 والتي تعتبر أقل من حساب النتائج الموجودة في الادبيات العالمية. ووجدت الدراسة أن مستويات كفاية رأس المال وجودة الأصول وجودة الإدارة والربحية والسيولة لها تأثيرا على كفاءة البنوك لكنها ليست معنوية. و لتحسين كفاءة المصارف اليمنية الإسلامية توصي الدراسة إتباع عدة مقاييس أهمها تحسين الإنتاجية من خلال تطوير رأس المال البشرى تطوير التقنية المصرفية وإدخال الخدمات المصرفية عبر الإنترنت والأهم من ذلك أن تكون الإدارة ذات كفاءة مختارة على أساس الخبرة و المنافسة.