CENTRE FOR EMEA BANKING, FINANCE & ECONOMICS

Do Islamic and Conventional Banks Have The Same Technology?

Walid Ghannouci
Franco Fiordelisi
Phil Molyneux
Nemanja Radić

Working Paper Series

No 34/12

Do Islamic and Conventional Banks Have The Same Technology?

WalidGhannouci[a*], Franco Fiordelisi[b], Phil Molyneux[c], Nemanja Radić[d]

[a] *University of Rome Tor Vergata, Faculty of Economics, Via Columbia 2, 00133 Rome, Italy*

[b]*Faculty of Economics, University of Rome III, Via S. D'Amico 77, 00145, Rome, Italy*

[c]*Bangor Business School, Bangor University, Hen Goleg, College Road, Bangor, LL257 Gwynedd, U.K.*

[d] *London Metropolitan University,* 84 Moorgate, London EC2M 6SQ, *U.K.*

Abstract

Is there a technology gap between Islamic and conventional banks? Do Islamic and conventional banks have different cost efficiency levels?We show that conventional and Islamic banks have similar mean (aggregate) cost efficiency levels in the MENA area and there is no technology gap between the two types of banks. At the country level, Islamic banks are more cost efficient than conventional banks in Indonesia, Pakistan, Turkey and United Arab Emirates, and less efficient in Bangladesh, Kuwait, Malaysia and Tunisia. We analyse a very large sample of banks in twelve MENA and South East Asian countries between 2000 and 2006 and we use the meta-frontier approach to account for the sample heterogeneity.

JEL classification: G21; L11; L22; G29

*Keywords:*Islamic Banking; Cost efficiency; Meta-frontiers; Technology gap ratios

---

* Corresponding author. Tel.: +39 065 733 5672; fax: +39 065 733 5797.
*E-mail addresses:*Walid.Ghannouchi@uniroma2.it (W. Ghannouchi), fiordelisi@uniroma3.it (F. Fiordelisi), p.molyneux@bangor.ac.uk (P. Molyneux), n.radic@londonmet.ac.uk(N. Radić)

1. Introduction

Islamic banking is one of the most dynamic areas in international finance: the annual growth of Islamic financial institutionshas been 10% in the Gulf area and 15% worldwide over the past 10 years (Standard & Poor's, 2007) and assets held by Islamic banks reached 822 US billion in 2008 (Banker, 2009).Islamic banking has been progressively expanding outside the Muslim regions to other countries, such as Russia, South Africa and China, among the others. Interest in Islamic banking relates to itsethical dimensionandlinks totherealeconomy. Furthermore, Islamic bankshave not beenas adverselyaffected by the credit turmoil from the 2007 onwards and this has further increased the interest to their business model (Hasan and Dridi, 2010).Specifically, Islamic banksoperate under rules dictated by Sharia law. The most noticeable differences are that Islamic banks prohibit the payment and receipt of interest – they engage in an array of profit-and-loss sharing agreements or/and lease/rent type deals where fees are charged for a particular service. In addition Islamic law also prohibits investing in certain 'harram' areas – gambling, arms, pornography,pork products). They offerbanking products and services in-line withIslamic ethicsandencourageproductive investment andrisk-sharing.In countries where Islam is the major religion, such as in the Middle-East and North Africa (MENA) as well as in parts of South Eastern Asia (SEA), Islamic banks have traditionally coexisted with conventional banksthat worked without the restrictions dictated by Sharia compliance. Consequently, Islamic and conventional banks have experienced different development in terms of financial products, risk mitigation and resources allocation, implying that these two groups of banks may have varying efficiency and technology levels.

Despite the growing commercial interest in Islamic bankingonly a handful of studies empirically investigate the efficiency of Islamic and conventional banks (Hussein, 2004; Hasan ,2006; Bader, et al., 2008).These studies derive efficiencymeasures for Islamic and conventional banks firms using a single frontier corresponding to a common (unknown) transformation function. As such, these studies implicitly assume that Islamic and conventional banks use the same technology. Such an assumption, we believe,cannot be made ex-ante becauseIslamic banksoperate under Sharia law that imposes various limitations on their activities.

This leads us to the questions: Is there a technology gap between Islamic and conventional banks? and once we take into account different productive conditions, DoIslamic and conventional banks have different cost efficiency levels? The main aim of our paper is to address these questions by using the meta-frontier approach to investigate bank cost efficiency for Islamic and conventional banks in twelve MENA and South East Asian countries between 2000 and 2006.This paper provides a cross-industry efficiency comparison between Islamic and conventional banks for twelve emerging countries 2000-2006 using the meta-frontier approach. Our results show that conventional and Islamic banks have similar mean (aggregate) cost efficiency levels in the MENA area and there is no technology gap between the two types of banks. At the country level, Islamic banks are more cost efficient than conventional banks in Indonesia, Pakistan, Turkey and United Arab Emirates, and less efficient in Bangladesh, Kuwait, Malaysia and Tunisia. However, our results confirm that these differences are not due to technology differences.

The main contribution of our paper is that it provides new evidence on technology gapsand cost efficiency differences between Islamic and conventional banks in emerging countries (MENA and the SEA regions).Furthermore, this is the first study to investigate whether Sharia compliance results in a technology gap between Islamic and conventional banks. Although previous literature(Hussein, 2004; Hasan ,2006; Bader, et al., 2008) measure cost efficiency either for a single country (using small samples) or using cross-country data, none of these directly address the issue of different production technologies and data heterogeneity issues.To face the latter problem[1], we apply the meta-frontier approach, as introduced by Battese and Prasada Rao (2002) and used to study banking by Bos and Schmiedel (2007),

[1] Various studies in commercial banking (Dietsch and Lozano-Vivas, 2000, Becalli 2004; Glass e McKillop 2006; Fiordelisi and Molyneux 2010) suggest the inclusion of environmental variables in the frontier estimations to face heterogeneity problems. Despite we may straightforwardly apply this approach, it would be inappropriate in our paper for two main reasons: first, Islamic banks are likely to access to different banking technologies than conventional banks under Sharia compliance and, second, emerging market countries (where most Islamic banks are present) display substantial macro-economics and financial differences that make it quite difficult to control all these factors (see Berger 2007, p. 121).

Kontolaimou and Kostas (2010) and Ben Naceur et al (2011). This approach allows us to relax the assumption that all banks in the sample are subject to the same external conditions. Consequently, we are able to compare Islamic and conventional banks using a unique dataset (overall, 1500 observations over the period 2000 to 2006from twelve emerging markets countries in the MENA and SEA regions) and test for the existence of technology gaps.

The remainder of the article is organized as follows: section 2 provides an overview of the literature. Data are described in section 3. We present an exposition of our estimation methods in Section 4. Results are discussed in section 5. Lastly, section 6 offers concluding remarks.

2. Literature review

The literature on Islamic bankefficiency remains somewhat limited compared to studies of conventional banks. The earliest compare Islamic and conventional banks operating within the same country. Majid, et al. (2003) use a translog cost function and stochastic frontier approach to derive cost efficiency estimates for a sample of 34 Malaysian commercial banks over 1993 to 2000. They find no difference in the cost features of the two types of banks. Hussein (2004)examines the (alternative) profit efficiency of Islamic and conventional banks in Bahrain over 1985 to 2001 and finds that former are significantly more efficient. Sufian (2006)uses Data Envelopment Analysis (DEA) to estimate (domestic versus foreign) Islamic bank efficiency in Malaysia from 2001 to 2004 and finds that foreign banks are more efficient..

A second group of studies examine cross-country bank efficiency.Al-Shammari (2002)for instance, uses a translog cost function and stochastic frontier approach to derive cost and alternative profit efficiency measures for ten Islamic and 62 conventional banks operating in the Gulf Cooperation Council (GCC) area over 1995 to 1999. The author finds that Islamic banks display higher cost and profit efficiency compared to conventional banks. Al-Delaimi and Al-Ani (2006)use DEA to study the cost efficiency features of 24 Islamic banks from 13 countries suggesting that (given the proportion of banks that lie on the frontier) they must have similar efficiency features.Hasan (2006)examine cost, revenue and profit efficiency aspects of banks operating in 21 countries over 1995 to 2001 using both parametric and non-parametric techniques – the study shows that Islamic banks are less efficient than their conventional peers. Ariss (2007) uses stochastic frontier analysis to estimate the cross-country cost efficiency of 41 Islamic and conventional banks in Bahrain, Qatar and United Arab Emirates over 1998 to 2003. The main findings are that cost efficiency improved over time for both conventional and Islamic bankswith the latter showing a substantiallymore efficient use of resources than conventional banks. Bader, et al. (2008)use DEA to find no difference in the cost, profit and revenue efficiencies of 43 Islamic and 37 conventional banks operating across 21 countries over 1990 and 2005.

All the aforementioned studies estimate bank efficiency relative to a common best-practice frontier. Recent studies on efficiency in the financial sector, however, (e.g.Bos et al., 2009)suggest that heterogeneity in the sample may bias estimation of a common frontier. To solve the problem, several studies(e.g. Coelli et al.,1999;Dietsch and Lozano-Vivas,2000;Becalli, 2004; Glass and McKillop, 2006;Fiordelisi and Molyneux, 2010) havesuggested that various control/environmental variables should be included in explanations of the efficiency term. This may partially address the heterogeneity issue although using a single frontier to derive cross-country efficiency estimates remains problematic because, "it may be virtually impossible to control for the very different economic environments in which the banks in different nations compete" (Berger 2007, p. 121).

One solution to the above is to use the "Meta-frontier) following the methodology proposed by Prasada Rao (2002) and Battese et al 2004. Focussing on banking,Bos and Schmiedel (2007)estimatea "meta-frontier" (that envelopescountry-specific frontiers) focussing on eight European banking systems to estimate nation-specific cost and profit frontiers. The authors argue that conventional estimates using common frontiers underestimate cost andprofit efficiency and this can result in biased cross-country efficiency comparisons.Kontolaimou and Kostas (2010) use a meta-frontier to compare the productive performance of co-operative, commercial and savings banks in Europe and show that the frontier corresponding to cooperative banking firms liesfurthest away from the meta-frontier suggesting a larger technology gap for these mutual banks.Finally Ben Naceur et al (2011) use DEA and a meta-frontier approach to examine the efficiency of Egypt, Jordan, Morocco, Lebanon and Tunisia between 1994 and

2008. They find that technology differences appear to be a major factor explaining the variation in efficiency across countries (they do not examine Islamic banks in their study).

3. Methodology

We use the stochastic frontier approach and a translog cost function to estimatecost efficiency. First, we assess differences between Islamic and conventional banksby poolingall banks in the sample andestimatingefficiency. Second, we then split banks into two sub-samples(conventional and Islamic) and estimate cost frontiers and efficiency for the two types of banks. Finally, we apply the stochastic meta-frontier approach to gauge the technology gap (if any) between the two types of banks.

Following Aigner, et al. (1977), Meeusen and Broeck (1977) and Battese and Corra (1977)we specify the cost frontier as follows:

$$\ln TC_{kt} = x_{kt}\beta + (v_{kt} + u_{kt}) \qquad (2)$$

where TC_{kt} represents the total cost of the bank k in period t, x_{kt} is a vector of input prices and output quantities, β is a vector of parameters to be estimated,v_i is a random variable, which is assumed to be *i.i.d.* distributed as a $N(0,\sigma^2_v)$ and independent of u_i. $u_i$is a non-negative random variable, which is assumed to account for the cost inefficiency in production and is assumed to be *i.i.d.* as truncations at zero of the $N(\mu,\sigma_U^2)$ distribution, η is a parameter to be estimated.We specify the following translog functional form with three inputs and three outputs:

$$\ln TC_{kt} = \beta_0 + \sum_{i=1}^{3}\beta_i \ln Y_i + \sum_{j=1}^{3}\alpha_j \ln P_j + \lambda_1 T + \frac{1}{2}\left(\sum_{i=1}^{3}\sum_{j=1}^{3}\delta_{ij}\ln Y_i \ln Y_j + \sum_{i=1}^{3}\sum_{j=1}^{3}\gamma_{ij}\ln P_i \ln P_j + \lambda_{11}T^2\right) + \sum_{i=1}^{3}\sum_{j=1}^{3}\rho_{ij}\ln Y_i \ln P_i$$

$$+\frac{1}{2}\tau_{EE}\ln E \ln E + \tau_E \ln E + \sum_{i=1}^{3}\beta_{iE}\ln Y_i \ln E + \sum_{j=1}^{3}\alpha_{jE}\ln P_j \ln E + \varepsilon_{kt} \qquad for I \neq j \quad (4)$$

where TC_{kt} is the natural logarithm of total cost of bank k in period t, Y_i is the vector of output 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. Altunbas, et al. (2000)Vander Vennet (2002),Fiordelisi and Ricci (2010)]. We specify the time trend T to capture technological change as in Altunbas, et al. (2000). A point estimation of cost efficiency is given by $E(u_{kt}|\varepsilon_{kt})$, i.e., the mean of u_{kt} given ε_{kt}. To estimate bank specific cost efficiency, we calculate

$$CE_{kt} = \exp(-u_{kt}) \quad (5)$$

For the estimation of the parameters of the stochastic frontier function we follow Stevenson (1980)and adopt the normal-truncated normal model using the maximum likelihood method and re-parameterize σ_v^2 and σ_u^2 as in Bos and Schmiedel (2007) by taking $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\lambda = \sigma_u/\sigma_v^2$.

If the two types of banks (Islamic and conventional) share the same technology, then the pooled stochastic frontier model would be enough to estimate efficiencies. We therefore run a likelihood ratio (LR) test with the null hypothesis (H_0) that the stochastic frontier models for the two groups are the same. The LR Statistic is defined as follows:

$$\lambda = -2\{\ln[L(H0)/L(H1)]\} = -2\{\ln[L(H0)] - \ln[L(H1)]\} \quad (1)$$

where $L(H_0)$ is the value of the log likelihood functions for the stochastic frontier estimated by pooling the data for all the two groups, and $L(H_1)$ is the sum of the values of the log-likelihood functions for the two stochastic cost functions estimated separately for each group. The degrees of freedom for the χ^2 distribution involved are 33, the difference between the number of parameters estimated under H_1 and H_0. This test, with a likelihood ratio value of 260, leads us to reject the Null hypothesis that both types of banks have the same technology. As such it supports the rationale for analysing the efficiency of the two types of banks separately as well as using the meta-frontier approach.

---

[2] λ represents the ratio of the standard deviation of the variance of the one-sided component to that of the symmetric component and hence is non-negative (Waldman and Donald 1982).

Various studies (e.g. Coelli et al.,1999; Dietsch and Lozano-Vivas,2000; Becalli, 2004; Glass and McKillop, 2006; Fiordelisi and Molyneux, 2010) suggest including various control/environmental variables in the estimation of the efficiency measure to deal with different bank production and other features. However,it has been argued that this approach is inappropriate as the inclusion of control/environmental variables may not solve sample heterogeneity issues if banks have access to the same technologies (Bos and Schmiedel, 2007).Consequently, we first estimate cost efficiency using frontiers derived for the two types of banks separately and then use the meta-frontier to arrive at estimates from our pooled sample.

The meta-frontier is defined as 'a deterministic parametric function (of specified functional form) such that its values are no smaller (larger in the case of our study as adapted to the cost function) than the deterministic components of the stochastic frontier production functions of the different groups involved, for all groups and time periods' Battese, et al. (2004, p. 93).The meta-frontier model can be defined as follows:

$$Y_{kt}^{*} \equiv f\left(x_{kt}, \beta^{*}\right) = e^{x_{kt}\beta^{*}} \tag{6}$$

where Y^{*}_{kt} represents the output of the bank k in period t under the meta-frontier model, x_{kt} is a vector of input prices and output quantities and β^{*} is a vector of parameters of the meta-frontier function to be estimated such as:

$$x_{kt}\beta^{*} \leq x_{kt}\beta \tag{7}$$

The meta-frontier is assumed to be a smooth function that envelops cost function for group j of frontiers considered.[3]Eq. (6) can be reformulated in its general form for the derivation of the meta-frontier as follows:

$$Y_{kt} = e^{x_{kt}\beta + v_{kt} + u_{kt}} \tag{8}$$

We can express this alternatively by:

[3] To simply notation, we drop the j^{-th} group notation from the equations considered in the functions. The j^{-th} group refers to the different groups of banks considered in the study.

$$Y_{kt} = e^{u_{kt}} \times \frac{e^{x_{kt}\beta}}{e^{x_{kt}\beta^*}} \times e^{x_{kt}\beta^* + v_{kt}} \tag{9}$$

Where $e^{u_{kt}}$ represents the technical efficiency relative to the stochastic frontier of bank *k* at time *t* in the *j*-th group.

$$TE_{kt} = \frac{Y_{kt}}{e^{x_{kt}\beta + v_{kt}}} = e^{u_{kt}} \tag{10}$$

$with\, 0 \leq TE_{kt} \leq 1$

The Technology Gap Ratio (TGR) which measures the ratio of the output for the frontier for the *j*th group relative to the potential output defined by the meta-frontier is as follows:

$$TGR_{kt} = \frac{e^{x_{kt}\beta^*}}{e^{x_{kt}\beta}} \tag{11}$$

$with\, 0 \leq TGR_{kt} \leq 1$

Technical efficiency relative to the meta-frontier is defined as follows

$$TE^*_{kt} = \frac{e^{x_{kt}\beta^* + v_{kt}}}{Y_{kt}} \tag{12}$$

To estimatethe meta-frontier we follow the steps as proposed by Battese, et al. (2004), namely we: 1) obtain the maximum-likelihood estimates, $\hat{\beta}_j$ for the β_j parameters of the stochastic frontier for the *j*-th group; 2) derive estimates, $\hat{\beta}^*$, for the β^* parameters of the meta-frontier so that the estimated function best envelopes the deterministic components of the estimated stochastic frontiers for the different groups. To identify the best envelope, we use as a criterion the sum of squares of deviations of the meta-frontier values from those of the group frontiers; 3) estimates for the technical efficiencies of firms relative to the meta-frontier are given by $\hat{TE}^*_{kt} = \hat{TE}_{kt} \times TG\hat{R}_{kt}$ where $\hat{TE}^*_{kt}$ is the predictor for the technical efficiency relative to the given group frontier, as outlined in Battese and Coelli (1992) $TG\hat{R}_{kt} = e^{x_{kt}\hat{\beta}} / e^{x_{kt}\hat{\beta}^*}$ is the estimate for the TGR for the i^{th} firm in the j^{th} group relative to the industry potential, obtained by using the estimates for the parameters involved.We chose the constrained linear least squares method in order to minimise the distance of the j^{th} group relative to the industry potential. We set as well the constraints such that $x_{kt}\beta^{*} \leq x_{kt}\hat{\beta}$ is respected and bound the results of the β* such that it smoothly envelops the minim estimators of j^{th} group

This leads to the following optimization problem:

$$\min L^{**} = \sum_{t=1}^{T}\sum_{k=1}^{N}\left(x_{kt}\hat{\beta} - x_{kt}\beta^{*} \right) \; with\, x_{kt}\beta^{*} \leq x_{kt}\hat{\beta} \tag{13}$$

3.1.Inputs and Outputs

The definition of Islamic banks' inputs and outputs is akey issueif we wish to accurately compare Islamic and conventional banks. Among the array of approaches that can be used (see Hughes and Mester, 2008, for a review), we follow the intermediation approachsinceboth Islamic and conventional banks collect deposits and other liabilities and transfer these sources of funds into earning assets such as loans and investments.

We collect the following input and output data for Islamic and conventional banks. For conventional banks we chose three outputs:loans, securities and the nominal value of off-balance sheet items. For Islamic banks,loans are defined summing all specific Islamic forms of debt (i.e. *Murabaha, Salam* and *Quard* funds for short term debts, and *Sukuk*, Leasing and *Istisna* for long term debts);securities are obtained by summing all equity financing (i.e. securities, *mudaraba, musharakah*and other investments); and the third output is the nominal value of off-balance sheet items[4]. We use three inputs for both types of banks: the price of labour, the price of funds and the price of physical capital and we include bank's equity capital as a fixed input as previously discussed in the methodology.For Commercial banks, the price of labour is obtained by dividing the total personnel expenses over the total

[4] See Baele et al (2010) for a detailed explanation of the different types of Islamic finance and their conventional equivalents.

assets; the price of funds is obtained by dividing the total interest expenses over the total funds; and the price of physical capital is obtained by dividing the total depreciation and other capital expenses over the total fixed assets. For Islamic banks, the price of funds is obtained by dividing the profits distributed to depositors and investors (the case of savings accounts for the former and the case of profit and loss sharing investment accounts for the latter) resulting from the Islamic banks' investing and financing activities (specifically labelled as "funding expenses" in the Bankscope Database) over total funds.The returns on the deposits at Islamic banks (whether in savings or two-tier *mudarabah* mode) are determined ex-post depending on the economic return on investment in which the deposits were placed (according to Sharia' principles).

Total cost for conventional banks includes all interest and operating expenses. For Islamic banks it is calculated as the sum of the profits distributed to depositors and investors that hold accounts (savings accounts and profit and loss-sharing investment accounts), commission expenses, fee expenses, trading expenses and total operating expenses.

4. Data

We gather bank accounting data from twelve countries in the MENA and SEA regions where Islamic banking is most developed[5]. Data are obtained from the Bankscope database for conventional and Islamic banks (but excluding Islamic windows of conventional banks) over 2000 to 2006. For comparability purposes, the annual reports of conventional banks are drawn-up under IFRS standards whereas for Islamic banks' they are established under the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) Standards. Table 1 summarizes the number of banks and observations per country and per bank type.

<< INSERT TABLE 1 >>

[5] Gabon, Lebanon, Iran, Yemen and Brunei are omitted due to data unavailability.

Overall, the sample consists of 1,390 observations for conventional and 115 observations for Islamic banks (there was a substantial number of missing values for the Islamic banks which meant we had to drop a substantial number of observations). Descriptive statistics for the outputs, inputs and other variables are provided in Table 2.

<< INSERT TABLE 2>>

Table 3 illustrates that Islamic banks, on average, incur lower total costs than conventional banks even though total lending is similar. Other earning assets comprise a smaller component of the total balance sheet for Islamic banks and they are significantly less active in off-balance sheet activity. It is also interesting to note that for our sample Islamic banks have higher labour costs, lower funding costs and more capital compared to their conventional counterparts.

5. Results

Table 3 reports the cost efficiency scores for estimates derived from: 1) a single frontier estimation (pooled cost efficiency); 2) individual frontier estimates for Islamic and conventional banks (single cost efficiency); 3) technology gap ratios and 4) efficiency estimates derived from the meta-frontier.

<< INSERT TABLE 3>>

Our results showthat the conventional and Islamic banks display similar mean cost efficiency levels irrespective of which approach is taken although the metafrontier estimates are slightly lower compared to the pooled and single frontier results. Similarly, mean technology gap ratios (obtained from each industry specific efficiency frontier relative to the meta-frontier) are also close at around 98%. This impliesthat both conventional and Islamic banks produce on average 98% of the potential output given the technology available. Overall, these results signalthat while there are technology differences between the two types of banks these are not large. It also suggests that even though Islamic banks operate under different principles – the prohibition of interest and restrictions in areas they are allowed to invest – this does not appear to mark them out as being noticeably different in terms of their production features or efficiency compared to conventional banks.

<< INSERT FIGURE 1>>

By distinguishing mean cost efficiency levels across the time period analysed (i.e. 2000-06),we showthat meanmeta-frontier efficiency levels for both types of banks area also similar from 2001 to 2005,although in 2006 Islamic banks experience a decline in cost efficiency (figure 1).These results again provide further evidence that Islamic banks use similar technology to conventional banks. One explanation for this finding could relate to the nature of the lending contracts that Islamic banks use to undertake their activities. Typically there are two main types of contract – first there are profit and loss-sharing agreements where borrowers contract to repay loans at rates based on the performance of the project on which loans are made and second there are contracts (like*Murabaha*) where loans are based on the purchase of a good and repayment includes a principal plus a mark-up. There is some evidence that Islamic banks do relatively little profit and loss business and focus more on mark-up activity (Baele et al , 2010) and these mark-ups can be very similar to traditional interest rates (particularly in countries where Islamic banks compete head-on with conventional banks, which is the case in most countries in our sample)[6]. This may explain why production technologies do not appear to differ substantially.

<< INSERT TABLE 4>>

[6] See Abedifar et al (2011) who support this with empirical evidence on 56 banks from 22 countries between 2001 and 2008.

Country differences (table 4) are apparent from the meta-frontier estimates but these are typically not large in countries where Islamic banks are found to be the most cost efficient.For instance they are more efficient than conventional banks in Indonesia (87% versus 83%), Pakistan (86% v 80%), Turkey (83% v 81%) and the United Arab Emirates (87% v 85%). However, greater variation is found in countries where conventional banks are the most efficient as in Bangladesh(86% v 65%), Kuwait (95% v 74%), Malaysia (84% v 78%) and Tunisia (83% v 81%). These differences are not due to substantial technology gapsas mean values for both types of bank are similar across countries producing on average at the same level (around 98%) of the potential output given the technology available in the country. Overall, our results confirm that Islamic banks are using the same technology as their conventional counterparts.

6. Conclusion

This paper provides a cross-industry efficiency comparison between Islamic and conventional banks fortwelve emerging countries 2000-2006 using the meta-frontier approach. Our results show that conventional and Islamic banks have similar mean (aggregate) cost efficiency levels in the MENA area and there is no a technology gap between the two types of banks. At the country level, Islamic banks are more cost efficient than conventional banks in Indonesia, Pakistan, Turkey and United Arab Emirates, and less efficient in Bangladesh, Kuwait, Malaysia and Tunisia. However, our results confirm that these differences are not due to technology differences. Production processes therefore appear similar and this we suggest is probably due to the nature of Islamic financing contracts. The widespread use by Islamic banks of mark-up style contracts (where ‘prices’ are more likely to be set in a similar manner to interest rates) is likely to result in technology features that are similar between the two types of banks.

Acknowledgements

We thank YenerAltunbas, JaapBos, Claudia Girardone, John Goddard, Tom Weyman-Jones, and participants at the 2009 International Tor Vergata Conference in Banking and Finance and to the 2009 meeting of European Working Group on Efficiency and Productivity Analysis, Leicester University (UK)for helpful comments. We alone are responsible for remaining errors.

Table 1: Sample Composition

Panel A: Number of observations per country over the period 2000-2006

COUNTRY / YEAR	2000	2001	2002	2003	2004	2005	2006	Total
BAHRAIN	11	10	9	13	13	18	19	93
BANGLADESH	28	30	31	31	30	30	29	209
INDONESIA	36	27	26	32	31	35	31	218
JORDAN	14	13	13	13	16	15	14	98
KUWAIT	6	8	9	9	11	13	10	66
MALAYSIA	26	28	33	33	34	32	38	224
PAKISTAN	13	12	13	17	18	24	25	122
QATAR	3	4	6	7	7	7	9	43
SAUDI ARABIA	10	10	5	10	9	10	11	65
TUNISIA	8	7	7	12	11	15	13	73
TURKEY	16	6	19	26	29	29	24	149
UNITED ARAB EMIRATES	16	17	21	21	22	24	24	145
Total	**187**	**172**	**192**	**224**	**231**	**252**	**247**	**1505**

Source of data: Bankscope

Panel B: Number of observationsper country and per industry over the period 2000-2006

INDUSTRY / YEAR	2000	2001	2002	2003	2004	2005	2006	Total
Conventional Banks	181	166	184	213	213	221	212	1390
Islamic Bank	6	6	8	11	18	31	35	115
Total	**187**	**172**	**192**	**224**	**231**	**252**	**247**	**1505**

Source of data: Bankscope

Table 2: Descriptive statistics of the Outputs, Inputs, Dependant Variables and Equity Capital used in the empirical analysis

Panel A) Conventional banking industry*

		Mean	StdDev	Min	Max
TC	Total Cost	289,774	678,140	347	9,476,828
Y1	Loans	2,190,534	3,869,356	1,142	35,769,685
Y2	Other Earning Assets	1,967,806	3,697,947	1,320	35,586,853
Y3	Off Balance Sheet Items	1,967,930	4,408,247	42	65,905,989
P1	Price of Labour	0.011959	0.007791	0.000282	0.071624
P2	Price of Funds	0.048493	0.032043	0.001368	0.223574
P3	Price of Assets	1.055104	1.395393	0.000875	13.292683
E	Equity capital	475,126	819,122	1,561	6,408,385

Panel B) Islamic banking industry*

		Mean	StdDev	Min	Max
TC	Total Cost	156,351	216,439	4,700	1,317,009
Y1	Loans	2,242,446	3,947,185	18,800	24,107,477
Y2	Other Earning Assets	874,800	1,292,638	70	7,506,744
Y3	Off Balance Sheet Items	708,855	1,277,013	100	8,022,937
P1	Price of Labour	0.01353	0.01132	0.00056	0.08592
P2	Price of Funds	0.03768	0.02654	0.00265	0.14051
P3	Price of Assets	1.03185	1.54045	0.00886	8.84722
E	Equity capital	789,501	1,504,592	9,195	7,220,964

*All values are in thousand dollars, except for relative prices

Source of data: Bankscope

Table 3: Cost efficiency scores and technology gap ratios

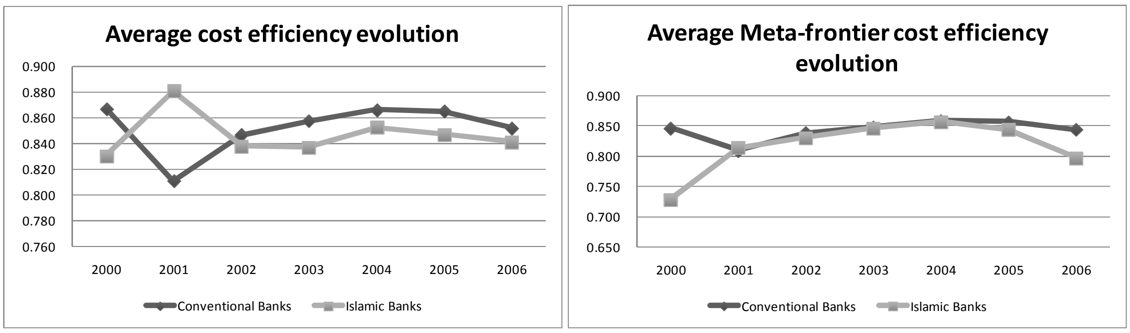
Conventional Banking Industry	Observations	Mean	Std. Dev.	Max	Min
Pooled Cost Efficiency	1390	0.860	0.076	1.000	0.185
Single Cost Efficiency	1390	0.853	0.087	1.000	0.150
Technology Gap Ratio	1390	0.982	0.018	1.000	0.836
Metafrontier Cost Efficiency	1390	0.838	0.088	0.998	0.147

Islamic Banking Industry	Observations	Mean	Std. Dev.	Max	Min
Pooled Cost Efficiency	115	0.842	0.108	0.974	0.271
Single Cost Efficiency	115	0.845	0.092	0.968	0.464
Technology Gap Ratio	115	0.979	0.020	1.000	0.898
Metafrontier Cost Efficiency	115	0.828	0.092	0.943	0.453

Table 4: Mean cost efficiency scores and technology gap ratios by countries

	Islamic banks		Conventional banks	
COUNTRY / YEAR	**Technology Gap Ratio**	**Metafrontier Cost Efficiency**	**Technology Gap Ratio**	**Metafrontier Cost Efficiency**
BAHRAIN	0.97	0.83	0.98	0.86
BANGLADESH	0.94	0.65	0.98	0.86
INDONESIA	0.99	0.87	0.97	0.83
JORDAN	0.98	0.82	0.99	0.83
KUWAIT	0.99	0.74	0.99	0.85
MALAYSIA	0.99	0.78	0.98	0.84
PAKISTAN	0.98	0.86	0.97	0.80
QATAR	0.97	0.86	0.98	0.87
SAUDI ARABIA	0.96	0.83	0.99	0.86
TUNISIA	0.97	0.81	0.98	0.83
TURKEY	0.99	0.83	0.99	0.81
UNITED ARAB EMIRATES	0.99	0.87	0.98	0.85
Total	**0.98**	**0.81**	**0.98**	**0.84**

Figure 1: Mean pooled and Meta-frontier cost efficiency evolution over the time period



Source of data: computed by the author

References

Abedifar, Pejman, Molyneux, Philip and Tarazi, Amine, Risk and Stability in Islamic Banking (April 3, 2011). Available at SSRN: http://ssrn.com/abstract=1663406Aggarwal, Rajesh K., and Tarik Yousef, 2000, Islamic Banks and Investment Financing, *Journal of Money, Credit and Banking* 32, 93-120.

Aigner, Dennis, C. A. Knox Lovell, and Schmidt Peter, 1977, Formulation and Estimation of Stochastic Frontier Production Models, *Journal of Econometrics* 6, 21-37.

Al-Delaimi, and Al-Ani, 2006, Using Data Envelopment Analysis to Measure Cost Efficiency with an Application on Islamic Banks, *Scientific Journal of Administrative Development* 4.

Al-Muharrami, Saeed, 2007, The causes of productivity change in GCC banking industry, *International Journal of Productivity and Performance Management* 56, 731-743.

Al-Shammari, S. Hamad, 2002, Structure-Conduct-Performance & Efficiency in Gulf Cooperation Council (GCC) Banking Markets, Division of Financial Studies (Université of Wales, Bangor).

Alhabshi, Syed Musa, 2002, Financial Performance Measurement and Distribution Policy Of Islamic Financial Institutions, *International Islamic University Malaysia , Journal of Economics and Management* 10.

Altunbas, Yener, Ming-Hau Liu, Philip Molyneux, and Rama Seth, 2000, Efficiency and Risk in Japanese Banking, *Journal of Banking and Finance* 24, 1605-1628.

Ariss, Rima Turk, 2007, On the rise of Islamic banking among giant commercial banks: a performance and efficiency analysis, *Journal of International Business & Economics* VII.

Bader, Mohammed Khaled I, Shamser Mohamad, Mohamed Ariff, and Taufiq Hassan, 2008, Cost, Revenue and Profit efficiency of Islamic versus Conventional Banks: International evidence using data envelopment analysis, *Islamic Economic Studies* 15, 75.

The Banker Report, the global finance magazine of the Financial Times and Group HSBC Amanah, Issue November 2009.

Baele, Lieven, Farooq, Moazzam and Ongena, Steven R. G., Of Religion and Redemption: Evidence from Default on Islamic Loans (October 1, 2010). CentER Discussion Paper Series No. 2010-136; European Banking Center Discussion Paper No. 2010-32. Available at SSRN: http://ssrn.com/abstract=1740452

Battese, GE, and TJ Coelli, 1992, Frontier production functions, technical efficiency and panel data with application to paddy farmers in india, *Journal of Productivity Analysis* 3, 153 - 169.

Battese, George E, and D. S. Prasada Rao, 2002, Technology Gap, Efficiency, and a Stochastic Metafrontier Function, *International Journal of Business and Economics* 1, 87-93.

Battese, George E, D. S. Prasada Rao, and Christopher J. O'Donnell, 2004, A Metafrontier Production Function for Estimation of Technical Efficiencies and Technology Gaps for Firms Operating Under Different Technologies, *Journal of Productivity Analysis* 21, 91-103.

Battese, George E., and Greg S. Cona, 1977, Estimation of a Production Frontier Model: With Application to the Pastoral Zone of Eastern Australia, *Australian Journal ofAgricultum1 Economics* 21, 169-179.

Becalli, Elena, 2004, Cross-country comparisons of efficiency: Evidence from the UK and Italian investment firms, *Journal of Banking and Finance* 28, 1363-1383.

Ben Naceur, S., Ben-Khedhiri and Casu, B, 2011. What Drives the Performance of Selected MENA Banks? A Meta-Frontier Analysis," IMF Working Papers 11/34, January, IMF: Washington DC

Berger, Allen N., 2007, International Comparisons of Banking Efficiency, *Financial Markets, Institutions & Instruments* 16, 119-144.

Berger, Allen N., R. DeYoung, H. Genay, and G.F. Udell, 2000, Globalization of financial insitutions: Evidence from cross-border banking perfomance, in R.E. Litan, and A. Santomero, eds.: *Globalization of financial insitutions: Evidence from cross-border banking perfomance* (Brookings-Wharton Papers on Financial Services).

Berger, Allen N., and David B. Humphrey, 1997, Efficiency of Financial Institutions: Internation Survey and Directions for Future Research, *European Journal of Operational Research* 98, 175-212.

Bos, J W B, and H Schmiedel, 2007, Is there a single frontier in a single European banking market?, *Journal of Banking and Finance* 31, 2081-2102.

Bos, JWB, Michael Koetter, James W. Kolari, and Clemens J. M. Kool, 2009, Effects of heterogeneity on bank efficiency scores, *European Journal of Operational Research* 195, 251-261.

Dietsch, M, and A Lozano-Vivas, 2000, How the environment determines banking efficiency: A comparison between French and Spanish industries, *Journal of Banking and Finance* 24, 985-1004.

El-Gamal, Mahmoud A., 2006. *Islamic Finance, Law, Economics and Practice* (Cambridge University Press).

Ferrier, Gary D, and C.A. Knox Lovell, 1990, Measuring Cost Efficiency in Banking: Econometric and Linear Programming Evidence, *Journal of Econometrics* 46, 229-245.

Fiordelisi, Franco, and Phil Molyneux, 2010, The determinant of shareholder value in banking. Journal of banking and finance, (Forthcoming).

Fiordelisi, Franco, and Ornella Ricci, 2010, What are the efficiency gains of Bancassurance? A two-side analysis: the banking and the insurance standpoint, (Forthcoming, Submitted to European Journal of finance).

Hasan, M., and Dridi, J , 2010, The Effects of the Global Crisis on Islamic and Conventional Banks: A Comparative Study, IMF working Paper 10/201, September, IMF: Washington DC

Hasan, Kabir, 2006, The X-Efficiency in Islamic Banks, *Islamic Economic Studies* 13.

Hughes, J.P., and L.J. Mester, 2008, Efficiency in banking: theory, practice and evidence, Working Paper (The Wharton School, University of Pennsylvania).

Hussein, 2004, Efficiency in Bahrain: Islamic Vs Conventional Banks, (Islamic Research and Training Institute, Saudi Arabia).

Kontolaimou, A., Tsekouras, k., 2010. Are cooperatives the weakest link in European banking? A non-parametric metafrontier approach. Journal of Banking & Finance 34 (2010) 1946–1957

Majid, M. A, N. G. M Nor, and F. F Said, 2003, Efficiency of Banks in Malaysia, Fifth International Conference on Islamic Economics and Finance (Bahrain).

Meeusen, Wim, and Julien van den Broeck, 1977, Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error, *Interrzational Economic Review* 18, 435-444.

Standard&Poor's, 2007, Islamic Finance Outlook 2008.

Stevenson, Rodney E., 1980, Likelihood Functions for Generalized Stochastic Frontier Estimation, *Journal of Econometrics* 13, 57-66.

Sufian, Fadzlan, 2006, Size and return to scale of the Islamic Banking industry in Malaysia: Foreign versus domestic banks, *IIUM Journal of Economics and Management* 14.

Vander Vennet, Rudi, 2002, Cost and Profit Efficiency of Financial Conglomerates and Universal Banks in Europe, *Journal of Money, Credit, and Banking* 34, 254-282.

Waldman, Donald M., 1982, A Stationary Point for the Stochastic Frontier Likelihood, *Journal of Econometrics* 18, 275-279.