Capital Adequacy Ratios, Efficiency and Governance: a Comparison Between Islamic and Western Banks

Lucia Dalla Pellegrina*

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Abstract

The profit and loss sharing principle that is peculiar to Islamic finance reformulates the allocation of risk between stakeholders. Since in Islamic banks depositors are closer to stockholders in terms of residual claiming on profits, the relationship between capitalization requirements and the performance of banks should in principle be weaker than in their Western counterparts. In this paper we first explore the nexus between capitalization and bank efficiency, no matter the type of bank (Islamic and/or Western). Second, we compare the relative impact of capitalization on the efficiency of different types of banks in order to provide evidence on the determinants of possible discrepancies. Results, obtained by means of a stochastic cost frontier analysis on samples of European-15 and Islamic banks during the period 1996-2002, show that the ratio of equity to deposits negatively affects inefficiency in both types of banks, but this effect is considerably undersized in Islamic banks as compared to European ones. This supports the reluctance that has accompained the proposal of capital adequacy ratios for Islamic banks in accordance to Basel Agreements.

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*Centro Paolo Baffi, Bocconi University, Milan, and University of MIlan-Bicocca, Italy. e-mail: lucia.dallapellegrina@unibocconi.it Tel. +39.02.5836.5335. Fax +39.02.5836.5343. I thank Paolo Colla, Eliana La Ferrara, David Llewellyn, Matteo Manera and Donato Masciandaro for useful comments on this paper. The usual disclaimer applies.

1 Introduction

Following the wave of the controversial debate on Basel agreements, some economists (Cornford, 2004; El-Hawary, 2004; Muljawan et al., 2004; Hussain, 2002; Chiuri et al., 2002) and financial institutions, such as the Islamic Financial Service Board (IFSB)[1], started discussing about the opportunity of extending bank capital adequacy ratios to Islamic banks.

A strong opposition has been encountered against those who are favorable to introduce minimum capital requirements. Some academics[2] claim that the requirement of capital adequacy is excessive and discriminating from the Islamic finance perspective, since the risk sharing nature of Islamic credit contracts is indeed, by itself, an efficient and suitable instrument of risk absorption.

Hence, the crucial point raised in this paper is wether capital ratios have to be imposed indiscriminately on every type of bank, or they need to be balanced on banks' operational setup and governance relationships.

On the one hand, in the Western model of banking, the contractual relationship that links shareholders to managers is clearly different from the one linking depositors to managers. In the first case, risk is somehow contemplated, while in the second, deposit contracts tend to insure both initial capital and nominal returns against the risk of bad management.

On the other hand, in the Islamic banking framework, the status of an investment depositor is closer to the status of a shareholder, since both are residual claimants on bank profits and also share losses, thus the latter is not necessarily supposed to insure the former. This peculiar feature in terms of the nature of contracts may imply a different impact of capitalization on banks' behavior.

As far as the Western model of banking is concerned, traditional theory on agency costs (Jensen and Meckling (JM), 1976; Myers (M), 1977, among others) states that the weight of equity, relative to other forms of funds provision could, under certain conditions, push managers towards an efficient behavior.

However, the answer provided by the theoretical approach to the optimal capital structure of firms is not univocally assessed (see for example Jensen (J), 1986). Empirical studies (Shrieves and Dahl, 1992; Editz et al., 1997) also provide ambiguous results.

Kwan and Eisenbeis (KE) (1997) and Huges and Moon (HM) (1995), shed some light on this debate arguing that it is necessary to recognize explicitly the concept of efficiency in the empirical models linking bank capital to risk and to distinguish between efficient and inefficient risk undertaking. Concentrating on this important element, their works provide evidence of a negative relationship between equity and X-inefficiency (à la Liebenstein, 1966) for the U.S. banking sector, and this should provide some support to the introduction of capital adequacy ratios at least within the Western banking system.

[1] As part of its response to Basel II the IFSB has issued standards on risk management and capital adequacy that are recommended for implementation in 2007.

[2] Obaidullah (2004), among others.

But it does not necessarily mean that capital ratios, when imposed to Islamic banks have the same benefits they have in the Western banking system. Benefits could be smoothed for several reasons. Among other effects, the increasing level of monitoring that can be obtained in Western banks by rising equity –and its positive influence on managers to perform– could be weaker where depositors are also interested in monitoring managers (this effect, for example, follows from JM (86)).

To our knowledge, in the literature there is no empirical work aimed at checking the relevance of this issue. In particular, there is no attempt to compare the impact of capitalization requirements in terms of efficiency on different models of banking.

In this paper, the impact of capitalization on bank efficiency is analyzed by means of stochastic frontier techniques (Aigner et al., 1977; Jondrow et al., 1882; Schmidt and Sickles, 1984) on a sample of European-15 and Islamic banks.

Results show that the reduction of inefficiency implied by a higher equity to deposits ratio is significant for both types of banks in the sample, but it is almost twice as weak for Islamic banks. This supports the idea that capital ratios are somehow effective in terms of efficiency, but they need to be targeted on each specific model of banking.

The paper is organized as follows: Section 3 illustrates the state of literature on efficiency and banking governance and in Section 3 we discuss its application to Islamic banks. In Section 4 we describe the dataset, and in Section 5 we explain the econometric techniques used for estimation of the efficiency frontier. Results are presented in Section 6. Finally, Section 7 concludes.

2 Efficiency and governance

Since the pioneering work of Modigliani and Miller (1958), academics have so far tried to find explanations for the non-neutrality of the choice between debt –deposits, in case of a bank– and equity.

The key problem raised by this literature is the moral hazard behavior of managers, which ends up in the theory of agency costs. Actually, since managers have interests that depart from those of shareholders –and, in the case of the banking industry, from those of depositors as well– they might have an incentive to waste firm resources rather than increasing firm value. However, the literature on this topic provides conflicting implications. In a broad sense, it follows two main directions.

On the one hand, JM (1976) and M (1977), among others, focus on the possible inverse relationship between the strong use of leverage and firm performance. The authors claim that a higher leverage also means higher agency costs due to the presence of conflicting interests between shareholders and debt holders. This moral hazard problem suggests that leverage may be negatively correlated with firms performance.

On the other hand, J (1986) points out that, when managers' rewards are dependent upon the dimension of banking assets, the banking activity could be expanded beyond its maximum level of efficiency. In this case, debt financing might raise the pressure on managers to perform, because it reduces their hazardous behavior by lowering the "free cash-flow" at the disposal of managers. Consequently, firms with a higher leverage should be the most inclined to improve their performance.

Nevertheless, a survey of the empirical literature on this debate (Short, 1994) shows a lack of consensus on the link between leverage and bank performance. However, two key elements may explain this divergence.

First, this literature uses various measures of performance, either basic accounting ratios or more sophisticated measures, such as total factor productivity indicators. Consequently, it can be argued that different conclusions can result from the differences in the measures of performance (Weill, 2002).

Second, this phenomenon may also be the result of the fact that many studies use unsatisfactory measures to evaluate corporate performance are well known. It is worth noting, however, that all studies were only performed on one country. Therefore, different conclusions may result from the influence of the institutional framework on the relationship (*ibidem*).

As previously mentioned, we follow KE (1997) and HM (1995) interpreting efficiency as a good measure of bank performance while measuring the effectiveness of capitalization. Indeed, low capitalization requirements appear to be a good proxy for bank failures, which may be originated by inefficient risk undertaking (Estrella et al., 2000; Beim and Calomiris, 2001).

In the following sections we empirically estimate the impact of capitalization on bank efficiency in both Islamic and Western banks using a stochastic cost efficiency frontier approach. This method interprets inefficiency as the diversion between actual expenditure observed for a bank and the minimum expenditure achievable in order to produce a certain output[3].

We pursue this task taking into account the fact that Islamic institutions might face different unitary costs or make a different use of inputs with respect to Western ones. For this reason, we do not try to compare the efficiency of Islamic and Western banks. Our task is instead to measure the impact of capitalization on efficiency within each group of banks.

Finally, a crucial point is that, in the banking framework, the traditional conflict between managers and shareholders has to be reconsidered in order to take account of another class of stakeholders –depositors– whose interests, in the Islamic financial system, are rather more similar to those of equity holders than to those of debt holders.

[3] In the empirical analysis output is considered net of problem loans (see next sections). Hence, a low output should capture, among other factors, inefficient risk undertaking.

3 Islamic bank contracts

Mudaraba and Musharaka constitute the twin pillars of Islamic finance. They are the typical profit and loss sharing contracts accepted by the Shariah.

On the one hand, the Musharaka principle is invoked in the equity structure of banks and is similar to the modern concepts of partnership and joint stock ownership. On the other hand, as far as depositors are concerned, the bank manages their funds to generate profits subject to the rules of Mudaraba. In this case, depositors are entitled to earn a share of profits on a pre-specified basis –they might also incur in losses– but are not allowed to participate to decisions concerning funds allocation[4].

Islamic deposits can be of four types: current accounts, saving deposits, investment deposits and some special investment accounts. As in the most part of Western countries, current accounts do not receive any remuneration and are exempted from losses. In all other cases, deposits are typically pooled by the bank under a Mudaraba agreement to provide funds to its customers.

Sometimes, Islamic bank contracts take the form of the so-called "two-tier" or "triple" Mudaraba principle. In this arrangement, the Mudaraba contract is extended to include three parties: depositors as financiers, the bank as an intermediary, and an entrepreneur who requires funds. Thus, the bank acts an entrepreneur when it receives funds from depositors and as a financier when it provides the funds to its customers, but without interfering with their investment decisions.

Hence, Islamic investment deposits yield a variable return which depend on the return on the pool of assets in which the customer's funds are invested by the bank. The replacement of returns on a fixed basis with a profit and loss share principles where the returns to the lender is in accordance with an agreed ratio of the outcome of the project financed, implies some peculiarities with respect to the Western financial system.

The main problem with profit and loss sharing remuneration principles comes from asymmetric information.

On the one hand, it is possible that borrowers receiving loans do not report the correct return of their investment in order to pay a lower profit amount to the bank. This problem has been deeply analyzed by Presley and Sessions (1994), who conclude that under imperfect information profit and loss sharing principles may allow a more efficient revelation of any informational advantage that the borrower may have over the bank. Thus, in an imperfect information setup, Islamic contracts may constitute a more efficient instrument than Western ones in order to achieve efficiency[5]. This does not mean that it is possible to

[4] See Lewis and Algaud, 2001 and Ariff, 1982, for details on these and other types of contacts.

[5] This does not mean that it is possible to compare the efficiency of Western and Islamic banks on a theoretical basis. In fact, Islamic banks seem to deal with strong imperfect information, often due to their lower disclosure. In this framework profit and loss sharing contracts should be more efficient than Western ones (they would reach a second best). However, Western contracts would constitute a first best only if information were perfect (otherwise they would represent a third best). But this is not always the case.

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On the other hand, (investment) depositors and equity holders are subject to a double agency problem. In addition to the imperfect information that the bank has on its borrowers' actions, they also may suffer from imperfect information concerning the bank's reported return on its investments. Thus, as Archer et al. (1998) point out, investment account holders are subject to "vicarious" monitoring by or on behalf of shareholders[6].

Now, turning to the general realationship between efficiency and governance, empirical studies (KE, 1997 and HNM, 1995) tested both the theories of JM (1976) and J (1986) assessing the prevailing strength of the former. It might be that, in general, monitoring can be effective in inducing an efficient managerial activity (JM, 1976, pp.127-128). In particular –apart from the case of current accounts– since Islamic banks depositors are residual claimants on profits, they will be deeply concerned about the behavior of managers ruling the bank and have incentive to monitor their choices.

The same should not be true for Western banks[7], where depositors have their capital –and also returns, as long as these are predetermined on the principal and not on the return of the project– insured. This practice could end up in a different impact of equity over deposits in Islamic banks as compared to Western financial institutions.

In particular, reducing leverage through higher capital adequacy ratios should in principle induce more monitoring and a high pressure on managers to perform in Western banks, while this effect may be considerably smoothed in their Islamic counterparts.

Finally, it is worth to point out that within the Islamic framework, equity and deposits should not be considered identical in any situation. In general, since under a Musharaka agreement the equity holder can interfere with the bank's activity, he/she is also entitled to a larger share of profits and losses with respect to depositors.

Hence, treating the Islamic capital structure of a firm –might it be a bank or not– does not simply reduce to the analysis of a Western type of firm where debt is absent. Therefore, even in Islamic banks, we would still expect some

[6] There are other monitoring devices used by depositors in Islamic banks. Khan and Mirakhor (1992) discuss about the possibility of having both direct and indirect control in these situations. The former realizes through some explicit restrictions on the contract (restricted Mudaraba), while the latter operates through implicit agreements, such as the threat of withdrawing sums or inducing a loss of reputation, that are even more effective in a highly trust-based environment, such as that of Islamic financial institutions, than in more anonymous contexts, as those of Western banks.

[7] Here we depart from the extreme case of bankruptcy or bank runs (for details on this topic, see Diamond and Rajan, 2000). Moreover, the presence of a Deposit Insurance in many Western countries tends to reduce depositors' willingness to monitor managerial activity.

different impact of equity, as compared to deposits, on bank performance.

4 The data

Our sample of Islamic banks (excluding mixed banks with Islamic services)[8] has been extracted from the database Bankscope for the period 1996-2002[9].

The original sample included 49 banks but, due to mortality and mergers, we had to drop 14 banks. Hence, the analysis has been carried out on 35 banks during the period 1996-2002 for a total of 245 observations.

As a representative sample of the Western banking system, data on European-15 banks[10] have been extracted for the same period of interest. In this case, the original sample included 8,017 banks but, again due to mortality and mergers, they have been reduced to 6,800.

More accurate details concerning the procedure followed in the empirical analysis to perform comparisons between the two blocks of financial institutions will be described in the next section.

Descriptive statistics reported in Table 1 show some differences and similarities between European and Islamic financial institutions. First, from the liability side, the average percentage of deposits in the period 1996-2002 in European and Islamic banks respectively, is 60 and 69 per cent of total liabilities, including equity and reserves (i.e., total assets).

Risk capital, on its turn, is 9 per cent of liabilities in the sample of Islamic banks and 7 per cent in the sample of European banks. The remaining part of liabilities is composed by certificates of deposit, bonds, and other sources of debt.

Second, from the revenue side, Islamic banks seem more willing to exert a traditional activity with respect to their European counterparts: in fact, net ordinary loans represent 50 per cent of total asset composition, against 28 per cent of other earning assets.

The situation is somehow different in the case of European banks, where net loans constitute only a weakly dominant fraction of the asset supply (46 per cent against 44 per cent represented by services, and 10 per cent of non earning assets). The same tendency is confirmed if we observe the off-balance sheet items, that are lower in Islamic banks (18 per cent of total assets) with respect to what takes place in Europe (25 per cent).

[8] The database does not allow to separate resources used for investments that are Shariah-compatible with those who are not within Western banks that also offer Islamic services. However, since these are typically large institutions, Islamic services should weight for a relatively small percentage of their revenues. We suppose that these do not provide large biases in our results.

[9] The selection criterion is exclusively based on data availbility at the time of collection.

[10] The reason why we choose European-15 banks is that they are part of a block of countries that are similar in terms of financial regulation. Moreover, banks established in these conuntries, seem more willing than others to accept Basel II principles of capital adequacy at the moment.

Third, Islamic banks seem to be less profitable than Western banks, since net averaged profits are 7 per cent of equity, while European banks show a ROE of about 10 per cent. This aspect concerning profit ratios is strengthened by the fact that earning assets are 78 per cent of total assets in Islamic banks, as compared to 90 per cent of European banks. Moreover, fixed assets as well are higher in Islamic banks (3 per cent of total assets) than in Europe (1 per cent).

Fourth, at a first glance, the excess of liquidity seems to represent a problem for Islamic banks, possibly reflecting a substantial rigidity of the interbank market and the consequent storage of a large amount of liquid resources for precautionary purposes. The ratio of liquid funds over total deposits and borrowing is indeed 35 per cent, as compared to 23 per cent in Europe.

Input costs are summarized in Table 2. Interest expenses[11], despite being not very different in both groups of banks, are slightly higher in Europe, and this perhaps can give an explanation for the larger use of deposits with respect to other funding instruments in Islamic banks (see again Table 1).

Moreover, some important differences emerge from the analysis of two other inputs adopted in the estimation of the cost frontier: fixed assets and employees.

The cost of fixed assets, that is depreciation, is higher in the group of Islamic banks (4.8 per cent), than in the European sample (2.8 per cent), although, as illustrated in Table 1, the use of fixed assets seems quite larger in the former group of banks than in the latter. Even the annual unitary staff cost is clearly higher for Islamic institutions (82 th. EUR) than for their European counterparts (66 th. EUR), which perhaps justifies a larger use of human resources in Europe (0.11 against 0.08 over total assets in mil. EUR, Table 1).

All the mentioned features suggest the presence of some sort of inefficiency in Islamic banks due to a possible incorrect use of inputs. On the one hand, despite the cost of fixed assets (depreciation) being higher than in Europe, Islamic banks make a massive use of this resource. On the other hand, staff seem to represent a considerable cost in the income statement of Islamic banks, even if our data do not permit to identify whether managers or employees are the primary source of this discrepancy as compared to European banks.

Bad loans and reserves are other important potential sources of inefficiency. Apparently, Islamic banks seem to retain a larger amount of reserves (406 per cent versus 53 per cent in European banks). However, it has to be reminded that the use of reserves in Islamic banks is quite different with respect to Western banks, since the mechanism of loss sharing, together with some volatility of returns on deposits, implies that a massive presence of reserves can be absolutely normal.

In the next section we describe the inefficiency measures used to perform the empirical analysis and the procedure followed, then we compare empirical results with the descriptive statistics presented above.

[Tables 1-2 about here]

[11] This is implicitly computed for Islamic banks.

5 Inefficiency measurement

There are many ways to measure inefficiency. The most frequently used criteria are the data envelopment models (DEA), the free disposable hull analysis, the stochastic frontier analysis (SFA), the thick frontier approach and the distribution free approach (DFA). The first two approaches mentioned are non-parametric techniques, while the remaining three are parametric methods[12]. Clearly, the preference of a technique over another depends on the type of study that is carried out.

An important issue concerns what type of inefficiency should be determined. Depending again upon the type of research, but also on data availability, one may want to estimate technical efficiency, cost efficiency or profit efficiency as well. For example, technical efficiency measurement requires data on input use and output provision, whereas the estimation of cost inefficiency requires information on input prices, output quantities, and total expenditure on these inputs. Thus, in general, it is not possible to say in advance which technique is more onerous in terms of information.

In the credit industry, for example, many studies note that banks devote a plenty of their revenues to rent and employees expenses, while others claim that a higher level of efficiency implies higher staff costs. This result might be driven by an an incentive argument. Thus, given data availability on prices, in this study it seems reasonable to opt for the estimation of cost inefficiency. This is particularly suited in the case of cross-countries comparisons, which closely resembles the aim of this work, since prices can strongly differ from one country/block of countries to another.

Among the class of non-parametric methods, DEA models are the most widely used to estimate inefficiency. However, since the DEA approach is deterministic, it embodies a strong assumption, meaning that all deviations from the minimum cost or from maximum output are due to inefficiency. For this reason, many studies, like the present, have been conducted using a parametric approach which allows for random shocks, meaning the SFA analysis (Aigner et al., 1977).

The main problem when dealing with the SFA approach is to separate the actual inefficiency component from other purely random factors affecting producers behavior. SFA might suffer from strong assumptions as well, especially when the econometric has to deal with the hypothesis required on the distribution of the inefficiency component and its independence from other factors determining producer behavior.

However, as in our case, the availability of panel data substantially solves this problem without needing to make any distributional assumption on the inefficiency components, while obtaining consistent estimates. Schmidt and Sickles (1984), among others, note that cross sectional models require that the inefficiency error component be independent from the regressors, although it is easy

[12] Berger and Humphrey (1997) report a nearly equal split between the use of parametric and non parametric techniques in the literature.

to imagine that inefficiency might be correlated with input or output vectors producers select. Another important drawback of cross sectional models is that the estimates they provide, although unbiased, can be inefficient. Again this problem can be solved through the use of panel data.

Moreover, the pioneering work of Jondrow et al. (1982) has helped disentangling the issue of separating inefficiency from pure random components in maximum likelihood estimation of cross sectional data. We will make use of their contribution as well in our panel data context.

The standard against which cost efficiency is estimated is represented by the cost frontier; thus an input-oriented approach is utilized, as opposite to the output-oriented approach which is used in the case of technical efficiency measurement. Besides data requirements, the two techniques differ in the number of outputs they allow to insert in the frontier. A great advantage of the input-oriented approach is that it admits situations in which firms produce multiple outputs, whereas the output-oriented approach requires that firms produce a single output.

Suppose that the deterministic component of the cost frontier of the bank i in year t, is described as follows:

$$c(\mathbf{y}_{it}, \mathbf{w}_{it}, \boldsymbol{\theta}) \leq E_{it} \tag{1}$$

where E_{it} represents the total expenditure incurred by the bank i in year t, $\mathbf{y}_{it}$ is a vector of outputs, $\mathbf{w}_{it}$ is a vector of input prices faced by the bank, and $\boldsymbol{\theta}$ is a vector of parameters to be estimated. Cost efficiency is defined by the ratio of minimum feasible cost to observed expenditure and it is clearly lower or equal than 1.

In this model, $\mathbf{w}_{it}$ includes three inputs and their relative cost: the unitary cost of capital to the bank (the profit or interest paid on deposits, excluded demand deposits), the unitary cost of fixed assets (depreciation) and the unitary cost of labor (staff expenses over the number of employees).

The vector $\mathbf{y}_{it}$ contains three outputs: properly Islamic products (such as Musharaka and Mudaraba for Islamic banks, or net loans in the case of Western banks), investment in other earning assets (such as leasing), and off-balance sheet transactions. Off-balance sheet transactions have been included among outputs since, as pointed out by Berger and Mester (1997), the Basel I and II risk ratios imply that these assets have approximately the same perceived credit risk, and are thus good substitutes, of directly issued loans.

Moreover, some studies assess the importance of controlling for financial capital (Clark, 1996, among others). Traditional measures of efficiency, in fact, fail to capture the risk of insolvency. This is clearly a serious shortcoming when dealing with financial institutions, since they should not only be efficient, but also prudent and solvent. Thus, given the importance of financial capital in this study, and according to the approach followed by some authors (Huges and Mester 1993; Maudos et al. 2002), we included equity in the functional form of the frontier as a net output in order to control for these features.

If we assume that the deterministic component of the frontier has a translog

functional form[13], then the stochastic cost frontier corresponding to the deterministic model given in equation (1) can be written as:

$$\begin{aligned}\ln E_{it} &= \beta_{0t} + \sum_m \alpha_m \ln y_{mit} + \sum_n \beta_n \ln w_{nit} + \\ &+ \frac{1}{2}\sum_m\sum_j \alpha_{mj} \ln y_{mit} \ln y_{mit} + \frac{1}{2}\sum_n\sum_k \beta_{nk} \ln w_{nit} \ln w_{kit} + \\ &+ \sum_n\sum_m \gamma_{nm} \ln w_{nit} \ln y_{mit} + \varepsilon_{it}\end{aligned} \tag{2}$$

where β_{0t} is the production frontier intercept common to all banks in period t and ε_{it} is the sum of a positive inefficiency component, u_{it}[14], and an idiosyncratic term, v_{it}. All the remaining terms represent the deterministic component of the translog frontier, $c(\mathbf{y}_{it}, \mathbf{w}_{it}, \boldsymbol{\theta})$. Equation (2) can be rewritten as follows:

$$\begin{aligned}\ln E_{it} &= \beta_{it} + \sum_m \alpha_m \ln y_{mit} + \sum_n \beta_n \ln w_{nit} + \\ &+ \frac{1}{2}\sum_m\sum_j \alpha_{mj} \ln y_{mit} \ln y_{mit} + \frac{1}{2}\sum_n\sum_k \beta_{nk} \ln w_{nit} \ln w_{kit} + \\ &+ \sum_n\sum_m \gamma_{nm} \ln w_{nit} \ln y_{mit} + v_{it}\end{aligned} \tag{3}$$

where $\beta_{it} = \beta_{0t} + u_{it}$.

The SFA assumes that v_{it} is a two-sided normal random noise component with zero mean and a standard deviation σ_v, while the u_{it} is a non-negative cost inefficiency component typical of each bank in each year. As we will see further on, some estimation techniques require additional assumptions on the specific functional form to be attributed to the cost inefficiency component, while others do not necessarily involve such hypothesis.

After having imposed the linear restrictions of degree one price homogeneity and other usual restrictions typical of the translog cost function[15], we estimated the coefficients u_{it} by means of three different techniques. The first and the second techniques are respectively a fixed effects model and a random effects model. As in the traditional panel data literature, random effects assume that in the specification (2) and (3) u_{it} is randomly distributed and thus independent from the regressors, while fixed effects allows u_{it} to be correlated with other regressors. Also other considerations concerning the literature on panel data hold true, including the usual trade-off between unbiasedness and efficiency,

[13] The use of the Cobb-Douglas has been criticized by some authors (Hasenkamp, 1976) due to its inadequacy, especially in presence of multiple outputs. As a consequence, many econometrics adopt the translog functional form in the estimation of the cost frontier.

[14] Note that inefficiency is time-variant in this specification, as it will be explained further on.

[15] See Kumbhakar and Lovell (2000) for further details.

although both models are consistent for observations on individuals and time that approach infinity.

The third technique is a maximum likelihood approach developed by Aigner et al. (1976) and later by Jondrow et al. (1982). Pitt and Lee (1981) also used this technique to estimate technical inefficiency in the context of panel data. However, the strong distributional and independence assumptions required even in a panel data context (see below), have induced us to compare inefficiency coefficients estimated by this maximum likelihood procedure with the two alternatives mentioned above, namely LSDV and random effects.

Moreover, in order to allow for time-varying cost inefficiency, we follow Lee and Schmidt (1993) by assuming that the u_{it} in equation (2) are specified as:

$$u_{it} = \beta(t) \cdot u_i \tag{4}$$

where the function $\beta(t)$ is represented by a set of time dummy variables[16].

The LSDV and the random effects models are estimated by means of a two-way error component regression[17]. In the first case (LSDV), time and bank dummy variables are simply included in the regression and the u_{it} are estimated as follows:

$$\widehat{u}_{it} = \left(\widehat{\beta}_t \widehat{u}_i\right) - \min_i \left\{\widehat{\beta}_t \widehat{u}_i\right\} \tag{5}$$

where $\min_i \left\{\widehat{\beta}_t \widehat{u}_i\right\}$ represents the β_{0t}, that is the production frontier intercept common to all banks in period t.

If instead we assume that the inefficiency component has constant mean and variance, and is not correlated with the regressors and with the random noise v_{it}, a random effect model is specified. In this case the estimation procedure is carried out by means of GLS.

The problem with this model is that the variances of the inefficiency terms and of the random shock are not known, but have to be estimated in order to replace the true values in the covariance matrix of the random component, so that the estimated covariance matrix allows to perform feasible GLS. Many estimators of these variances have been suggested by the literature: here, we use the method of Judge et al. (1988). Once the constant term and the parameters of equation (3) have been estimated, the $\widehat{u}_{it}$ can be retrieved from the residuals[18].

The maximum likelihood technique requires two basic assumptions: the first is that the random component and the inefficiency term must be distributed independently of each other and of the regressors. Moreover, besides the assumptions on independence, this approach requires additional hypothesis on

[16] Although other specifications have been proposed (Cornwell, Schmidt and Sickles, 1990; Kumbhakar, 1990), the one of Lee and Schmidt is more suitable for panels which do not have a very large number of observations, since it requires the estimation of $T-1$ additional parameters, where T is the total number of years in the sample.

[17] See Baltagi (1995) for further details.

[18] See Kumbhakar and Lovell (2000) for further details.

the distribution of the term u_i. Thus, we assume that the u_i has an half-normal distribution, i.e. $u_i \sim \left|N(0, \sigma_u^2)\right|$[19].

In order to separate the random noise from inefficiency, the model of Jondrow et al. (1982) suggests a solution by considering the expected value of u conditional on ε. The authors proved that the conditional distribution of u given ε is that of a normal, $N(\mu_*, \sigma_*^2)$, truncated at zero, where μ_*/σ_* contains both variances of u and v. Then, the expected value or the mode of this distribution can be used as point estimates of u_{it}.

The procedure followed to separate the two variances uses the information included in the expected value of u conditional on ε, and goes through three steps. In the first step OLS are to be performed in order to get the starting values for all the parameters. In the second and third steps the standard errors of u and v can be estimated with a maximum likelihood procedure, and the expected value of the distribution of u conditional on ε is used to obtain estimates of the u_i. Once the u_i has been estimated, u_{it} can be retrieved by means of (5).

The correlation between the inefficiency terms computed through the three methods on the sample of Islamic banks is illustrated in the Appendix [20]. Coefficients reported in Table A1 show a strong correlation between the three methods, in accordance with the results obtained by the empirical literature[21].

In the second stage of our procedure, estimates of the u_{it}, which are nothing but the logarithm of technical inefficiency, are used to examine the sources of inefficiency. Following Hussein (2004), we do this by means of another standard panel data model where the inefficiency components are now regressed against logarithms of inputs and equity.

Here, the specific-effect is related to the country and not to the bank for a simple reason: despite the advantage of producing consistent estimates, a potential drawback of panel data models is indeed that they might also capture the effects of all phenomena in the system (such as the regulatory environment) and country effects are thus used to clean estimates from possible institutional components.

The estimated equation (Tables 3-4) is the following:

$$u_{it} = \alpha_0 + \alpha_1 \mathbf{x}_{it} + \mu_i + \delta_t \tag{6}$$

where u_{it} are the previously estimated inefficiency components, μ_i are country-specific effects, δ_t are time-specific effects[22]. $\mathbf{x}_{it}$ is a vector of quantities of input/net output used to estimate the stochastic frontier, which obviously includes a measure of the impact of equity as compared to deposits, namely their

[19] Other hypothesis have been used on the distribution of the inefficiency component: truncated normal, exponential and Gamma and there are seval studies on the sensitivity of estimates to the distribution assigned (see for example Greene, 1990).

[20] We do not report any correlation for European banks since the comparison occurs through a simulation over a high number of sub-samples as it will be clear further on.

[21] Gong and Sickles (1989), for example, obtained similar results on a series of Montecarlo experiments.

[22] Note that the first period dummy in the sample together with one country dummy have been dropped from the regressors in order to avoid the dummy varable trap.

ratio. Moreover, in order to eliminate the effect of scale economies or diseconomies, we use fixed assets and staff variables over total assets. A measure of excess liquidity (liquid assets over total deposits and borrowing) is also included to take account of the interbank market effects.

Furthermore, in order to make the results computed from the set of 35 Islamic banks comparable with the output of a quite larger set of 6,800 European banks, we performed a simulation over 3,000 sub-samples of the latter. The experiment has been conducted following the same procedure described above for Islamic banks, where each sub-sample was represented by 35 European banks, randomly picked from the initial larger sample.

Finally, for each technique used (LSDV, random effects and maximum likelihood) to estimate regression (6), the distributions of the difference between the coefficient equity/deposits estimated through the simulation and the correspondent coefficient computed for Islamic banks are reported in Figures 1-3. Table 4 reports average coefficients of the simulation over the sample of European banks.

6 Results

From the estimates of equation (6) reported in Tables 3 and 4, it is possible to draw some original conclusions about the different use of inputs in Islamic and European banks.

Estimates provide evidence of a significant (at 1 per cent level of confidence) negative impact of equity over deposits on cost inefficiency in both sets of banks. Hence, reducing cost inefficiency through capital adequacy seems possible. Moreover, the impact of equity in European banks quite offsets that of their Islamic counterparts (0.178 , on average, against 0.107 in Islamic countries). This is also evident from Figures 1-3, where all the distributions of the difference in equity/deposits coefficients between European and Islamic banks are skewed to the left for all estimation procedures. Thus, the hypothesis that a higher use of equity has a weaker impact on Islamic banks inefficiency with respect to European banks seems to hold true. As discussed in previous sections, this result could be due to the possibility that a higher share of risk capital strengthens the monitoring effect on managerial operational activity. As a consequence, the profit and loss sharing features that assimilate depositors to shareholders imply a weaker discrepancy, in terms of monitoring incentives, between the figure of a shareholder and that of a depositor in Islamic banks.

[Tables 3-4 about here]

Moreover, Islamic banks inefficiency positively depends on the use of fixed assets (the parameter is significant at 10 per cent level only with the ML estimation procedure), while results are the opposite as far as the European banks are concerned. The adverse effect of fixed assets in Islamic banks might be due

to the different form of activity they carry out. As illustrated in Section 3, Islamic financial institutions are more keen to grant a traditional type of credit (borrowing-lending), which requires a high level of human capital, especially at the time of customers evaluation when the system is highly trust-based. Conversely, in the Western banking system, the weight of non-traditional financial operations (services), which involve a considerable use of technology, is continuously growing in the last decades.

Furthermore, in the Islamic system, trust carries such an important role, so that the use of human resources should be crucial to understand inefficiency. However, despite the activity of Islamic banks being strongly focused on reputation and interpersonal relationships, human resources appear to be quite far from efficiency requirements. In fact, the parameter associated with staff is indeed positive and significant at 1 per cent level of confidence.

The result is in line with Ahmad et al. (1998) who observe that staff members are not sufficiently qualified in the Islamic banking industry. The estimated parameter is also positive (although largely undersized) in the simulation performed on the European sample of banks. The reasons of the inefficiencies of the staff component in Europe are probably quite different from the ones described for Islamic institutions and possibly linked to a restructuring process that is involving the entire Western financial system, which is likely to take several periods of time to complete.

Finally, the measure of liquidity carries some surprising results, since it is negatively related to inefficiency, meaning that Islamic banks that accumulate a significant amount of liquid resources also operate under better efficiency conditions.

This might depend upon the rigidities that characterize the Islamic financial world: an excess liquidity can improve efficiency within the system because it reduces the high cost of resorting to costly short-term lending. However, this problem should probably be offset with the presence of a dynamic interbank market. In fact, results could be reverted with the introduction of an efficient interbank market in the Islamic banking system, which is certainly an interesting issue for future research. It is worth observing that a negative relationship between liquidity and inefficiency also occurs in European institutions, although the effect is weaker and perhaps arising from reasons that are completely different from those characterizing Islamic banks[23].

[Figures 1-3 about here]

[23] This adverse result could be the effect of an excessive reliability upon the interbank market and might reflect the extra-cost of continuously monitoring liquidity.

7 Conclusions

In this work we concentrated on a debated issue within the literature on Islamic banking, such as the requirement of capital adequacy ratios, in line with the recommendations introduced with Basel Agreements.

A number of studies on the topic of Islamic finance have long suggested that capital adequacy prerequisites could not be at the basis of an improvement, in terms of better risk management, from the perspective of an Islamic financial institution. The reason goes along with the argument concerning the different contract structure of Islamic banks, which is based on profit and loss sharing principles.

This principle, by reformulating the allocation of risk between shareholders and depositors, can basically act as an incentive for the latter to share the monitoring activity on managerial decisions with the former. This does not occur in Western banks, where depositors' capital –and also returns, as long as they are determined in advance– does not suffer, with few exceptions, from excessive risk undertaking.

Given this debate, here we focused on the impact of capitalization on cost inefficiency. Since Islamic depositors' interests are closer to shareholders' interests in terms of residual claiming on profits, the effect of capitalization should in principle be smoothed in Islamic banks rather than in their Western counterparts. For this reason, capital adequacy requirements might end up to be somehow redundant.

Results, obtained by means of a stochastic cost frontier approach aimed at analyzing inefficiency of both a sample of European-15 banks and a sample of Islamic banks during the period 1996-2002, show that the expected inverse relationship between capitalization and inefficiency is confirmed for both groups of banks, since the indicator of inverse leverage (equity/deposits) negatively affects inefficiency.

However, in line with the argument discussed above we observed that the effect described above is considerably undersized in Islamic banks as compared to European ones. Thus, empirical evidence provide a justification to the reluctance, from the point of view of some Islamic banks and academics, that has accompanied the proposal of capital coefficient revision in accordance to Basel I and II Agreements.

Finally, interesting conclusions can be drawn about a better use of inputs in Islamic banks: first, from the empirical evidence, a clear signal of inefficiency emerges from an insufficient role of staff members in Islamic financial institutions. This implies that Islamic banks should work in the direction of better selecting and training managers and employees rather than focusing recapitalization recommendations. Second, the excessive importance of liquidity in reducing inefficiency leaves room for future research issues in terms of an accurate analysis of instruments that make the Islamic interbank market of funds more flexible.

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Appendix

Correlation between estimation procedures:

The following table reports the correlation coefficients between fixed effects, random effects and maximum likelihood estimation procedures:

[Table A1 about here]

Table 1 – Average Value of the Variables (1996-2002)

Variables	Islamic Banks	European Banks
Total Assets	109.000 (mil.. EUR)	46.041.130(mil. EUR)
Deposits/ Total Assets	69%	60%
Equity/Total Assets	7%	9%
Net Loans/ Total Assets	50%	46%
Other Earning Assets/ Total Assets	28%	44%
Total Earning Assets/ Total Assets	78%	90%
Off-balance Sheet Items/ Total Assets	18%	25%
Net Profits/ Equity (ROE)	7%	10%
Fixed Assets/ Total Assets	3%	1%
Liquid Assets/Deposits	35%	23%
Reserves/Bad Loans	406%	53%
Number of Employees/ Total Assets (mil. EUR)	0.08	0.11

Table 2 – Average Value of the Variables (1996-2002)

Variables	Islamic Banks	European Banks
Interest Expenses/Deposits	4.3%	5.7%
Depreciation/Fixed Assets	4.8%	2.8%
Staff Expenses/Number of Employees	82 (th. EUR)	66 (th. EUR)

Table 3 – Determinants of Inefficiency – Islamic Banks

Variables in logs Dependent Variable: u_{it}	Fixed Effects	Random Effects	Maximum Likeliood
Fixed Assets/Total Assets	0.077	0.065	0.085*
	(1.58)	(1.45)	(1.92)
Number of Employees/Total Assets	0.436***	0.165***	0.397***
	(11.03)	(4.54)	(11.05)
Equity/Deposits	-0.113***	-0.105***	-0.104***
	(5.50)	(5.54)	(5.54)
Liquidity/Short Term Funding	-0.214***	0.030	-0.188***
	(2.77)	(0.42)	(2.68)
1997	0.092	0.109	-0.314**
	(0.59)	(0.75)	(2.21)
1998	0.296*	0.339**	0.191
	(1.87)	(2.33)	(1.33)
1999	0.451***	0.412***	0.056
	(2.88)	(2.86)	(0.39)
2000	0.550***	0.468***	0.071
	(3.51)	(3.24)	(0.50)
2001	0.302*	0.310**	0.006
	(1.93)	(2.15)	(0.05)
2002	0.392**	0.303**	0.078
	(2.50)	(2.10)	(0.55)
Constant	1.810***	-0.217	1.809***
	(4.12)	(0.54)	(4.52)
Observations	245	245	245
R-squared	0.80	0.81	0.79

Absolute value of t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4 – Determinants of Inefficiency – European Banks

Variables in logs Dependent Variable: u_{it}	Fixed Effects*	Random Effects*	Maximum Likeliood*
Fixed Assets/Total Assets	-0.0295	-0.022	-0.005
Number of Employees/Total Assets	0.104	0.068	0.086
Equity/Deposits	-0.189	-0.166	-0.181
Liquidity/Short Term Funding	-0.036	-0.012	-0.030
1997	-0.012	-0.012	-0.098
1998	-0.011	-0.005	-0.055
1999	-0.029	-0.026	-0.044
2000	-0.011	-0.016	-0.027
2001	0.000	-0.012	-0.042
2002	0.000	0.007	0.002
Constant	3.045	1.891	2.407

*Average of 1-5 per cent significant estimated parameters from 3000 simulations over sub-samples of 35 European banks.

Table A1 – Correlation Between Estimation Procedures – Islamic Banks

FE-RE	0.8950
FE-ML	0.9816
RE-ML	0.8818

Fig. 1-Equity/Deposits Estimated Coefficients (LSDV)

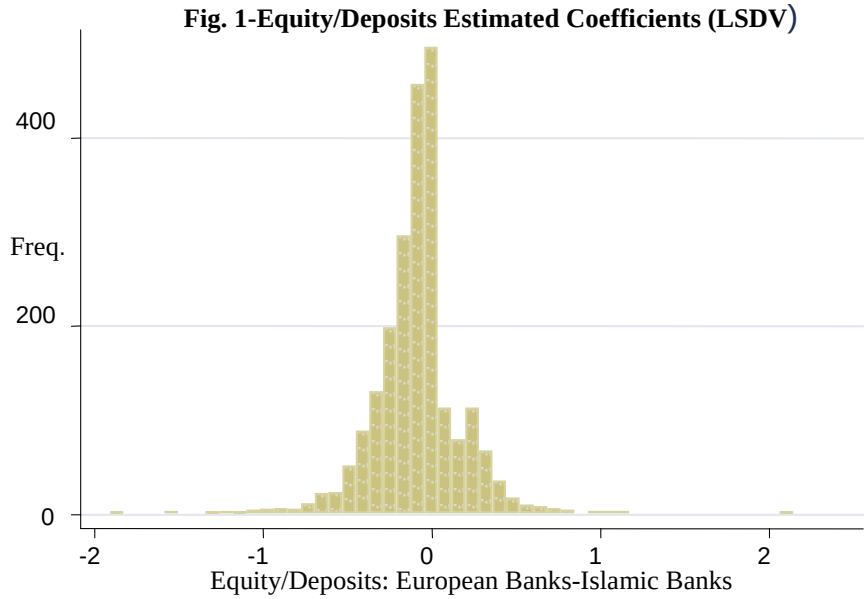
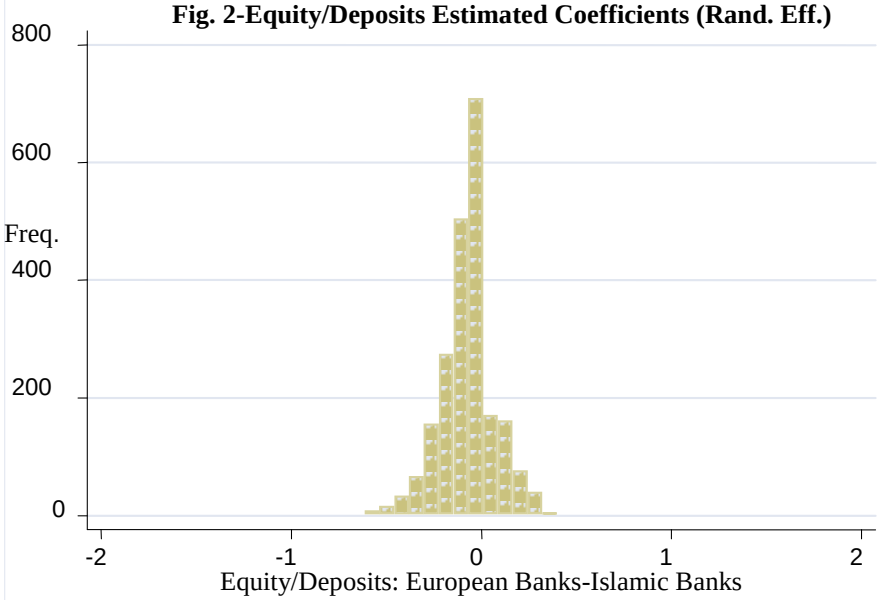


Fig. 2-Equity/Deposits Estimated Coefficients (Rand. Eff.)



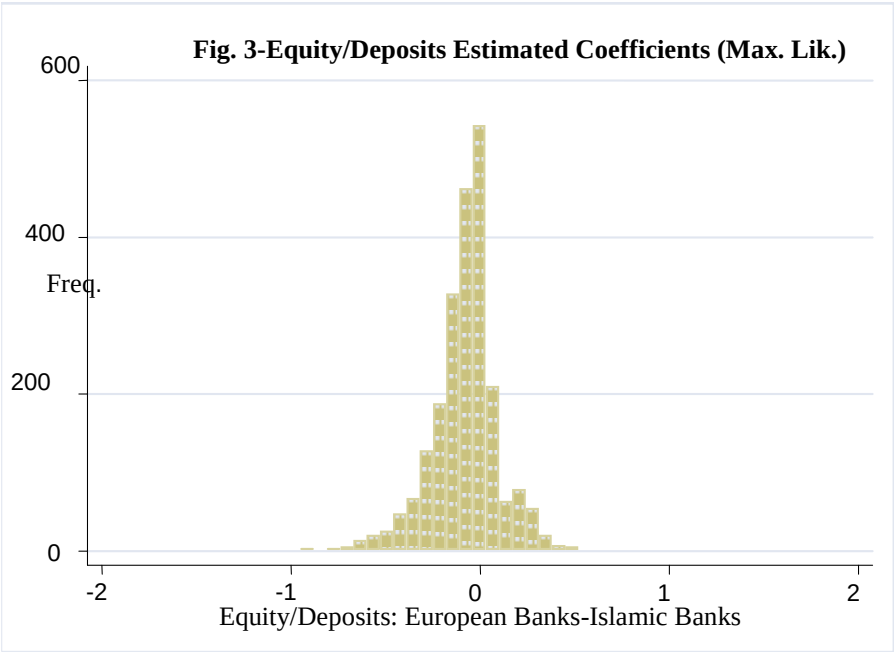


Fig. 3-Equity/Deposits Estimated Coefficients (Max. Lik.)
600
400
Freq.
200
0
-2
-1
0
1
2
Equity/Deposits: European Banks-Islamic Banks