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Abstract

The banking industry market is shared by conventional and Islamic Banks in MENA. These latter banks have been expanding during the last decade. In an intensely competitive environment, it is interesting to compare banking performance and resiliency by considering two competing bank groups: Islamic and commercial banks. Using parametric distance function models, hyperbolic and output distance functions, two efficiency measures related to profit and revenue are compared. Results find evidence of technical efficiency differences, some evidence with bank size but reject the common technology assumption. We evaluate the business risk of each bank group by considering the impact of a sharp abrupt deterioration in their activities. Results show that Islamic banks have the lowest resiliency to shocks when compared to the two other bank categories while a shock on non lending activities has a much more impact on Islamic business banks' business risk.

JEL Classification: E5, G7

Keywords: Technical efficiency, Distance Functions, Business Risk, Banks

ملخص

تشارك البنوك التقليدية والإسلامية في الشرق الأوسط في سوق الصناعة المصرفية. وتوسعت هذه البنوك الأخيرة خلال العقد الماضي. في بيئة تنافسية بشكل مكثف، ومن المثير للاهتمام مقارنة الأداء المصرفي والمرونة من خلال النظر لمجموعة من المتنافسين: البنوك الإسلامية والتجارية. باستخدام نماذج محدودة الوظيفة، وظائف عن بعد القطعي والمخرجات، واثنين من تدابير الكفاءة المتصلة بالربح والإيرادات تشير النتائج الى وجود دليلا على الاختلافات فى الكفاءة الفنية، بعض الأدلة ترتبط بحجم البنك، مع رفض الافتراض كفاءة التكنولوجيا هي عامل مشترك. نقوم بتقييم مخاطر الأعمال فى كل مجموعة من البنوك من خلال النظر في أثر التدهور المفاجئ والحاد في أنشطتها. وأظهرت النتائج أن البنوك الإسلامية لديها أدنى مرونة للصدمات مقارنة الفئتين مصرفية أخرى في حين أن الصدمة على الأنشطة غير الإقراض لديها تأثير أكثر من ذلك بكثير على مخاطر الأعمال البنوك التجارية الإسلامية.

1. Introduction

An important wave of the financial institutions efficiency literature has been interested in the comparison of the efficiency of Islamic and conventional banks. Both by considering the experience of one specific country, a group of homogeneous countries or even a larger sample of countries in the world, most of the scholars were motivated by the comparison of their business model orientation, the argument being that Islamic financial institution is still growing its market share within some emerging countries and also in Middle Eastern countries. Indeed, Islamic banks in the world hold billions of dollars in assets and constitute an attractive market. While there is no theoretical argument favoring Islamic banks against conventional banks in terms of performance, for example, Beck et al. (2013) argue that Islamic banks might have lower costs due to lower monitoring and screening costs, but at the same time, their younger age, and the complexity of Islamic banking products may increase their costs. Most of this empirical literature uses either some financial ratios or focuses on more synthetic indexes related to bank efficiency measures in order to compare the performance of the two bank groups. As we will see later and for several reasons, there is no consensus in this empirical literature whether one bank group outperforms the other one. More recently, a handful of papers were concerned by the link between bank resiliency and their performance, and seem to find evidence that Islamic banks are much more resilient because they have higher assets quality or are better capitalized (Beck et al. 2013). Furthermore, Cihak and Hesse (2010) using the Z-score bank measure of soundness, found some links between size and bank status, with Islamic banks being more stable when operating on a small scale, but less stable when operating on larger scale. Finally, within this empirical literature on Islamic banks and financial stability, Hassan and Dridi (2010) and Beck et al. (2013) found evidence that Islamic banks are more resilient in terms of risk insolvency compared to conventional banks during the crisis.

The main objective of this empirical study is twofold. First it tries to conduct an empirical comparison of economic performances between Islamic banks and commercial banks for a sample of 15 countries in the MENA region during the period 2002-2009. In our comparison, we consider several measures of bank performance, synthetic measures of profit efficiency and revenue efficiency, which will provide a more global view of the performance of these banks, instead of using financial ratios. It has been shown that conventional banks, which are efficient in controlling revenues, are less efficient in controlling costs (Berger et al. 1993). Conventional measures like productive efficiency and cost efficiency provide only a certain view of the efficiency of the bank managers, while the profit efficiency measure is more adequate because it takes into account the ability of the managers to control both costs and revenues. Unfortunately this measure imposes a strong assumption on the behavior of the banks (i.e., profit maximization). This assumption is problematic if it is not shared by all the banks within the sample under study[1]. For example, the case of public banks, which do not necessarily have this behavioral objective, as they may also have other stated social and economic development objectives. Also, the estimating of cost or profit frontier assumes a precise measure of input and output prices, this is particularly difficult to obtain for heterogeneous samples, particularly those based on Bankscope data. Within this framework, Koetter (2006) compared cost and profit efficiency sensitivity to three definitions of prices. He found that both bank efficiency levels and also German banks' ranking are affected when employing alternative input prices. Finally, estimating bank performance is usually based on the construction of a frontier that is assumed to be common to all the banks. In other words, due to bank's business heterogeneity, if the frontiers are multiple, there is difference in productivity owing to the technology adopted, which is not interpreted as technical inefficiency. This is an important issue for economic policy by differentiating between technical inefficiency attributed to inefficient operations with

[1] Non standard profit function could also be used when banks have some market power; in this particular case all the firms in the sample should verify this assumption, which is a very restrictive assumption too.

respect to a target, and technology inefficiency, more specific to the production process itself. Furthermore, the link between bank efficiency and bank size is also investigated.

The second issue addressed in this paper is to compare the resiliency of these banks to an adverse depreciation in their activities, by evaluating and comparing their business risk. Based on a recent methodology using distance function developed by Chaffai and Dietsch (2015) for French retail banks, we build on a simulation model in order to evaluate the business risk of each bank type. The main idea is to use historical extremes abrupt fall within the sample in terms of profit loss in order to predict their potential impact on bank profitability when these shocks entail a reduction in banks activities. Like a stress tests, several scenarios have been considered, first we evaluate bank business risk when banks are allowed to adjust their costs or not. Second, we evaluate the business risk by considering either the impact of a sharp abrupt deterioration in lending, non lending activities or both, this exercise is important to evaluate the resiliency with respect to each bank activity. Finally, we also consider the link between business risk and bank size.

We use distance function methodology that does not necessitate data on prices to measure bank performance. The distance function has been extensively used in the empirical literature evaluating performance, but is very limited in banking. Most of the empirical studies evaluating bank performance use cost frontier models. Several distance functions have been used in the literature on banking performance, (i) input distance functions, (ii) output distance functions or (iii) directional and hyperbolic distance functions. The first model provides an efficiency measure much more related to the cost efficiency, by measuring by how much the inputs could be deflated to reach the efficient frontier while producing the same level of outputs. The second model provides an efficiency measure related to revenue, and measures the expansion of the activities while using the same bank resources. Finally, directional and hyperbolic distance functions, much more recent compared to the previous models, evaluate bank performances while allowing simultaneously both output expansion and input reduction, which offer a more complete measure of performance related to profit. Directional distance function has been recently used to evaluate bank dynamic performances by Park and Weber (2006), while Cuesta and Zofio (2005) employ hyperbolic distance function to evaluate the efficiency of Spanish saving banks, Chaffai and Dietsch (2015) used directional distance function to evaluate business risk of French retail banks. However, radial distance functions (i) and (ii) are much more employed to evaluate banks efficiency. Recent studies using this methodology to evaluate the performance of Islamic and conventional banks include Abudl-Majid et al., (2010) and Jhones et al., (2014)[2]. To our knowledge, using an efficiency measure related to both cost and revenues (iii) to evaluate bank efficiency is much more limited. Bader et al., (2007) compare cost efficiency, revenue efficiency and profit efficiency between Islamic and conventional banks for a panel data including 21 countries. Employing DEA model to construct the frontier envelop, they find no evidence of overall difference in efficiency between Islamic banks and conventional banks. The main limit of this study is that DEA model uses proxy for price data in order to evaluate profit efficiency. So, using hyperbolic distance function model to compare the profit efficiency between Islamic and conventional banks in the MENA region without using price data would contribute to this empirical literature.

This paper offers another aspect of the comparison of Islamic banking to conventional banks by providing a global measure of the business risk of each bank type to gross potential shocks on their lending and non-lending activities. Our findings suggest some significant differences in the technology used by the two bank groups, but there is evidence of the superiority of conventional banks to Islamic banks in terms of profit and revenue efficiency but the difference

[2] For an exhaustive list of studies dealing with the comparison of the efficiency between Islamic and conventional banks, see Table 1, page 595 in Johnes et al., (2014).

is very small. However, very large banks seem to be more efficient than small or middle size banks. Additionally, Islamic banks are found to be much less resilient in terms of business risk than conventional banks. The low resiliency of these banks is found to be much more linked to non lending activities compared to conventional banks, while large banks seem to be more resilient than small banks.

The remainder of the paper is organized as follows: Section two presents a brief overview of the empirical literature and the motivations of this paper. Section three deals with the methodology of the efficiency measure and the evaluation of business risk. Section four discusses the empirical findings and section five concludes.

2. Related Comparative Literature

There is vast comparative empirical literature on bank performance. Most of these studies focus on bank ownership structure, public banks, private banks, and foreign banks. The comparison is made within a common country or across countries. The comparative performance literature between Islamic banks and conventional banks follow this wave of banking comparisons and can be divided into two groups according to the methodology used: financial ratio analysis (FRA) versus synthetic efficiency indexes. FRA, are much more popular, focusing on some financial ratios, for example cost to revenue ratio, return on assets, and return on equity etc. Using this framework, Bader et al. (2007) explore a larger sample including 43 Islamic banks and 37 conventional banks in three regions. Over the period 1990-2005, they compare banking efficiency through several ratios dealing with cost revenue and profit, but they do not find evidence for the superiority of Islamic banks in terms of performance. More recently, Beck et al. (2013) have also found using FRA, cost to total assets ratios and cost to income ratios, that Islamic banks are less efficient than conventional banks even if they have higher intermediation ratio, higher assets quality and are better capitalized, which explains why Islamic banks perform better during crises. In the same vein of research, Hassan and Dridi (2010) also find superior performance of Islamic Banks during the crisis. These two studies relate efficiency to bank resiliency. The second group of empirical literature employs more synthetic indexes of performances based on efficiency models to compare Islamic and conventional banks. The empirical literature being voluminous, we only provide a sample of these studies related to the Middle East region. The pioneering empirical work is Al Jarrah and Molyneux (2004) who found evidence for Islamic banks' superiority in terms of cost efficiency in 4 countries but for an old period, 1992-2000 and a very limited sample of banks. In the same vein, Ariss (2007) compared cost efficiency on a larger sample and more recent data in three Gulf Cooperation Council Countries (GCC). She found that Islamic banks are more cost efficient than conventional banks during the (1993-2003) period, the cost efficiency being (88% and 74%) respectively. The comparison is based on a stochastic cost frontier model where off balance sheet is retained as output. However, Srairi (2010) found that Islamic banks are much less efficient than conventional banks in the GCC over the period 1999-2007. Both cost efficiency and profit efficiency (derived from non standard profit function) have been evaluated. Finally, Jhones et al., (2014) found no significant difference in gross efficiency between Islamic and conventional banks and find significant differences between the bank types in the components (managerial efficiency of Islamic banks being higher), the analysis cover MENA banks including some Asian countries over (2004-2009). An important issue related to these empirical studies is that they did not establish a robust result on the superiority of one type of banks against the other. It seems that the conclusions depend on the methodology used to evaluate bank's performance, financial ratios or synthetic efficiency measures. The conclusions are also sensitive to the sample of countries considered. Even with synthetic measure which is commonly used in the empirical literature to evaluate bank performance, the results may depend on which type of efficiency is evaluated, technical efficiency, scale efficiency, cost efficiency, profit efficiency and also on the definition of the outputs and the inputs retained. So many considerations have to be kept in mind before reching a definitive answer on which bank category is performing better.

As it has been shown by Berger (1993), some banks could be highly efficient in making profits, but are not necessarily efficient in terms of costs. It has also been evidenced that banks which are using extra cost are those who accept to increase their costs in order to compensate for extracting higher revenues or additional profits. Furthermore, comparing profit efficiency using frontier models, assumes that banks have a common objective of maximizing profit in a competitive market. Efficiency is then measured by estimating a standard profit frontier model. Sometimes, banks may have market power; Berger et al (1997) suggest estimating a non standard profit frontier which became very popular in estimating profit efficiency in banking. Srairi (2010) used this model to evaluate banks' efficiency according to their type in the GCC.

The comparison is more complicated where heterogeneous behavior is present within the sample of banks under study. As a result, a common frontier has no meaning in terms of efficiency; an inefficient bank could be the result of inadequate access to the technology instead of its inability to optimize costs or profits. Another issue concerns the common technology assumption in order to envelop the data. Most of the empirical studies dealing with banking comparisons assume that Islamic banks and conventional banks share a common frontier but do not test for this assumption.

Another strand of literature, but much more limited, evaluates some kind of stability of Islamic banks compared to conventional banks. Focusing on insolvency risk, Cihak and Hesse (2010) evaluate the Z-risk index by considering 19 countries over the period 1993-2004. They show that the Z-score index is, on average, significantly much higher for Islamic banks compared to conventional banks and conclude that Islamic banks are more stable. Some differences across bank size have been evidenced, with small Islamic banks be found to be more stable than small conventional banks. In another strand of the empirical literature there is some evidence of the high resiliency of Islamic banks compared to conventional banks during the crisis. In this respect, Beck et al., (2013) consider a sample of 22 countries where both Islamic and conventional banks operate over the period 1995-2009 and compare their business orientation. By focusing on their efficiency and asset quality, they found no evidence of one bank type superiority against the other. However, when they compare their business orientation during the historical crisis, by considering both country specific financial crisis and the global financial crisis, they found that Islamic banks are better capitalized, have lower non performing loan ratios and have higher assets quality compared to conventional banks. In the same strand of research, Hassan and Dridi (2010) examine the impact of the last global financial crisis on the profitability the assets and credit growth and external agency rating of Islamic banks and conventional banks in 7 MENA countries plus Malaysia over the period 2007-2010. They find evidence that Islamic banks are on average more resilient than conventional banks during the crisis. Finally, by considering the case of only one MENA country, and by applying a stress test, Elsiefy (2012) assesses the resilience of the Qatari banking sector by considering three risk types, credit risk, interest rate risk and foreign exchange rate risk by considering the case of 5 conventional banks and 3 Islamic banks over the period 2006-2010. He finds evidence that Islamic banks are less resilient compared to conventional banks in this country. Moreover, their results show that credit risk is the major source of vulnerability compared to the other two aforementioned risk types.

Our paper build on these two brand of literature by considering both efficiency and resiliency comparison between Islamic banks and conventional banks by considering a large sample including 15 countries within MENA over the period 2002-2009. First, bank efficiency measures are based on distance function models, hyperbolic distance function and radial output distance functions. The first model measures by how much an inefficient bank could increase its activities while in the same time it could also decrease its resources, a kind of profit efficiency measure. The second model allows only the improvement of the activities while still using the same level of bank resources, a common measure related to revenue efficiency. These two models have the advantage to provide measures of bank performances without imposing specific bank behavior assumption (i.e., profit maximization or revenue maximization) and using dual cost or revenue functions. Moreover, distance function model require only data on input and output quantities to evaluate banks performance. Unfortunately, most of the aforementioned banking studies using cost frontier, non-standard profit frontier or even DEA models to estimate profit efficiency use only proxy for inputs or outputs prices, which render the efficiency measures questionable. Second, resiliency measures retained for the comparison are a kind of business risk measure recently proposed by Chaffai and Dietsch (2015) to evaluate the bank resiliency of French retail banks. These authors evaluate business risk through simulations. Using frontier methodology, business risk is a measure of profit loss which would result from an important adverse shock on lending and non-lending bank activities. More precisely, we compare the observed profit distribution and the simulated one followed by an abrupt fall in bank activities. We evaluate the impact of the shocks according to two scenarios: when the banks are able to contract their resources, or are not.

3. Distance Function Methodology

Banks use financial and physical inputs to produce several services, loans, investments, and securities. Indeed, the usual production function cannot entirely describe the multiproduct production process or derive some efficiency measures. However, to evaluate bank performance, the economics literature proposes several synthetic indicators, technical efficiency measures, cost efficiency measures, and profit efficiency measures among others. These indicators can be constructed while imposing a strong behavioral assumption for the banks (i.e., cost minimization, profit or revenue maximization assumption). It is difficult to assume this kind of assumption when some banks are more active in maximizing profitability, like conventional banks, compared to other banks like public or Islamic banks where they may also be guided by other social objectives. Islamic banks focus on profit and loss sharing, which is not an objective for conventional banks. Moreover, estimating dual cost or profit functions require precise information on prices, so using a proxy for input or output prices may be problematic for the efficiency scores derived by these models. Non-behavioral models based on distance function models are commonly used methodologies to evaluate bank performance, avoiding the use of input prices. Several efficiency models have been recently developed: we distinguish between radial distance functions Färe R., Primont(1995), and non radial distance functions Färe et al. (1985), Cuesta and Zofio (2005). There are several distance functions, output oriented, input oriented, hyperbolic distance function and directional distance function Färe et al. (1985) commonly used to evaluate the performance of firms. Given a sample of inputs and outputs of banks, these functions project a bank into the frontier to derive a measure of its technical efficiency. We will focus in this paper on two distance function measures: the output distance function and the hyperbolic distance function. We do not use the directional distance model because it needs to fix a specific direction in order to construct the efficient frontier; hyperbolic distance function does not impose such assumption. The two proposed models offer a vision of the banks' efficiency in conducting their business and measure by how much they could increase their activities while using the same level of their resources and an alternative measure which allow the contraction of the resources. Figure 1 illustrates these measures according to the two distance functions retained, taking the particular case of one output and one input.

Bank A, inside the production possibility set below the curved line, which represent the production frontier envelop, is technically inefficient. This bank could be projected on the frontier to derive a measure of its efficiency score in several ways. First, it can be projected in

A’, by increasing its level of output while using the same input xA. Technical efficiency of this bank is yA/ yA’, this is the output orientation measure of technical efficiency. Second, we can project the bank on A” along the hyperbolic path AA”. In this case, it will increase its efficiency by expanding its output and in the same time by contracting its input. Technical efficiency is measured by the ratio yA/ yA”. Each distance function derives a specific level of inefficiency score, unless the bank is on the frontier (100% efficient), the case of bank B. For the hyperbolic distance function, any improvement in technical inefficiency of bank A would results in an increase of its profit coming from both the expansion of its revenues and the decline in its costs, while for the output distance function, bank A will just improve its revenue, input being fixed. Notice that the output distance function is dual to the revenue function while the hyperbolic distance function is dual to the profit function, Färe et al. (1995) and Cuesta and Zofio (2005).

Two commonly used methodologies are proposed to construct the frontier: parametric and non-parametric DEA methods. The first approach allows considering random errors terms, which are not under the control of the managers but the parameter estimates have standard errors and statistical tests on the technologies can be derived. The second methodology uses linear programming methods but do not allow such investigations. However, the parametric method needs to assume a particular functional form for the distance function, while the non parametric method is functional form free. We will retain the parametric approach in this study because it has the merit to distinguish between random phenomena that are not under the control of the bankers from bank inefficiency that is under their control. O’Donell and Coelli (2005) notice that the inefficiency level tends to be overestimated with DEA models because the frontier is biased. This issue is particularly important in this paper when we construct our bank business risk measure. Also, it is much easier to conduct usual statistical inference with the parametric approach with panel data structure.

The distance function is an interesting methodology to measure the efficiency of banking multiproduct outputs technology. Consider a vector of M outputs produced $Y=(y_1, y_2, ..., y_M)$ by a sample of banks which use a vector of K inputs $X=(x_1, x_2, ..., x_K)$. The production possibility set denoted T, is the set of all the combinations of outputs and inputs for which X can produce Y. For a particular bank which belongs to this set, the distance function projects this point to the frontier and is defined by:

$$D_{\delta}(Y, X) = \inf_{\theta} \left\{ \theta > 0, (\frac{\mathrm{Y}}{\theta}, \theta^{\delta}\ \mathrm{X}) \in \mathrm{T} \right\} \tag{1}$$

Where δ is equal 1 for the hyperbolic distance function model, 0 for the output distance function model.

Following Cuesta and Zofio (2005) the stochastic distance along a particular path to the frontier can be represented by a flexible translog functional form:

$$\begin{aligned} Log(\mathrm{D}_{\delta}) &= a0 + \sum_{j=1}^{M} \beta j Log(y_j) + \frac{1}{2}\sum_{j=1}^{M}\sum_{j'=1}^{M} \beta jj' Log(y_j) Log(y_{j'}) + \\ &+ \sum_{i=1}^{k} \alpha_i Log(x_i) + \frac{1}{2}\sum_{i=1}^{k}\sum_{i'=1}^{k} \alpha_{ii'} Log(x_i) Log(x_{i'}) + \\ &\sum_{j=1}^{M}\sum_{i=1}^{k} \gamma_{ji} Log(y_j) Log(x_i) + v \end{aligned} \tag{2}$$

v is the random error term, and D_{δ} is the unknown inefficiency term. The hyperbolic distance function should verify some regularity conditions, the most important is the almost homogeneous property which suggests, that if the outputs are multiplied by a certain proportion λ and the inputs deflated by the same proportion the distance to the frontier, i.e the efficiency score remains unchanged. For the output distance function case (δ =0) linear homogeneity with respect to the outputs imply that the efficiency score is the same if the outputs are multiplied by λ. According to this property, if we deflate the outputs and inflate the input by the first output y1 retained as the numeraire:

$$Log(\mathrm{D}_{\delta} / y_1) = \ln TL(y_i / y_1, x_j . y_1^{\delta}) \tag{3}$$

Given the homogeneity property, the estimable form of equation (3) is:

$$\begin{aligned} -Log(\mathrm{y}_1) = a0 + \sum_{j=2}^{M} \beta j Log(y_j / y_1) + \frac{1}{2}\sum_{j=2}^{M}\sum_{j'=2}^{M} \beta jj' Log(y_j / y_1) Log(y_{j'} / y_1) + \\ + \sum_{i=1}^{k} \alpha_i \left[Log(x_i) + \delta Log(y_1)\right] + \frac{1}{2}\sum_{i=1}^{k}\sum_{i'=1}^{k} \alpha_{ii'} \left[Log(x_i) + \delta Log(y_1)\right]\left[Log(x_{i'}) + \delta Log(y_1)\right] + \\ \sum_{j=2}^{M}\sum_{i=1}^{k} \gamma_{ji} Log(y_j / y_1)\left[Log(x_i) + \delta Log(y_1)\right] + v + u \end{aligned} \tag{4}$$

Where $u = -Log(\mathrm{D}_{\delta}) \geq 0$. Technical details are provided in Cuesta and Zofio (2005). Notice that equation (4) is a common stochastic frontier model which could be estimated by maximum likelihood method. Technical efficiency level u could be estimated according to the conditional method of Jondrow et al. (1980), see details in Kumbhakar and Lovell (2000). Notice also, that whatever is the numeraire retained to deflate the outputs, the efficiency score is the same unless the likelihood function does not converge.

The methodology used by Chaffai and Dietsch (2015) for the directional distance function to measure bank business risk is adapted to the hyperbolic distance function case. The main idea according to this methodology is to use historical extreme observed situations in terms of profit loss from the industry in order to simulate their impact on the overall profit within the industry. As mentioned in Chaffai and Dietsch (2015), “shocks imply a decrease in profits which corresponds to an increase of the distance value. In other words, for a given bank, and a given output’s volume shock, the increase in distance represents the decrease in profits owing to the decline in the outputs’ volume.”

We illustrate in Figure 2 the steps used to construct the business risk measure for the case of a frontier model with one output and one input. Step 1 constructs the initial frontier by projecting each firm on the frontier along the hyperbolic curve, bank A is projected to A* on the frontier and efficiency scores are derived. In a second step, we apply a random shock on the activity of each bank, let for example a reduction of the output by 20%, point A will move to point A^s, while bank B is moved to point B^s according to another random shock. The shock distribution is obtained by sample drawing in the first percentile (10%) of the inefficiency profit distribution obtained in Step 1, in other words we consider extreme historical and exceptional situations which imparted an important loss on the observed banks profit during the observed period 2002-2009. In step 2, the shocked points which are plotted with hollow circles in the Figure 2, are then used as new production possibility sets to estimate a new frontier, called shocked frontier. In step 3, we measure the distance between the two frontiers as a measure of business risk, the distance A* A^{s*}, the lower is the distance between the two frontiers, the higher is the resiliency of the bank to a hypothetical reduction in its activities. These exercises in step 2 and step 3 are replicated several times by the bank, the business risk measure being the upper percentile of this profit loss distribution (1% or 5%), which can be interpreted as an earning at risk measure. This resiliency measure can be seen as a kind of stress test which assesses the vulnerability of each bank to exceptional events.

Summing up, the simulations we perform proceed in the following steps:

Step1

Estimate the hyperbolic distance function and derive the distance to the frontier for each bank. This step is also used to derive the first decile of the inefficiency bank scores, within this sub sample, only extreme historical shocks on the activities are retained for the simulations. Notice, at this step we will pool the two bank categories in the MENA region, which means that simulations of banking shocks are as large as possible within the studied period 2002-2009, including the financial banking crisis period 2008.

Step2

For each bootstrapping experience, b=1,2,..B, we draw a random sample of shocks in the first decile (Step1), and for each bank we reduce the outputs by the same amount. After constructing the new vector of shocked outputs we re-estimate the frontier. The number of replications used is B=1000[3].

Step 3

The business risk is obtained by evaluating for each drawing and for each bank the distance between the two frontiers (the initial frontier, estimated in step 1, and the shocked outputs frontier, in step 3), which provide a measure of business risk. More precisely we retain at each simulation the upper percentile, (1%, 5%), the average values of the B percentiles is the value of the business risk (earning-at-risk).

Let us mention that we consider three cases: the first one is to apply a shock on total loans only; the second scenario considers the shock on the other non-lending services (commissions and investments etc.), the business model retained assumes two outputs produced. Finally we evaluate the impact of the same shock on the two activities. This exercise is interesting because it allows estimating the magnitude of a sudden deterioration of a specific activity on the business risk of each bank type and its resiliency. Moreover, we consider two illustrative scenarios: the first one allows banks which face a deterioration of activities to adjust cost (hyperbolic distance), the second scenario is to evaluate the bank resiliency where adjusting costs is not possible (output distance).

4. Empirical Results

To conduct a comparative analysis, we consider a sample of 1683 observations in the MENA region using Bankscope data. The sample includes 262 banks in 15 countries over the period 2002-2009. The country list (with the number of banks between parentheses) is: Algeria (14), Bahrain (22), Egypt (27), Iraq (7), Iran (19), Jordan (13), Kuwait (15), Lebanon (41), Morocco (11), Oman (6), Qatar (11), Saudi Arabia (11), Tunisia (18), United Arab Emirates (24) and Yemen (10). In total, the sample is an unbalanced panel of banks which have been classified in two categories according to their activities: Commercial banks (1388 observations, 262 banks), and Islamic banks (2 observations, 50 banks). Whatever their stream, these banks compete in the same markets, and have different market shares within each country. Also, we retain the intermediation approach for the definition of the outputs and the inputs to evaluate the efficiency performances of these banks. This choice is dictated by the lack of more detailed data on the number of accounts or the number of loans by bank, and also by the fact that most of the comparative studies between banks use this approach, so our results could be compared to most of these studies. We assume that the banks use three inputs: labor measured by personnel expenses, physical input measured by book value of fixed assets, and financial input measured by interest expenses to produce two kinds of outputs, lending activities measured by total loans, and all other financial services (commissions, trading, investments), measured by other earning assets. All the monetary variables have been deflated by each country price index,

[3] In fact the number 1000 is the total net number of simulations for which the likelihood function converge.

2000 being the base year. Table 1 provides the descriptive statistics pooled for all years and banks by bank type. On average Islamic banks produce more loans but less other non-lending services compared to commercial banks. Furthermore, their physical and financial inputs are higher compared to the other banks. The average total assets of Islamic banks are slightly greater (17.6%) than commercial banks. Preliminary efficiency ratios and financial ratios, net income to total assets and profit to total assets ratio suggest that Islamic banks are more profitable in terms of average income (+25%) and profit (+33%). At the same time, Islamic banks in the sample have higher equity ratio and higher Z-score, which suggests that the sampled banks have on average lower risk of insolvency, this result is in line with Beck et al. (2013).

In order to compare bank efficiency according to their type, we estimate both output oriented distance function and hyperbolic distance. In other words, banks which are efficient and active in providing maximum services are not necessarily producing them with great vigilance with respect to their costs. The two definitions have been retained in particular to evaluate the impact of gross shocks on bank activities with respect to their income and also their profit. So it is important to test for the assumption of a common technology according to the banking type.

We have estimated stochastic hyperbolic and output distance functions according to equation (4). The model includes country dummy variables to take account of environmental and regulation differences and the trend to take account of the shift of the frontier due to technical progress. In the stochastic specification, we assume that the inefficiency term follows a half normal distribution, which is one of the most popular used distributions in stochastic frontier modeling. Likelihood ratio test is conducted in order to test for the assumption of a common technology. Under the null hypothesis, the two banking streams are assumed to share a common technology (i.e., the same frontier), while under the alternative the technologies of each bank type has its own technology frontier. We estimate a stochastic frontier for the pooled sample, (under the null), and then a stochastic frontier by banking stream, then we derive the LR test statistics. Results presented in Table 2, reject the common technology assumption at 1% of significance level, so the technologies used are likely to be different across the two bank groups. In other words the technology used to transform resources into financial services differ between Islamic and conventional banks. Moreover, this result is robust to the model retained to represent the technology (i.e., the specification of the distance function when we replace the time trend by temporal dummies). Meta frontier models can be used to decompose global efficiency scores into the technology gaps and net efficiency measures, Jhones et al. (2014), Bos and Schmiedel (2007), but this decomposition is not an objective of this paper.

4.1 Efficiency comparison

Estimating separate frontiers is not a useful tool to compare efficiency scores across bank categories since the reference sets are not comparables. So a common frontier has been estimated while dummy bank category has been introduced to capture potential technology differences, country dummies variables are also included to capture country regulations and environmental differences. We propose estimates of the efficiency scores according to these two different orientations (i.e., contraction of inputs and expansion of outputs), the hyperbolic distance function model, and by only allowing expansion of the outputs, the output distance model. For both orientations, the same stochastic translog frontier has been estimated, and a half normal for the inefficiency distribution has been assumed.

4.1.1 Hyperbolic efficiency measure

The general pattern that emerges in Table 3 is that commercial banks are slightly more efficient (87%) than Islamic (86.2%), but the t-test of the mean difference in efficiency scores is significant. The mean technical efficiency score by bank is close to 86-87% whatever the bank type is. So, during the studied period, MENA banks could on average decrease their resources by about 16-15% and in the same time expand their activities by (13%-13.8%)[4], which could render them more profitable. We have also evaluated bank efficiency according to their size, some empirical literature have evidenced higher efficiency of large banks which has been explained by scale economies, scope economies or market structure. This issue is particularly important since bank categories in MENA differ across countries and size. We construct four subgroups according to the distribution of total assets in the sample, small (<500 millions), moderate (500-1 Billion) large (1-2 Billions), very large (>2 Billions). Some differences in efficiency by bank size prove to be significant in particular for large and very large banks for commercial banks, only very large banks for Islamic banks. Within these classes which include 67.3% and 53.2% of the sampled commercial and Islamic banks respectively, commercial banks outperform Islamic banks. This result suggests than the challenge of Islamic banks in MENA is with very large commercial banks which seem to have an advantage.

We also report the efficiency across country and by bank type in Table 4. Islamic banks are the less efficient in Kuwait, Syria and Bahrain, with an efficiency score close to 80-83%, a level below the average efficiency score of Islamic banks in the region. While Tunisian, Jordanian, Egyptian and Yemenite Islamic banks have the highest level of technical efficiency 92-90% in average. This result is in line with the previous result, since in these countries Islamic banks have a very small size. Islamic banks dominate commercial banks in 8 countries, Tunisia (+5%), Jordan (+4%), Lebanon and Egypt (+3%), Saudi Arabia (+2%) and Yemen (+2%), and Yemen (+7%), United Arab Emirates and Iran (+1%). However, commercial banks outperform Islamic banks in 4 countries: Kuwait (+10%), Bahrain and Syria (+4%), Algeria (+1%), and they are equally efficient in Qatar. This result suggests that there is no evident conclusion in favor of the superiority of one bank type over another, due to country heterogeneity, even if we consider a more homogeneous country group, the (GCC) group of countries for example. Indeed, the dominance of Islamic banks in terms of efficiency is mitigated; compare for example Qatar and Saudi Arabia to Bahrain or Kuwait.

4.1.2 Output oriented efficiency measure

For the output oriented model, the efficiency scores represent the percentage by which a bank expands its activities while using the same level of inputs. On average the average efficiency score is equal to 72.7%, in the overall region, banks activities could be expanded by 27.3% with the same resources whatever is their bank group. As reported in Table 3 commercial banks are slightly more efficient than Islamic banks (+1.3%), the difference being higher (+2.6%) for very large banks. Some differences in the efficiency scores are found across country and bank type, Table 4.

If we compare the two inefficiency measures, revenue inefficiency is much higher than profit inefficiency, which means that on average bank revenues could be much more expanded than profit for inefficient banks. Large commercial and Islamic banks and very large banks are more efficient than small banks. Moreover, by size class, there is significant difference in technical efficiency only between large Islamic banks and commercial banks. This result is consistent with our assumption that comparing Islamic and conventional banks depends on the efficiency measure retained and also on bank types. However, the correlation coefficient between the efficiency scores is quite high, which suggests that bank managers which are efficient in terms of maximizing revenue are also efficient in maximizing profit.

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[4] As shown by Cuesta and Zofio (2005) the proportional change for an inefficient bank to reach the frontier is not the same for inputs or the outputs. According to the level of the efficiency score D_H, the proportional contraction of inputs is (1- D_δ) and the expansion level of outputs is (1/ D_δ).

However, there are significant differences between the two efficiency measures across countries, and also between Islamic and the two other banks categories as reported in Table 4 and figure 3 and 4.

To sum up, size seems to have a positive and a significant impact on bank efficiency for both efficiency models. This result suggests that in the MENA region, regulators should encourage small and middle sized banks to increase their size in order to benefit from scale economies and increase their efficiencies.

4.1.3 Bank resiliency comparison

We also compare the business risk of the two bank groups to a potential reduction in their activities. The methodology is based on applying some important shocks on the banks activities, derived from the historical gross shocks through simulations, in order to evaluate the business risk of these banks. The gross shocks distribution is obtained from estimating a common frontier, (hyperbolic distance function), and considering the 10% least inefficient situations. Replications within this distribution are then used to evaluate the impact of these potential shocks on each bank category. Recall that our previous results find differences in the technologies used, so for all the simulations conducted, specific frontiers have been estimated for each bank category in order to evaluate their business risk. So any differences in the bank resiliency will be attributed to the bank type of business instead of the impact of the shock itself. Table 5 reports the results of our resiliency measure for the overall sampled banks and also by size class.

Figure 5, illustrates the initial efficiency profit distribution by bank type. The first decile varies between 0.44 (the lower level obtained by a commercial bank in Algeria) and 0.83 (a score obtained by several banks, the red line in Figure 5). Let us mention that these exceptional situations within this decile have been observed both by commercial banks and by Islamic banks, which means that our historical shocks will not be restricted to a specific type of bank group. Moreover, most of the countries (except Oman) belong to the first decile of the extreme situation for which our business risk measure will be evaluated, which suggests that the business risk measure is based on most of the exceptional historical events which have affected the sampled banks in the MENA region as a whole.

Several scenarios have been considered with two cases in order to evaluate banks business risk, the difference focus on the possibility to the banks which face an abrupt reduction in its business activities to adjust costs or not. We evaluate the business risk by bank type, commercial versus Islamic with three possible scenarios, an abrupt reduction in loans activities alone, an abrupt reduction in all other non-loan activities alone and finally an abrupt reduction in both activities. This exercise will permit us to evaluate the business risk by bank activity.

If we consider the general case where banks are able to adjust costs (the first scenario), the simulations reported in Table 5, evaluate the business risk to (13.16%) for commercial banks (24.67%) for Islamic banks. These scores correspond to the potential decrease in total profit evaluated at the 5% percentile of the profit loss distribution. This result suggests that Islamic banks are much less resilient than commercial banks for a global shock on all banks activities. Moreover, some differences in bank resiliency by bank activity and across bank groups are found. Indeed, when shocks are applied to non-lending activities (commissions, investment, and trading) the risk is even higher for Islamic banks (22.79%) compared to commercial banks being the most resilient (7.26%). Finally, the resiliency to lending activities suggests that Islamic banks (14.63%) are also less resilient than commercial banks (12.02%). Summing up, Islamic banks are less stable when shock impact non-lending activities, while commercial banks are less stable when the shocks affect lending activities. The conclusions are robust when we take the lower percentile 1% to evaluate the business risk. Moreover, the banks' business risk increases when the costs are more rigid (i.e., quasi fixed), whatever the bank group is.

According to this second scenario, the banks which do not have the possibility to adjust their costs rapidly when they face a strong reduction in their activities, for example through a staff redundancy arrangement, by closing some non profitable branches or illiquid assets or when the interest rates are fixed. In other words, in case of extreme shocks on the lending and non-lending activities, the banks are not able to reduce their operational and financial costs according to this scenario. In this case both bank types are highly less resilient: (24.82%) for commercial banks and (30.02%) for Islamic banks, about two times more important compared to the first scenario with cost adjustment possibilities.

This result is not consistent with that of Beck et al.(2014) and Cihak and Hesse (2010) who found that Islamic banks are more stable in terms of bank insolvency. One possible explanation is that as mentioned by Beck et al. (2013) our measure of bank resiliency is based on evaluating disaggregated data on specific products and not on a global effect by considering specific financial ratios. Moreover, our comparison is based on a much larger sample of banks in the region and focuses on business risk. However, our results seems consistent with the one obtained by Chaffai and Dietsch (2015) who, using the same methodology to evaluate business risk, found that a shock on lending activities causes the highest decrease in profit of the French retail banks. They also found that the business risk is sustainable when the banks are not able to adjust their costs in the short run. Moreover, our results are therefore in line with those of Elsiefy (2012) who found evidence that credit risk is the major source of bank vulnerability for both Islamic and conventional banks in Qatar, applying the stress tests methodology. They also found that Islamic banks are less resilient than conventional banks in this country.

Another important issue investigated is the question of bank resiliency and its link to the size of the banks. We reconsider the simulation exercise and evaluate the business risk by bank size according to the definition of the size classes used previously. The results reported in Table 5 according to the first scenario with possibility of cost adjustment, show evidence that large banks are much more resilient than small banks for Islamic banks or commercial banks. This result is also consistent under the scenario of separate shocks on lending or non-lending activities and with or without cost adjustments. This result is partly in line with the one obtained by Cihak and Hesse (2010), who found that large Islamic banks tend to be less stable than large commercial banks; but we did not find that small Islamic banks are more stable.

5. Conclusion

Our aim in this paper has been to compare the performance of Islamic banks to conventional banks in MENA, during the period 2002-2009, and to evaluate their business risk. Performance is evaluated according to parametric stochastic frontier modeling using distance function methodology, where both profit and revenue efficiencies are investigated. Efficiency comparisons are made by allowing banks to improve their activities with or without possible contraction of their resources, which provide two different measures of technical efficiency. First, we test for the common technology assumption which has been rejected, suggesting that Islamic banks are using different technologies compared to conventional banks. Significant differences in technical efficiencies by bank streams have been evidenced, but some differences are found with size, in particular large commercial banks outperform small and medium sized banks in the region, and also some differences have been evidenced in some countries. It is also found that most of the bank inefficiencies in the studied sample are coming from revenue inefficiencies instead of profit inefficiencies. In other words, to improve their efficiencies these banks need to reinforce and develop their activities instead of reducing their costs. The comparison also incorporates an important issue related to the bank resiliency comparison through evaluating their business risk. Through simulations, by evaluating the impact of historical shocks on their business, Islamic banks are found to be much less resilient than commercial banks in the region. Moreover, their profitability may suffer much more from a deterioration of non-lending than from lending activities. Larger banks seem to be more stable than smaller banks. More research is needed to confirm or reverse these findings. In particular, it seems that the issue of low resiliency of Islamic banks to a gross shock on their non lending activity compared to their lending activities remains an open issue for further research. Finally, comparing business risk resiliency, the bank measures used in this paper to stress tests remains an avenue for further research on bank resiliency.

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Figure 1: Distance Functions and Efficiency Measures

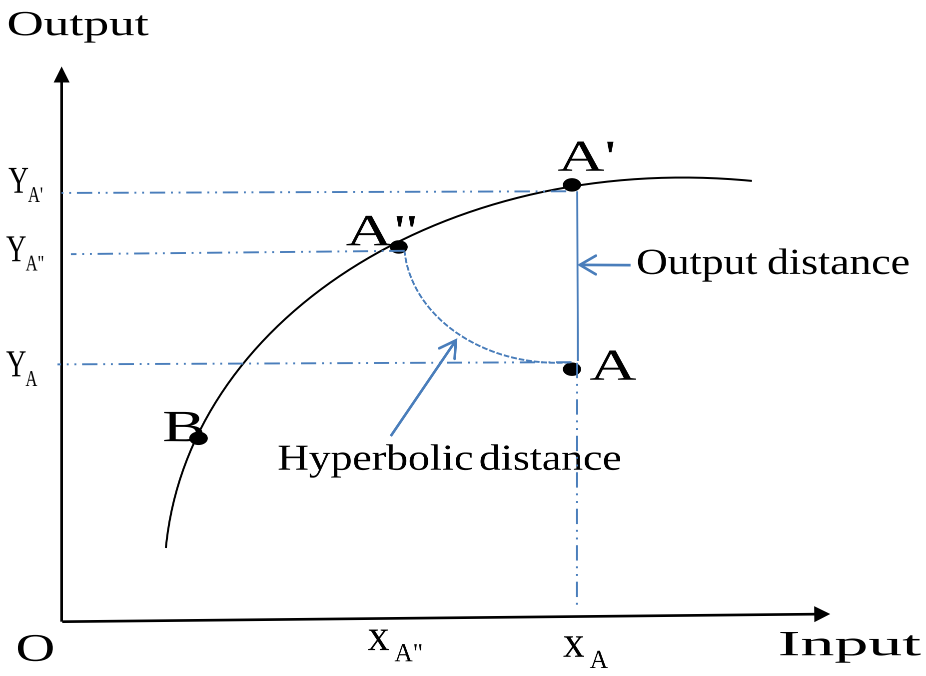

Figure 2: Distance Function and Bank Resiliency Measure

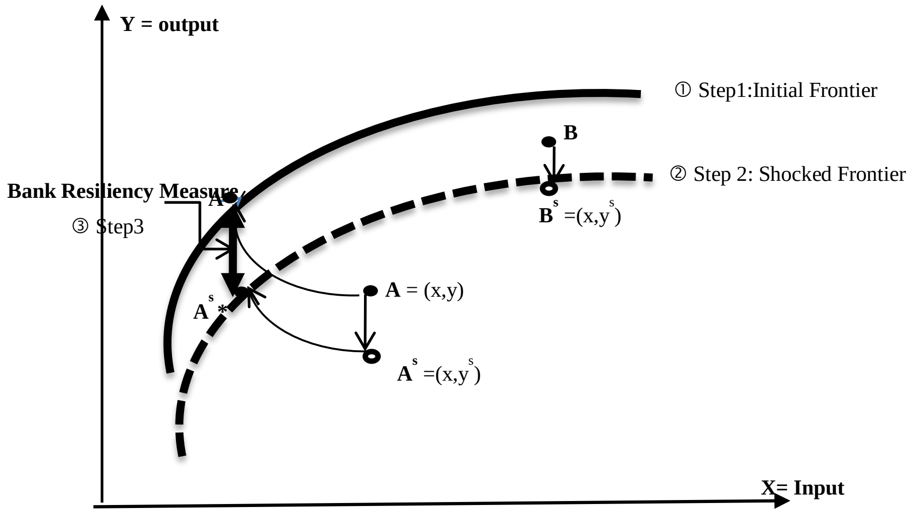

Figure 3: Average Efficiency Score by Country for Commercial banks

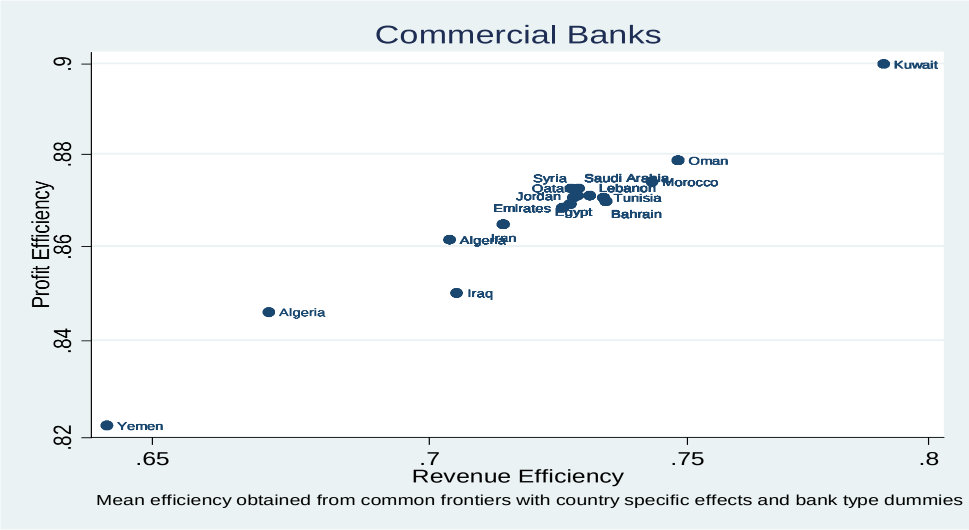

Figure 4: Average Efficiency Score by Country for Islamic Banks

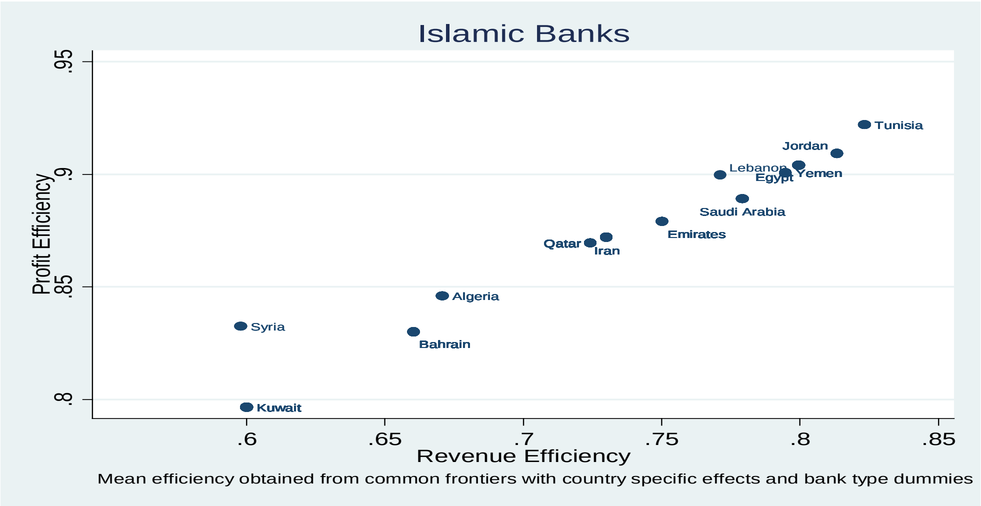

Figure 5: Box Plot of the Profit Efficiency Distribution by Bank Type and Country

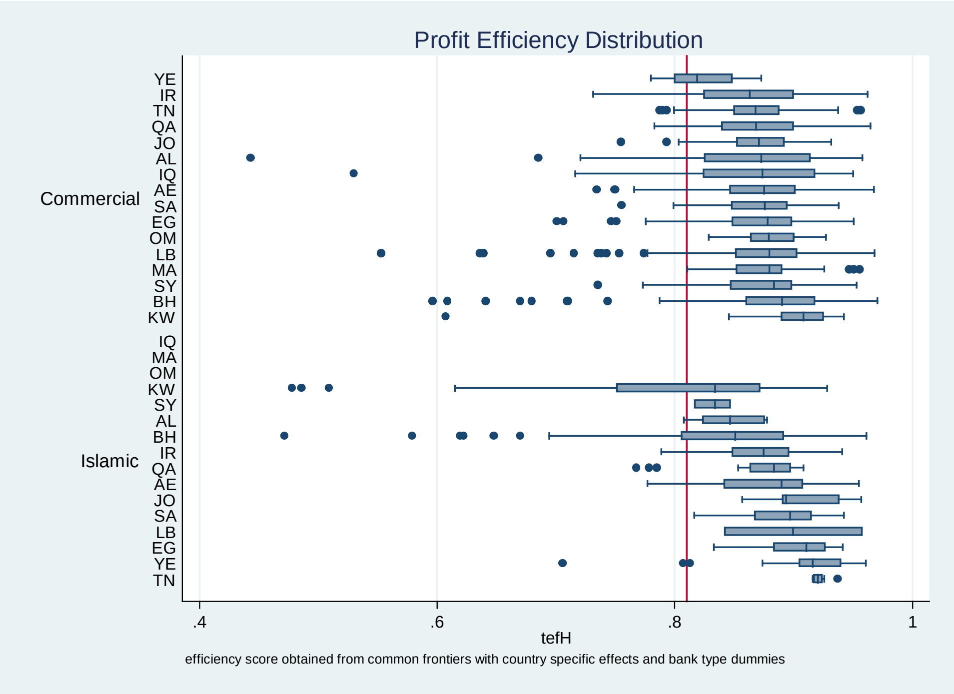

Table 1: Descriptive Statistics

Variables	Commercial Banks		Islamic Banks		t-test (mean-difference)
	Mean	sd	Mean	sd	p-value
Loans (y1)	3091.5	5727.9	4376.6	6526.5	0.000 ***
Other earnings (y2)	2353	3926.7	1833.5	2675.3	0.03 **
Personnel expenses (x1)	45.8	70.1	72	109	0.000 ***
Book value (x2)	74.6	186	249.7	489.1	0.000 ***
Interest (x3)	170.6	320.4	209.2	340.1	0.063 *
Total assets	6155.9	10006.6	7242.2	2243.6	0.092 *
Total income/ total assets	0.08	0.03	0.1	0.06	0.000 ***
Profit/total assets	0.015	0.02	0.02	0.06	0.006 ***
Equity Ratio	0.13	0.11	0.21	0.24	0.000 ***
Z-score	3.11	1.71	4.86	4.16	0.000 ***
Number of obs.	1388		295		

Notes: All monetary variables are in Billions of US dollars.

Table 2: Likelihood Ratio Test for Common Frontier Assumption

	Hyperbolic Distance (Log L)	Output Distance (Log L)
Pooled sample Banks	493.94	-677.22
Commercial Banks	579.7	-408.75
Islamic Banks	93.94	-107.37
LR Test Statistics	358.61***	322.20***
Degrees of freedom	66	66

Notes: (***) significant at 99% level, country specific effects are included and time trend in the frontier. Log L is the log likelihood function

Table 3: Technical Efficiency by Bank Category and Size in %

Efficiency Measure	Commercial	Islamic	t-test
Small			
Hyperbolic D. (Profit)	84.8	87.4	ns
Output D. (Rev)	65.9	67.9	ns
# obs	269	51	
Medium			
Hyperbolic D. (Profit)	87.5	86.3	ns
Output D. (Rev)	73.2	72.6	ns
# obs	185	38	
Large			
Hyperbolic D. (Profit)	87.1	85.9	*
Output D. (Rev)	73.4	71.4	ns
# obs	218	44	
Very Large			
Hyperbolic D. (Profit)	87.7	86.7	***
Output D. (Rev)	75.3	72.7	***
# obs	717	157	
All Banks			
Hyperbolic D. (Profit)	87	86.2	**
Output D. (Rev)	72.9	71.6	*
# obs	1388	295	
Spearman-Correlation(Output-Hyperbolic)	96.8***	97.9***	

Notes: t-test is the equality of means test result (one tailed test), * ,**,*** significance level,(90%, 95% and 99% respectively; ns, not significant)

Table 4: Technical Efficiency across Country

Country	Bank-Type	Hyperbolic D. (Profit) Mean	min	max	N	Output D. (Revenue) Mean	min	max	N
Algeria	Commercial	0.86	0.44	0.96	71	0.7	0.1	0.93	71
	Islamic	0.85	0.81	0.88	7	0.67	0.6	0.75	7
Bahrain	Commercial	0.87	0.6	0.97	73	0.73	0.28	0.94	73
	Islamic	0.83	0.47	0.96	57	0.66	0.15	0.93	57
Egypt	Commercial	0.87	0.7	0.95	186	0.73	0.4	0.92	186
	Islamic	0.9	0.83	0.94	13	0.8	0.64	0.89	13
Iran	Commercial	0.86	0.73	0.96	57	0.71	0.48	0.93	57
	Islamic	0.87	0.79	0.94	56	0.73	0.56	0.89	56
Iraq	Commercial	0.85	0.53	0.95	16	0.71	0.21	0.89	16
	Islamic	-	-	-	-	-	-	-	-
Jordan	Commercial	0.87	0.75	0.93	89	0.73	0.47	0.86	89
	Islamic	0.91	0.86	0.96	13	0.81	0.7	0.91	13
Kuwait	Commercial	0.9	0.81	0.94	54	0.79	0.27	0.89	54
	Islamic	0.8	0.48	0.93	37	0.6	0.17	0.86	37
Lebanon	Commercial	0.87	0.55	0.97	296	0.73	0.2	0.94	296
	Islamic	0.9	0.84	0.96	2	0.77	0.63	0.91	2
Morocco	Commercial	0.87	0.81	0.96	61	0.74	0.61	0.9	61
	Islamic	-	-	-	-	-	-	-	-
Oman	Commercial	0.88	0.84	0.93	43	0.75	0.64	0.84	43
	Islamic	-	-	-	-	-	-	-	-
Qatar	Commercial	0.87	0.78	0.96	50	0.73	0.48	0.93	50
	Islamic	0.87	0.77	0.91	20	0.72	0.5	0.81	20
Saudi Arabia	Commercial	0.87	0.76	0.94	72	0.73	0.5	0.88	72
	Islamic	0.89	0.82	0.94	12	0.78	0.61	0.89	12
Syria	Commercial	0.87	0.74	0.95	34	0.73	0.44	0.92	34
	Islamic	0.83	0.82	0.85	3	0.6	0.57	0.63	3
Tunisia	Commercial	0.87	0.79	0.96	126	0.73	0.52	0.92	126
	Islamic	0.92	0.92	0.94	8	0.82	0.8	0.86	8
United Arab Emirates	Commercial	0.87	0.73	0.97	136	0.73	0.43	0.9	136
	Islamic	0.88	0.78	0.95	46	0.75	0.55	0.91	46
Yemen	Commercial	0.82	0.78	0.87	24	0.64	0.58	0.75	24
	Islamic	0.9	0.71	0.96	21	0.79	0.43	0.91	21

Table 5: Bank Business Risk Measures to Gross Shocks in MENA (2002-2009)

Scenario	Bank Size	Bank type	Percentile	Resiliency to lending services	Resiliency to other non lending services	Resiliency to all services
	Small	Commercial	5	12.94	9.14	13.39
			1	16.06	11.56	14.41
		Islamic	5	14.77	28.11	28.22
			1	17.19	39.65	32.96
		Commercial	5	11.9	7.71	13.16
	Medium		1	14.3	8.97	14.17
		Islamic	5	16.38	22.66	24.35
			1	17.99	25.17	25.55
		Commercial	5	12.04	6.57	13.12
	Large		1	13.41	6.97	13.65
		Islamic	5	14.26	20.15	23.6
			1	17.04	22.21	24.56
With cost		Commercial	5	11.91	5.94	13.59
Adjustment	Very large		1	12.67	6.7	22.71
		Islamic	5	13.54	18.95	22.71
			1	15.75	22.9	23.94
		Commercial	**5**	**12.02**	**7.26**	**13.16**
	All Banks		**1**	**13.87**	**9.23**	**13.92**
		Islamic	**5**	**14.63**	**22.79**	**24.67**
			1	**17.33**	**28.18**	**28.39**
		Commercial	5	24.52	18.67	25.07
			1	30.17	23.18	26.88
	Small	Islamic	5	28.13	33.55	28.33
			1	32.53	43.84	31.47
		Commercial	5	22.55	15.68	24.57
			1	27.11	18.58	26.27
	Medium	Islamic	5	31.2	26.26	27.13
			1	33.83	30.6	28.95
		Commercial	5	22.9	13.61	24.63
	Large		1	25.41	14.53	25.34
		Islamic	5	26.72	22.47	26.6
			1	32.32	25.78	28.79
Without cost Adjustment	Very large	Commercial	5	22.66	12.5	24.8
			1	23.93	14.26	25.56
		Islamic	5	25.73	19.92	26.31
			1	29.73	28.35	28.33
		Commercial	**5**	**22.86**	**14.92**	**24.82**
	All Banks		**1**	**26.17**	**18.89**	**26.03**
		Islamic	**5**	**27.75**	**25.12**	**26.97**
			1	**32.76**	**33.95**	**30.02**