Risk-Efficiency Relationship in Islamic Banking : Global Evidence

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Abstract

With the rapid growth of Islamic banking system as an alternative to an established conventional banking system many countries across the globe are embarking on this new banking system. This paper analyses efficiency and risk taking behavior of 99full-fledged Islamic banks from top14 Islamic banking countries between 2000 and 2010.The paper makes use of Seemingly Unrelated Regression model to allow for simultaneity between banks' risk and efficiency. This paper also analyzes the risk –efficiency relationship of most efficient and least efficient Islamic banks. Empirical evidence shows that bank inefficiency and risk are inversely related for Islamic banks. Our evidence also shows that environmental factors can considerably prejudice the banking efficiency scores.

JEL classification: G15, G21, C14

Key words: Islamic banking, Bank efficiency, Bank performance, Risk management

1. Introduction

During the last two decades the banking sector across the globe has experienced major transformations due to advent of alternative profit based financial system. Islamic finance in Gulf Cooperation Council (GCC), South East Asia (SEA) and many European countries has now become an important element in their economic development agendas and it is also gaining ground in the financial landscape across the globe. It is also a growing business as it caters to the financial needs of the people without conflicting with their social and religious values.

Even though Islamic banking system has witnessed a rapid surge in its global operation surprisingly there is no reported study on risk–efficiency relationship among Islamic banks. To overcome this gap, this research builds on previous literature and assesses the inter-temporal relationships between bank risk and efficiency. This paper uses a large data set of 795banks observation from 14biggest

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Islamic banking nations ranging from year 2000 to year 2010. The list of the countries and their position in global Islamic banking system is shown in table 1. The paper tries to carry out a suitable comparison of banking efficiency across countries by using a global best-practice econometric frontier whereby the banks in each country can be compared against the same standard.

Table 1: Major Contributors to the World Islamic Finance Assets, 2010

Rank	Country	Shariah Compliant Assets in US$ Million	Total Assets as % of World Total Assets
1	Iran	314,897.4	35.18%
2	Saudi Arabia	138,238.5	15.45%
3	Malaysia	102,639.4	11.47%
4	UAE	85,662.6	9.57%
5	Kuwait	69,088.8	7.72%
6	Bahrain	44,858.3	5.01%
7	Qatar	34,676.0	3.87%
8	Turkey	22,561.3	2.52%
9	UK	18,949.0	2.12%
10	Bangladesh	9,365.5	1.05%
11	Sudan	9,259.8	1.03%
12	Egypt	7,227.7	0.81%
13	Indonesia	7,222.2	0.81%
14	Pakistan	6,203.1	0.69%
Total		870,849.6	97.3%

Source: The Banker, 2010

The rest of this paper is organized as follows: section 2 includes a literature review while section 3 presents the methodology, variables and data. The empirical results are explained in sections 4 and section 5 concludes the paper.

2. Literature Review

The efficiency studies applied to the banking sector focus predominantly on conventional banking. Berger and Humphrey (1997) surveyed 130 studies that apply frontier efficiency analysis to conventional financial institutions in 21 countries and found that the various efficiency methods do not necessarily yield consistent results. Berger (2007)critically reviewed over 100 studies that compare bank efficiencies across nations. The study found that efficiency disadvantages of foreign-owned banks relative to domestically owned banks tend to outweigh the efficiency advantages in developed nations and opposite in developing nations. In conventional banking literature, researchers had linked efficiency to many different factors. Some studies focused on cross-country comparisons of conventional banks efficiency. For example, Bonin et al. (2005) in their study on eleven transition countries found that foreign-owned banks are more cost-efficient than other banks and that they also provided better service, in particular if they have a strategic foreign owner. Recent bank efficiency studies also considered country-specific environmental conditions. For example, Bos and Kool (2006) used dataset of 401 largely independent cooperative local banks in the Netherlands and found that use of exogenous input prices rather than endogenous input prices is particularly important for the cost frontier as the spread in cost inefficiencies becomes larger and more plausible. Furthermore the study also highlighted that nation's environmental factors do play a role to a certain extent on efficiency score. Studies also focused on the efficiency of conventional banks based on their size, specialization or diversification, and type like retail or wholesale banking. Kwan (2006) in his study on Hong Kong banks found that Banks' X-efficiency decline with bank size, deposit-to-asset ratio, loan-to-asset ratios, provision for loan loss, and loan growth, and increase with off-balance sheet activities.At the same time some studies have compared efficiency scores of foreign-owned banks with domestic-owned banks. In this regard, Isik and Hassan (2002b) in their study on Turkish banks found that foreign banks, both in subsidiary and branch forms, have higher cost and profit efficiencies than their domestic peers, but the difference in profit efficiency is much more pronounced.

With regard to cross country comparison on bank efficiency score, Berger (2007) summarized 100 studies and noticed that efficiency has been measured using either: 1. the estimation of nation-specific frontiers; and 2. the estimation of common frontiers including specific variables in the estimation to account for countries differences. While the first approach guarantees the sample homogeneity, it does not enable the authors to directly compare banks from different countries. In contrast the second approach allows a direct comparison of efficiency levels and rankings from different countries (e.g. Coelli et al., 2005; Bos and Schmiedel, 2007) by implicitly

assuming that banks in different countries have access to the same technology and effectively compete with each other. However, this approach requires dealing with the sample heterogeneity by controlling for systematic differences across banks that are not due to inefficiency, which can cause volatility of efficiency results (Bos et.al, 2009).

There are a few studies, which deal with the Islamic Banking efficiency. Hassan and Hussein (2003) investigated relative efficiency of the banking industry in Sudan by employing a panel of 17 banks for the years 1992and 2000. They employ a variety of parametric (cost and profit efficiency) and nonparametric(data envelopment analysis) techniques to examine five efficiency measures (cost, allocative, technical, pure technical and scale efficiency scores). The average cost and profit efficiency over 1992-2000 are about 55% and 50%,respectively. They suggested that Sudanese banks should improve their X-efficiency by best managing and allocating their inputs. Hassan (2003) conducted another study for exploring the efficiency of Islamic banking system in Pakistan, Iran and Sudan. The study found that Islamic banking system is relatively more cost efficient as compared to conventional banking practices, while the same is inefficient in general profit generation. Furthermore the study found that Islamic banks which are large in size and reaping high profits are more efficient. On the same lines another study was carried out by Brown and Skully (2003), who found that in comparison banking system in Iran is more established than Sudan. The analysis was conducted for 35 banks of both the countries. The reasons behind the well performance of Iranian banks were identified to be the large size of its banking industry. This reason is attributed to the cost efficiency of Iranian banking. The reason of least cost efficient banks in Sudanese bank was the financing practices in primary sectors of agriculture. Yudistira (2004) uses aDEA method to examine the technical and scale efficiencies for 18 Islamic banks across 12 countries during 1997-2000.The overall efficiency results suggested that inefficiency across 18Islamic banks is small at just over 10 percent, which is quite low compared to many conventional counterparts. The findings indicated that there are diseconomies of scale for small-to-medium Islamic banks. Bader et.al (2007) estimated the cost, revenue and profit efficiency of 43Islamic and 37 conventional banks over the period 1990-2005 in 21 countries using DEA. The findings suggested that there are no significant differences between theoverall efficiency results of conventional versus Islamic banks.

On the same note, Shamsher et.al (2008) compared the cost and profit efficiency of 37 conventional banks and 43 Islamic banks, in 21 (OIC) countries using the Stochastic Frontier Approach (SFA). The findings suggested that there are no

significant differences between the overall efficiency results of conventional versus Islamic banks.

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 shorter time frame and inadequate number of Islamic banks. The scarcity of efficiency studies in Islamic banking can be explained by three main factors: first, the lack of good quality data; second, the difficulties in successfully modeling the uncharacteristic nature of Islamic banks' cost-revenue model (i.e. a problem of profit versus interest); and third, the need to accurately account for different environmental conditions in various countries.

Recently researchers have started to incorporate risk characteristics in cost or profit efficiency functions estimation, (Athanasoglou et al., 2008; Brissimis et al. 2008; Fiordelisi and Molyneux, 2010; Lepetit et al. 2008). Berger and DeYoung (1997) postulated the "bad management" hypothesis, in which banks operating with low levels of efficiency have higher costs largely due to inadequate credit monitoring and inefficient control of operating expenses. Declines in cost and revenue efficiency will temporally precede increases in banks' risk due to credit, operational, market and reputational problems.

Overall, the vast majority of the literature on bank risk- efficiency relationship focuses on conventional banking and, to the best of researcher knowledge; no study has specifically investigated risk efficiency relationship in Islamic banking system The present study advances the existing literature by examining specifically cost and profit efficiency bearing on risk taking of the Islamic banking system in 14 top Islamic banking countries and by taking into account of environmental factors in the estimation.

3. Methodology

3.1 Data

This study comprises banks' balance sheet, income statement and annual reports data for 14top Islamic banking countries over 2000-2010. The data were obtained from the Bank scope Database which includes banking information for both conventional and Islamic banks. Table 2 illustrates the breakdown by country, and average asset size of Islamic banking system in given country. The total number of observations is 795; in terms of average Islamic banking assets for all Islamic banks, Iran banking system has biggest asset size. Bahrain has the largest number of Islamic financial institutions both as a total and by year where as UK has lowest number of Islamic banks. Majority of the countries here are predominant oil economy and has experienced rapid growth in the last decade.

Table 2: Sample description: Number of Islamic banks and Average asset by Country, 2010

Islamic Banking (IB)	Number of banks By country and by Year												
Country /Year	2000	01	02	03	04	05	06	07	08	09	2010	Total by Country	Avg. asset of all IB in 2010 (Milln USD)
Bahrain (12)*	8	8	9	10	12	12	13	15	17	17	17	138	2422
Bangladesh (15)	2	3	3	3	3	3	3	3	3	3	3	32	709
Egypt (19)	2	2	2	2	2	2	2	2	2	2	2	22	3854
Indonesia (5.5)	2	2	2	2	3	3	3	3	4	4	4	32	1602
Iran (100)	10	11	11	13	13	14	14	15	15	15	15	146	23124
KSA (57)	1	1	1	1	2	2	2	2	3	3	3	21	19897
Kuwait (35)	2	2	2	2	3	3	3	3	3	3	3	29	17960
Malaysia (22.6)	2	2	2	3	3	7	10	12	16	16	16	89	5121
Pakistan (6.4)	1	1	1	2	3	3	5	6	6	6	6	40	555
Qatar (20)	2	2	2	2	2	2	3	3	3	3	3	27	9668
Sudan (100)	6	6	6	7	7	7	10	10	10	11	11	91	842
Turkey (4.5)	3	3	3	3	3	4	4	4	4	4	4	39	6480
UAE (18)	5	5	6	6	6	6	7	7	9	9	9	75	8458
UK (6)	0	0	0	0	1	1	1	2	3	3	3	14	633
Total By Year	46	48	50	56	63	69	80	87	98	99	99	795	

Source: Bank scope database and Author calculation. * Figure in parenthesis shows Islamic banking asset as percentage of total banking asset

3.2 Efficiency estimation and environmental factors

Our empirical analysis aims to identify the framework for comparing investment banks' efficiencies across nations. Cost and profit efficiency are measured using the Stochastic Frontier Analysis (SFA) that can be written as follows:

$$\ln TCi,t = xi,t \quad + (Vi,t + Ui,t) \ldots\ldots\ldots\ldots\ldots (1)$$

where t denotes the time dimension, ln TC_i is the logarithm of the cost of production of the i-th bank, x_i is a kx1 vector of input prices and output quantities of the i-th bank, β is a vector of unknownparameters, V_i are random variables which are assumed to be i.i.d N(0, ,σ_V^2) and independent of U_i, $U_i$are non-negativerandom

variables which are assumed to account for cost inefficiency and to be i.i.d. as truncations at zero of the N(0, ,σ_U^2).

We use the following translog functionalform as supported by Berger and Mester (1997) and used in Altunbas et al. (2000), and Altunbas et al. (2001):

$$\ln TC_{k,t}(\ln TP) = {}_{o} + \sum_{i=1}^{2} {}_{i} \ln Y_i + \sum_{j=1}^{2} \sim_{j} \ln P_j + {}^{a}{}_{i} T + \frac{1}{2}\left(\sum_{i=1}^{2}\sum_{j=1}^{2} ¢_{ij} \ln Y_i \ln Y_j + \sum_{i=1}^{2}\sum_{j=1}^{2} ¥_{ij} \ln P_i \ln P_j + {}^{a}{}_{ij} T^2 \right) +$$

$$\sum_{i=1}^{2}\sum_{j=1}^{2} {}^{\circ}{}_{ij} \ln Y_i \ln P_i + \sum_{i=1}^{2} {}_{iT} T \ln Y_i + \sum_{j=1}^{2} \sim_{jT} T \ln P_j + \frac{1}{2} {}^{2}{}_{EE} \ln E \ln E + {}^{2}{}_{E} \ln E +$$

$$\sum_{i=1}^{2} {}_{iE} \ln Y_i \ln E + \sum_{j=1}^{2} \sim_{jE} \ln P_j \ln E + \sum_{j=1}^{M} \bar{}_{j} \ln z_{ji} + £_{kt} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where $\ln TC_{kt}$ (ln TP) is the natural logarithm of total cost (total profit) of bank k in period t, Y_i is the vector ofoutput quantities, P_j are the input prices, E represents bank's equity capital and is included as a fixed input,specifying interaction terms with both output and input prices in line with recent studies (e.g. Beccalli, 2004; and Vander Vennet, 2002). Following Coelli et al. (1998) and Bos and Kolari (2005), linear homogeneity was imposed in input prices by normalizing the dependent variables and input price variables before taking logarithms. We also account for M environmental factors, z_j, assuming different values for each i-th firm. Estimates incorporating the effect of the environmental factors can be viewed as 'gross' measures of efficiency. In this case we are assuming that all firms share the same technology, and environmental factors have an influence only on the distance between each firm and the best-practice. We include the time trend t to capture technological change.

We will apply equation (2) in two scenarios, *normal scenario* which do not include M environmental factors and *scenario 1* which will include M environmental factors. This will help us to estimate if there is any difference in efficiency level of banks if we account for environmental factors surrounding it.

We apply the same methodology presented above to estimate the alternative profit efficiency. The frontier definition is similar to the one described in equation (2). There are only two important differences: we replace total cost (TC) with total profit (TP) as dependent variable; and the inefficiency term (U_i) is subtracted, given that we need to solve a profit maximization problem.

If we look into bank efficiency literature, the definition of inputs and outputs varies across studies and depends on researcher's assumption. The most common among all is, where inputs are identified are labor, physical capital and deposits while output

constitutes total loans and other earning assets (Berger and Humhprey, 1997, Berger and Mester, 1997, Hughes and Mester, 2008). This study will also apply the same variables for estimating bank efficiency scores.

In order to select on which environmental factors will have direct bearing on bank efficiency, we follow the most recent empirical literature in this area. Accordingly, we account for potential differences arising from country-specific aspects of banking system on one hand and from the environmental conditions on the other. We added asset diversity (AD)[2] as a measure of diversification across different type of assets. AD takes values between 0 and 1 with higher values means greater diversification hence more profitable (Laeven and Levine, 2007).

To take into account of the diversification across different sources of income, we include a measure of income diversity (ID) (e.g. Laevena and Levine 2007; Fiordelisi and Molyneux, 2010). ID[3] takes values between zero and one with higher values indicating greater diversification. The asset and income diversity measures are complementary in that asset diversity is based on stock variables and income diversity is based on flow variables. The efficiency model also incorporates bank specific profitability determinants such as the return on assets (ROA) and the return on equity (ROE) as environmental model as specified by authors like Athanasoglou et al., 2008; and Lepetit et al. 2008.

Macroeconomic conditions such as GDP and FDI inflow was accounted for under which these banks operate. GDP per capita affects numerous factors related to the demand and supply of banking services (Carbo-Valverde et.al, 2007, Fiordelisi and Moleynux, 2010). Countrieswith a higher GDP per capita have a banking system that operates in a mature environment resulting in morecompetitive interest rates and profit margins. Finally, FDI is a measure of foreign ownership of productive assets. Growth of oil economy and emergence of Islamic finance in our sample emerging markets have fuelled the profitability of these sectors, primarily Islamic banks, which have had the relationship and networks to capture these flows. We expect to find, a significant impact of these environmental factors on cost (profit) efficiency.

3.3 Risk-Efficiency relationship

The modeling framework adopted to estimate the relationship between risk and efficiency build on from the approaches suggested by Kwan and Eisenbeis (1997), and Altunbas et.al (2007). We specify a system of equations and estimate these using Zellners's (1962) seemingly unrelated regression (SUR) approach. This allows for

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2 AD = 1 – { (Net loans – Other earning assets)/ Total earning assets}

3 ID = 1 – { (Net Interest Income – Other operating income)/ Total operating income}

simultaneity between banks' risk and efficiency while also controlling for important other environmental factors. There are two main motivations for use of SUR. The first one is to gain efficiency in estimation by combining information on different equations. The second motivation is to impose and test restrictions that involve parameters in different equations. As discussed above in literature it can be seen that risk and efficiency shows some interactions. The system of equations estimated is as follows:

$$LLRi_j = \sim + bINEFF_{ij} + cNLTA_{ij} + dTA_{ij} + eLAD_{ij} + fLATAC_j + gLLPTL_j \ldots\ldots\ldots\ldots\ldots (3)$$

$$INEFF_{ij} = \sim + bLLR_{ij} + cNLTA_{ij} + dTA_{ij} + eLAD_{ij} + fLATAC_j + gOETAC_j + hLLPTL_j \ldots\ldots (4)$$

Variable Definition:

LLR_{ij}	=	Loan-loss reserves for bank i in country j
$INEFF_{ij}$	=	Cost inefficiency for bank i in country j (derived from stochastic cost frontier estimatesfrom normal scenario used in section 3.1)
$NLTA_{ij}$	=	Net loans to total assets for bank i in country j
TA_{ij}	=	total assets for bank i in country j
LAD_{ij}	=	Liquid asset to short term deposit for bank i in country j
$LATAC_j$	=	Banking system liquid assets to total assets in country j
$OETAC_j$	=	Banking system operating expenses to total assets in country j
$LLPTL_j$	=	Banking system loan-loss provisions to total loans in country j

Equation 3 and 4 examine the risk–efficiency relationship. A number of bank-specific and country specific variables are also included that are believed to also explain the variation in bank risk and inefficiency across Islamic banking system. Loan loss reserves as a fraction to total assets (LLR) is used as measure of banking risk. Higher levels of reserves are suggestive of greater banking risk accounting for any future bad times. Of course, this estimation as measure of riskiness can be questionable but accounting ratio like this has been widely used across literature to assess bank appetite for risk.

Individual bank efficiency (INEFF) is obtained as the distance of a bank's observed operating cost to the minimum efficient cost frontier obtained from normal scenario as explained in section 3.2.

For the explanatory variables we used a broad range of variables that are believed to be important in explaining the performance and risk taking propensity of banks. The bank-specific variables include net loans to total assets(NLTA) as rapid loan growth may increase risk and impact adversely on bank efficiency in the long run. Banks that

are more liquid may be more efficient in the sense that all other things being equal, an efficient bank can produce more output part of which includes liquid and other assets so we account for this by using liquid assets to deposits ratio (LAD). Bank size, through economies of scale, may influence the relationship between risk and efficiency so we control for the assets size of banks (TA). Big banks typically are more diversified and gain from other size advantages (Hughes et.al, 2001) so it is important to control for this factor. Finally, a range of country-specific banking variables are included to take account of broad banking system differences across the nations. These include indicators of banking system liquidity (LATAC), efficiency (OEPAC) and risk(LLPTL). While these variables are similar to the bank-specific indicators they provide another aspect to the analysis in that they control for country differences in efficiency and risk. In other words they help to show if country-specific financial differences impact on bank-specific risk and efficiency.

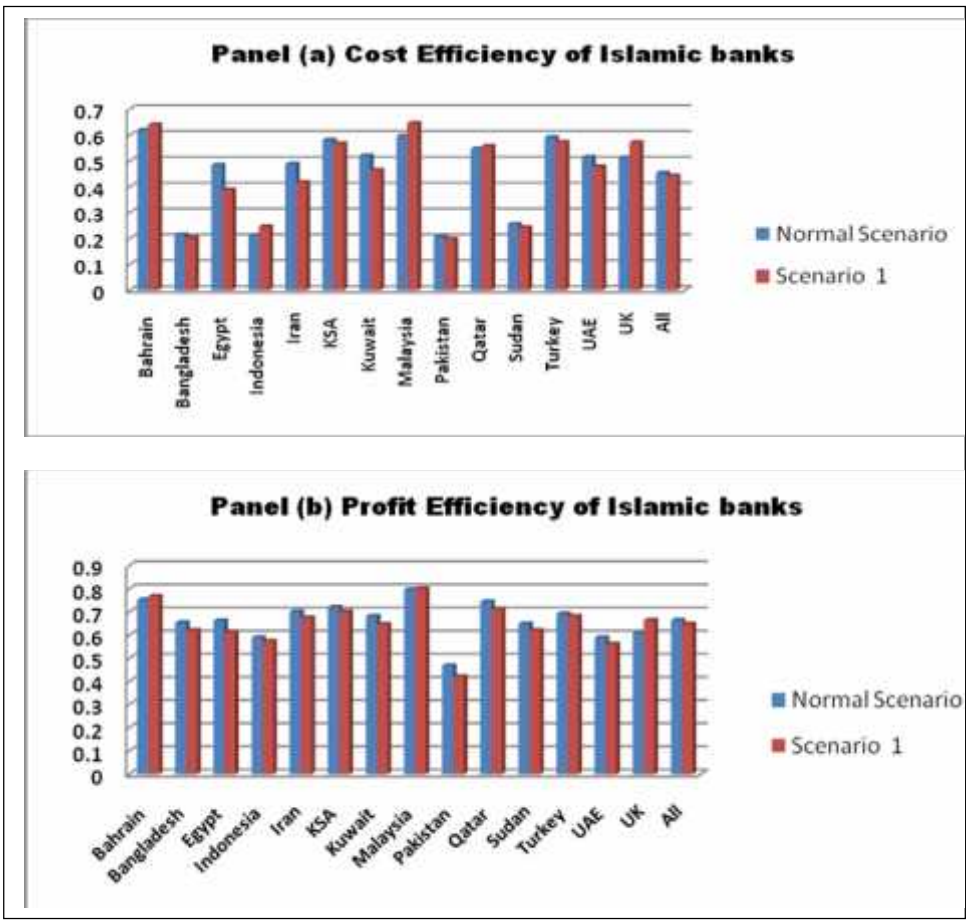
4. Empirical results

In our empirical analysis we first report the bank efficiency results under normal scenario (common frontier includes bank specific inputs and output) and scenario 1 (which accounts for impact of associated external factors on bank efficiency). Later we highlight the risk efficiency relationship for Islamic banks.

Chart1 display the estimated mean cost and profit efficiency levels as calculated in two alternative scenarios. On a country by country basis, Islamic banks in Bahrain and Malaysia are the best cost efficient operating at around 62 percent to 60 percent. One interesting observation from Chart 1 panel (a) is that if we include environmental factors (scenario 1) the cost efficiency scores changes drastically for many nations. Bahrain and Malaysian Islamic banks cost efficiency increases under the presence of country specific factors. This can be due to the fact Islamic banks in these two countries are well diversified and attract a lot of global interest in their Islamic banking operation. Overall average cost efficiency levels for Islamic banks of 46 percent are less than for well-established American and European banks (e.g. Berger and Young, 1997; Altunbas et.al, 2007) that operate at 80 percent to 90 percent efficiency level.

Regarding profit efficiency, Islamic banks from all nations performed well under normal scenario scoring an average score of 65 percent. The higher rankings for Islamic banks are consistent with rapid growth of Islamic banks over the last decade. One more plausible reason for Islamic banks to be more profit efficient is that Islamic banks hold more profitable assets like Mudarabah and Musharakah (investment accounts based on profit sharing) than loan, securities and derivatives instruments held by their conventional counterparts.

Chart 1: Cost and profit Efficiency estimates (means)



* Cost and profit efficiencies are based on SFA for the translog cost and profit functions with 5% truncation level

Focusing on country estimates of profit efficiency in panel (b), Islamic banks in Malaysia and Bahrain have outperformed the rest of the sample. The least profit efficient country is Pakistan (47 percent). The most striking of the observation is that Malaysia and Bahrain profit efficiency scores improves with addition of environmental factors while other countries faces a decline. This can be due to the reason that these two countries have well developed dual banking laws, separate Islamic banking laws and conventional banking laws while the rest of the sample countries still operate under single banking law. Our estimates of profit efficiency are somewhat larger than for developing and transition countries as reported by Yildirim and Philippatos (2007) and Olson and Zoubi (2011).

Estimates from the risk equation (equation 3) derived from the simultaneous estimation are reported in Table 3. The risk equation uses loan-loss reserves as fraction of total asset (LLRij) as the dependent bank-risk variable. The columns report the results obtained for three estimations of the system – for all banks, conventional banks and Islamic banks in our sample. The independent variables include: cost inefficiency estimates derived for each bank from stochastic cost frontier estimation (INEFFij), the net loans to total assets ratio (NLTAij) for each bank, an indicator of the size of each bank measured by the total assets (TAij) and the liquid assets to customer and short-term deposits ratio (LADij) for each bank. External factors to banks include: a measure of banking system liquidity given by the liquid assets to total assets ratio (LATACj), and overall banking system risk measured as the loan-loss provisions to total loans (LLPTLj).

Table 3 shows that for the full sample and most efficient banks there is a negative relationship between inefficiency and bank risks. Islamic banks with higher loan loss reserves tend to be more inefficient. For least efficient Islamic banks the relationship is positive. This can be result of cost constraints impediment which restricts the ability of inefficient Islamic banks to take on additional risks. Furthermore the table shows that net lending (NLTAij) is negatively related to risk suggesting that loan growth is inseparably linked to loan loss reserve levels. Bank asset size (TAij) also seems to be important as big and efficient Islamic banks have a lower loan loss reserve but least efficient Islamic banks tend to keep higher reserve. This can be also interpreted that there are potential diversification benefits associated with size as noted by Altunbas et al. (2007).

Table 3: Bank Risks LLRij as Dependent Variable

Variables	All Islamic Banks	Most Efficient Islamic banks[1]	Least Efficient Islamic Banks[2]
INEFFij	-0.0267*	-1.109*	0.075*
NLTAij	-0.012*	-0.023*	-0.019*
TAij	-0.013*	-0.006**	0.029*
LADij	0.127*	0.068**	-0.047*
LATACj	0.069*	0.094*	0.039*
LLPTLj	0.612*	0.927*	0.462*
Observations	795	204	194
R^2	0.3496	0.5122	0.2837

Notes: i) * and ** indicate significance at the 1% and 5% levels, respectively.

1. The top quartile of cost efficient banks are used as sample
2. The bottom quartile of cost efficient banks are used as sample

There also appears to be a mix relationship between liquidity and risk as most efficient banks with higher liquidity levels have higher reserve levels while less efficient ones have lower reserve associated with higher liquidity. This suggests that banks with higher liquidity levels take on more risks which confirm to the Basel guidelines whereby banks are encourage being more liquid to cover the risks being taken. This result also confirms that big Islamic banks tend to be more liquid compared to their inefficient counterparts.

Finally, the country specific banking sector variables also suggest that the level of liquidity (LATACj) and loan loss provision (LLPTLj) in the respective country's financial system are positively related to overall banking sector risks. In other words banking systems will take on more risks if they are more liquid and banks are provisioning for loan loss at a higher level. There do not appear to be major differences in the relationships across most efficient and less efficient banks.

Estimates from the inefficiency equation (equation 4) derived from the simultaneous estimation are reported in Table 4. The inefficiency equation uses inefficiency estimates (INEFFij) obtained from stochastic cost frontier used in equation 2 under normal scenario as the dependent variable. The columns report the results obtained for three estimations of the system – for all banks, conventional banks and Islamic banks in our sample. The independent variables include: loan loss reserves to total asset(LLRij) as measure of risk, the net loans to total assets ratio (NLTAij) for each bank, an indicator of the size of each bank measured by the total assets (TAij) and the liquid assets to customer and short-term deposits ratio (LADij) for each bank. External factors to banks include: a measure of banking system liquidity given by the liquid assets to total assets ratio (LATACj), overall banking system risk measured as the loan-loss provisions to total loans (LLPTLj) and operating expenses to total banking asset (OETACj).

Table 4 presents the results for inefficiency equation derived from the simultaneous estimates. Risk (loan loss reserves LLRij) is found to be inversely related to inefficiency which means efficient banks take on more risk. The results for the full sample suggest that inefficient banks hold more loan loss reserves however results vary across most efficient and least efficient banks. This can be a useful result to prove that Islamic banks suffer fewer damages and experienced no banking failures during the recent credit crunch of 2007-2008.

Table 4: Bank Cost Inefficiency INEFFij as Dependent Variable

Variables	All Islamic Banks	Most Efficient Islamic banks[1]	Least Efficient Islamic Banks
LLRij	-0.0167*	-0. 213*	0.0482*
NLTAij	-0.036**	-0.068*	0.012**
TAij	0.763*	0.015*	0.428*
LADij	-0.045*	-0.006**	0.008*
LATACj	0.387*	0.163*	-0.002*
LLPTLj	-0.743**	0.054*	-1.003**
OETACj	0.0286*	-0.048*	0.1475*
Observations	795	204	194
R^2	0.0582	0.1024	0.0329

Notes: i) * and ** indicate significance at the 1% and 5% levels, respectively.

1. The top quartile of cost efficient banks are used as sample.

2. The bottom quartile of cost efficient banks are used as sample

It can be seen from Table 4that cost inefficiency is positively related to asset size whereas bank lending appears to be inversely related to inefficiency suggesting that efficient banks are more successful in expanding their loans business. Evidence on the relationship between bank liquidity and inefficiency is mixed. Most efficient Islamic banks maintain higher liquidity level while least efficient Islamic banks maintain lower level of liquidity which can make them more prone to bank runs in near future. Viewing the country-specific indicators, overall it seems that banking system liquidity and banking system operating cost are positively linked to inefficiency while loan loss provision is negatively related to inefficiency.

5. Conclusion

This paper has looked at the risk-efficiency relationship of Islamic banking system for a large sample over the period 2000–2010.Overall study results suggest that Islamic banks are more profit efficient compared to its cost efficiency scores. Results also suggest that not accounting for environmental factors can significantly bias the cost and profit efficiency scores. Countries with better regulatory framework for Islamic banking system showed an improvement in efficiency scores while accounting for environmental factors. The overall efficiency results also show that the most efficient Islamic bank are better in generating profits than utilising its resources. The findings also show that profit efficiency is more stable than cost efficiency over the years.

Inefficient Islamic banks still maintain lower risk level due to cost constraints weakness which restricts the ability of inefficient Islamic banks to take on more risks. Similarly the positive correlation between bank size and efficiency suggests that Islamic banks would be more cost and profit efficient if they were larger. Thus regulators in Islamic banking countries should insure that Islamic banks can become and remain highly capitalized to achieve highest efficiency levels.

Empirical results validate some of the myths and hypes surrounding Islamic banking system which can lead to more rigorous research in this emerging financial system.

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