Efficiency in Islamic and conventional banks: A comparison based on financial ratios and data envelopment analysis

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We examine efficiency in Islamic and conventional banks in the GCC region (2004-2007) using financial ratio analysis (FRA) and data envelopment analysis (DEA). From the FRA, Islamic banks are less cost efficient but more revenue and profit efficient than conventional banks. Bootstrapping confirms these small sample results. From the DEA, average efficiency is significantly lower in Islamic than conventional banks. A decomposition method new to the banking context shows that the efficiency difference is more a consequence operating under Islamic rules than of managerial inadequacies. Productivity growth has been slight, and is caused mainly by positive technology change.

Keywords: Banking sector, Efficiency, Data Envelopment Analysis, Financial ratio analysis, Gulf region

JEL Classification: C14; G21

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Abstract

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1 Introduction

The recent financial crisis experienced in the conventional banking sectors around the world has focused attention on the Islamic banking sector where banks, which emphasise transparency and undue risk avoidance, have been largely insulated from the crisis (Hamdan 2009; Willison 2009). Islamic banking is guided by Shariah[2] principles whereby interest (riba) is prohibited; money is not treated as a commodity; there is prevalence of justice; and uncertainty (gharar) is prohibited (Hamdan 2009).

Islamic banks use profit-and-loss sharing (PLS) instruments[3] which do not guarantee a pre-determined profit to depositors and do not force borrowers to repay a pre-determined amount. In addition Islamic banks offer some fee-based services[4]. In contrast, conventional banks (both commercial and investment) earn profits through the implementation of interest on deposits where they offer a small interest rate, and loans where they charge a higher interest rate. In addition, commercial banks, and to a greater extent investment banks, earn a fee-based profit for some of their services.

Islamic banking is an important feature of the financial sectors mainly in developing countries; indeed some Muslim countries have considered converting their entire banking sector to Islamic principles. Since the growth, efficiency and competitive environment of the financial sector are vital for economic development and stability (Al-Jarrah and Molyneux 2005; Brissimis et al 2009) it is important to assess the efficiency of Islamic compared to conventional banking. The short time over which Islamic banking has been operating means that there is only a small literature evaluating its

[2]Shariah is the Islamic Law and is based on the Quran. In some countries it is recognised as a source of legal law.

[3]Mudarabah and Musharakah are some contracts that are based on the profit-and-loss sharing technique (PLS). In Mudarabah an investor (usually an Islamic bank) and an entrepreneur (individual or institutional) enter a joint venture where the investor provides the necessary funds and the entrepreneur provides knowhow. The investor cannot interfere with the running of the business which is left entirely to the entrepreneur. Both parties agree ex ante on a ratio according to which they will split the profits-which are unknown at the time of the arrangement (e.g. 70/30 bank and investor accordingly). In case of losses each party loses what he had contributed to the venture unless negligence of a party can be proven. Musharakah basically differs in the number of participants in the venture and the contributions each one is allowed to make.

[4]Fee-based services include the widely used contracts of Murabahah and Ijarah. Murabahah is in essence a cost-plus-profit sale. The bank arranges to sell a good to a customer and it charges a fee on the price which incorporates risks, costs and a profit margin. Ijarah is a lease contract where the bank leases an asset to an investor (or consumer) and the latter pays fees for being allowed to use the asset.

efficiency. The evidence from this literature is mixed; it is often based on small numbers of Islamic banks, or, in an effort to boost sample size, it is based on observations across a number of disparate countries. The primary purpose of this paper is to compare the efficiency of Islamic and conventional banks using a consistent sample of 50 conventional and 19 Islamic banks in the countries of the GCC[5] over the period 2004-2007.

Studying banking efficiency can be done in two ways: by use of traditional financial ratio analysis (FRA); or by frontier analysis methods such as data envelopment analysis (DEA) and stochastic frontier analysis (SFA). Previous papers which examine the performance of Islamic banks generally use one approach or the other. This paper adds to the literature by applying and comparing both approaches.

Financial ratios are popular for a number of reasons: they are easy to calculate and interpret (Hassan and Bashir 2005); they allow comparisons to be made between banks; they permit comparisons between banks and the 'benchmark' which is usually the average of the industry sector (Halkos and Salamouris 2004). Performance evaluation can, moreover, be examined from various perspectives including costs, revenue and profit.

Banks are complex organisations, however, which produce an array of outputs from a range of inputs. One ratio cannot capture the complete picture of performance of such an organisation over the breadth of its activities, and there is no criterion for selecting a ratio that is appropriate for all interested parties (Ho and Zhu 2004). In addition, the assumption underlying financial ratios that banks are interested in cost minimisation, profit maximisation, or revenue maximisation is a severe drawback of their application in the context of Islamic banking where these are not the most pressing objectives (Abdul-Majid et al 2008a).

The distance function approach is an alternative approach which requires no underlying optimisation assumption and which allows for both multiple inputs and multiple outputs. The distance function can be estimated using parametric methods, such as SFA, or non-parametric methods,

[5]The GCC countries are: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE).

such as DEA. SFA assumes a functional form for the distance function, and assumes distributions for the efficiencies and the stochastic errors. As a consequence of these assumptions, parameters of the function can be estimated and their statistical significance tested. The downside is that the assumptions which underpin this information may be incorrect and the distance function may suffer from misspecification problems.

DEA, on the other hand, estimates a non-parametric piece-wise linear frontier that envelops the data. There are no underlying assumptions and hence no problems of misspecification. Furthermore, by enveloping the data, the DEA distance function allows each unit to be different. In the present context this means that Islamic banks, whose main objectives are unlikely to be cost minimisation or profit maximisation, will not be penalised (in terms of their efficiency measurement) relative to their conventional counterparts who may well have these objectives. For this reason DEA is the frontier technique of choice in the subsequent analysis. The downside, however, is that there are no parameter estimates or statistical tests of the distance function. In addition, measurement and stochastic errors in the data are incorporated into the measurement of efficiency, and the results can be influenced by outliers in the data.

Increasing globalisation and the growing attraction of Islamic finance worldwide has led to direct competition between Islamic and conventional banks. Whilst a comparison of performance between Islamic and conventional banks is therefore of interest, of particular importance is the identification of the source of any efficiency differences. In particular, do the rules under which Islamic banks operate affect the efficiency with which they can operate? If so, to what extent? Answers to these questions are crucial to the development of appropriate policies to improve bank efficiency. This paper contributes to the literature by introducing to the financial literature a non-parametric methodology, similar to one introduced by Charnes et al (1981), for decomposing the efficiency of banks into two components: one which is due to the context in (or rules under) which the bank operates (i.e. conventional or Islamic); and one which is due to managerial competence at converting inputs into outputs within the context in which the bank

operates.

The paper is in 7 sections of which this is the first. Section 2 looks at the background of Islamic banking and banking generally in the GCC region. A brief literature review is presented in section 3, while section 4 describes the methodological approaches used in the subsequent empirical analysis. Sample data and the DEA model are described in section 5 and results are presented and interpreted in section 6. Conclusions and policy implications are discussed in section 7.

2 Islamic banking and the GCC

Islamic banking has had a relatively short history. Demand for Islamic financial products grew as a consequence of the wealth accruing to Muslims during the 1970s oil boom (The Economist 2009a). When the first Islamic bank was founded (the Dubai Islamic Bank in 1975) only the most fundamental contracts were available (safekeeping accounts, sale and PLS contracts). The growth of Islamic banking, however, made it necessary to introduce facilities that were already available in the conventional banking system. So in 1978 the first Islamic bond (sukuk) was launched granting Islamic banks access to capital markets, although the sukuk market would take another 20 years to gain significant size (Iqbal and Mirakhor 2007). In the early 1990s the first Islamic equity funds were launched. These were the Islamic response to the conventional mutual and hedge funds. In the late 1990s takaful was introduced allowing the privilege of Shariah compliant life and general insurance to millions of Muslims (Venardos 2006). The dawn of the 21st century witnessed the launch of Islamic indexes from Dow Jones, FTSE and more recently from S&P so that investors could track the performance of firms that comply with Islamic law. Nowadays many Islamic banks offer credit cards allowing their customers an overdraft facility despite the fact that it was considered completely unlawful a few years ago. Moreover Islamic banks are investing time and money in the implementation of Internet, mobile phone and telephone banking and, in some more liberal countries, such as the UAE, Islamic banks have gone a

step further by introducing special privileges for women clients following conventional practices (Dubai Islamic Bank website).

Recent figures suggest that during 2009, Shariah-compliant assets grew by 29% (The Economist 2009b) making Islamic finance amongst the fastest growing financial sectors (Arthur D Little 2009). Shariah-compliant assets are valued at just over US$800 billion (The Economist 2009b), and these could rise to US$4 trillion by 2015 (Arthur D Little 2009).

There are various reasons for the huge growth in Islamic banking worldwide. There has been a large increase in the population and affluence of Muslims. In addition, there has been an increasing desire of Muslims to have available financial instruments which are Shariah-compliant (Hamdan 2009). Islamic finance is not just restricted to Muslims, though: the traditional values of Islamic finance have had an increasing appeal to Western investors who are disillusioned with the banking practices of conventional banks in the wake of the global financial crisis (Arthur D Little 2009). Islamic banks are therefore no longer only a feature of traditional Muslim regions: there are more than 300 Islamic financial institutions spread across 70 countries of the world. Indeed, there are now 5 Islamic banks in the UK (the only EU country to have Islamic banks), and 19 Islamic financial institutions in the USA (Hamdan 2009).

Banking activities in the GCC region have been enjoying a period of growth over the study period (2004 to 2007) caused to some extent by the steady growth in the economy of that region (see Figure 1). Although the region is made up of 6 separate countries, the banking sectors of all 6 countries adhere to the guidelines of the Basel II Framework. Market structure differs slightly between countries: based on the Herfindahl Index calculated for 1995 and 2002, the banking sectors of Bahrain, Oman and Qatar are highly concentrated while those of Kuwait, Saudi Arabia and UAE are moderately concentrated (Al-Muharrami et al 2006). This description of market concentration appears to hold for the study period based on the evaluation of the normalised Herfindahl Index (HI*):

$$HI^* = \frac{HI - 1/N}{1 - 1/N} \tag{1}$$

where HI is the Herfindahl index and N is the number of firms. The normalised Herfindahl index ranges from 0 to 1 and gives lower rankings than the original Herfindahl index for industries with small number of firms (Baks et al 2006) and hence it is more appropriate in the present context. Results are displayed in Table 1.

[Figure 1 here]

[Table 1 here]

Islamic banks in the Gulf region currently control a market share of around 15% of the regional banking system's assets (see Figure 2). Saudi Arabia, Kuwait and the UAE are considered to be three of the 'big 4' countries (along with Malaysia) in global Islamic finance. Saudi Arabia has a large concentration of Islamic finance assets (compared to total assets) at 40%, compared to Kuwait and the UAE which have 21% and 20% respectively. The remaining three countries of the GCC are considered to be credible challengers to these 4 countries. Bahrain has a 15% concentration of Islamic finance assets compared to Qatar with only 5%.

[Figure 2 here]

3 Literature review

Comprehensive reviews of the literature pertaining to banking sector performance can be found in Berger and Humphrey (1997), Berger and Mester (1997) and Casu and Molyneux (2001). Research on the efficiency of Islamic banks is limited due to the lack of sufficient data and its short history (Iqbal and Molyneux 2005), and there are no previous analyses of the efficiency of

Islamic and conventional banks specifically in GCC countries[6]. The literature reviewed here therefore draws on the results of studies which compare Islamic and conventional banking sectors across a variety of regions.

Islamic banks might be expected to have lower efficiency than conventional banks for a number of reasons. First, the strict application of Shariah rules means that many of the Islamic banking products are unstandardised thereby increasing operational costs in Islamic banks relative to those of conventional banks. Second, Islamic banks tend to be small compared to conventional banks, and there is evidence that technical efficiency increases with size in the banking industry (Bhattacharyya et al 1997; Miller and Noulas 1996; Jackson and Fethi 2000; Isik and Hassan 2002; Drake and Hall 2003; Sathye 2003; Chen et al 2005; Abdul-Majid et al 2005; Drake et al 2006). Third, Islamic banks are often domestically owned. The majority of the evidence suggests that foreign-owned banks are more technically efficient than their domestically-owned counterparts (Isik and Hassan 2002; Hasan and Marton 2003; Sturm and Williams 2004; Kasman and Yildirim 2006; Matthews and Ismail 2006; Mokhtar et al 2008)[7].

Studies which use FRA have generally found, contrary to the earlier hypotheses, that Islamic banks are more efficient than conventional banks in terms of resource use, cost effectiveness, profitability, asset quality capital adequacy and liquidity ratios than conventional banks (Iqbal 2001[8]; Hassan and Bashir 2005). Commercial banks, however, have a more favourable operations ratio (Hassan and Bashir 2005).

Studies which use SFA to compare the performance of Islamic and conventional banks have found no significant difference between the two types of banks in Turkey and Malaysia, respectively (El-Gamal and Inanoglu 2005; Abdul-Majid et al 2005). A cross-country study finds that both cost

[6] Mostafa (2007) looks at banks in GCC countries, and Darrat et al (2002) examine banking efficiency in Kuwait, but neither study distinguishes between Islamic and conventional banks. Some analyses which investigate differences between Islamic and conventional banks have one or two GCC countries in their sample, for example, Bader et al (2008) and Hassan and Bashir (2005) include Bahrain, Kuwait, Qatar, Saudi Arabia and the UAE amongst the 21 countries in their samples; Al-Jarrah and Molyneux (2005) include Bahrain and Saudi Arabia amongst 4 countries in their sample.

[7] A small number of studies suggest the opposite (Sufian 2006; Sensarma 2006)

[8] Results from this study should be treated with caution because of its flaw in sample design (Hasan 2004).

and profit efficiency are higher in Islamic compared to conventional banks (Al-Jarrah and Molyneux 2005). This contrasts with the results of another cross-country study which suggests that Islamic banks have lower efficiency than conventional banks (Abdul-Majid et al 2008a). Whether or not these differences are significant, however, is not reported by either study.

DEA produces similarly mixed results. Cost efficiency is lower but revenue and profit efficiency are higher (on average) in Islamic banks compared to conventional banks on the basis of a cross-country sample (Bader et al 2008), but the differences are not significant. Both technical and cost efficiency are found to be lower for Islamic compared to conventional banks in Malaysia, and the difference is significant (Mokhtar et al 2008).

The results from many of the previous studies comparing efficiency of Islamic and conventional banks are unsatisfactory for several reasons. First a large proportion of the studies are based on small samples (particularly of Islamic banks). Second, where sample sizes are large, the data have often been collected across a variety of countries with very different economies. Third, the significance of the differences in efficiency between the two types of banking is often not tested. In the analysis which follows, the sample is derived from a set of countries which enjoy similar economic conditions and which is large enough to allow tests of significance between the two groups of banks. In addition, bootstrapping methods are used to assess the sensitivity of the significance of the results to sample size.

Few previous studies investigate the reasons why Islamic banks differ from conventional banks in terms of efficiency. An exception is a study by Abdul-Majid et al (2008b) which looks at efficiency in Islamic and conventional banks in Malaysia. They distinguish between gross efficiency scores which are estimated by applying SFA to an output distance function which makes no allowance for various characteristics of each bank (including whether or not it is Islamic), and net efficiency scores which are estimated by taking into account the operating characteristics of banks in the SFA output distance function. Gross efficiency is found to be highest for conventional banks and lowest for Islamic banks, but there are only slight differences in net efficiency between the different types of banks. This

suggests that operating characteristics (including operating under Islamic rules) explain much of the difference in efficiency. The analysis which follows will isolate precisely to what extent any differences in performance between Islamic and conventional banks are a consequence of managerial shortcomings, and to what extent they are a result of the rules under which the banks are constrained to operate.

Finally, few studies have investigated productivity change in Islamic and conventional banks. It appears that productivity in the banking system in Malaysia has increased over the period 1996 to 2002 and that this is primarily a consequence of increased technological change rather than efficiency improvements. The pattern of productivity change is similar for both conventional and Islamic banks (Abdula-Majid et al 2008b).

4 Methodology

4.1 Financial ratio analysis

For the analysis we make use of standard financial ratios which assess cost, revenue and profit efficiency. These are defined in Table 2 (see for example, Bader et al 2007).

[Table 2 here]

4.2 Distance function approach

In the general situation where multiple outputs are produced from multiple inputs, a measure of a bank's technical efficiency can be derived by comparing the bank's observed production level with the maximum possible production which can be achieved from a given set of inputs and evaluating the distance between the two[9]. We define the production technology of the firm as which represents the set of all output vectors $y \in R_+^s$ which can be produced using the vector of inputs $x \in R_+^m$. This can be written as:

[9] This leads to the estimation of an output distance function. See Coelli et al (2005) for details of the input distance function.

$$P(x) = \{y \in R_+^s : x \text{ can produce } y\} \tag{2}$$

The output distance function (Shepherd 1970) is defined on the output set as:

$$D_O(x, y) = \min_\theta \{\theta : (y|\theta) \in P(x)\} \tag{3}$$

It has the following characteristics (Coelli et al 2005):

- it is non-decreasing in y and increasing in x
- it is linearly homogeneous in y
- if $y \in P(x)$ then $D_O(x, y) \leq 1$
- $D_O(x, y) = 1$ only if y belongs to the frontier of the output set i.e. lies on the production possibility curve.

The output distance function is directly related to the output-oriented technical efficiency measure of Farrell (1957): if y is located on the boundary of the production possibility set, $D_O(x, y) = 1$ and this represents technical efficiency; if $D_O(x, y) \leq 1$ y lies inside the frontier and technical inefficiency exists[10].

The distance function can be estimated using parametric or non-parametric methods. The advantages and disadvantages of each of these estimating approaches are well known and described in detail elsewhere (Avkiran 1999; Coelli et al 2005). DEA is a non-parametric approach to estimating the distance function and hence deriving the technical efficiency score of a bank. Taking a DEA approach, the technical efficiency of decision making unit (DMU) k is defined as the ratio of the weighted sum of outputs to the weighted sum of inputs (Charnes et al 1978; 1979):

[10] It should be noted that allocative efficiency can also be estimated when output prices are known. This assumes, however, that firms aim to maximise revenue. Since this may not be the case for Islamic banks, allocative efficiency will not be evaluated in the ensuing analysis.

$$TE_k = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \tag{4}$$

where there are s outputs and m inputs; y_{rk} is the amount of output r produced by DMU k; x_{ik} is the amount of input i used by DMU k; u_r is the weight applied to output r; and v_i is the weight applied to input i. Each DMU therefore uses the set of weights which gives it maximum efficiency (subject to the constraint that weights must be universal). It is this which makes DEA such an attractive estimation technique in the present context where Islamic and conventional banks may have very different goals and priorities[11]. The linear programming (LP) equations needed to derive input and output weights are provided in detail under assumptions of constant returns to scale (CRS) or variable returns to scale (VRS) in Coelli et al (2005). DMU k is efficient if the efficiency score $TE_k = 1$

Figure 3 illustrates the DEA frontier and measure of technical efficiency under the assumption of VRS. Assume, for simplicity, that each bank produces one output (loans) from one input (fixed assets). The production points for a number of conventional and Islamic banks are plotted in figure 3. The boundary FGCDE envelops all banks in the sample. Banks lying on the frontier GCD are efficient (note that banks lying on the segments FG and DE are boundary but not efficient). Bank Y lies inside the frontier and has an efficiency score of $0y/0y''$. This represents the proportion of output (loans) achieved by bank Y relative to the best possible output achievable by all banks and given bank Y's input level.

[Figure 3 here]

In order to assess the sources of inefficiency of bank Y, we need to consider each bank's efficiency relative only to the banks of the same type. The original boundary FGCDE is the gross efficiency boundary. ABCDE is

[11] In fact, the random parameters variant of SFA also allows for differences between firms in terms of goals and priorities. This requires additional distributional assumptions and needs a large number of degrees of freedom. The relatively small sample used here makes such an approach impossible.

the boundary for conventional banks and FGHIJ the boundary for Islamic banks. We will call these the net efficiency boundaries. Bank Y has a net efficiency score of $0y/0y'$ which represents the proportion of output obtained by bank Y relative to the best possible output achievable by Islamic banks only and given bank Y's input level. The distance between the net and gross boundaries ($y'y''$) measures the impact of bank Y being Islamic on its output. The type-efficiency score is therefore $0y'/0y''$ and provides a measure of the impact of operating under Islamic rules on bank Y.

4.3 Malmquist productivity

The distance function methodology can be extended when data are available over time so that changes in productivity can also be derived. Let us assume time periods $t = 1, ..., T$ and modify the earlier notation so that superscripts denote period. Thus $D_O^t(x^t, y^t)$ and $D_O^{t+1}(x^{t+1}, y^{t+1})$ represent the output distance functions for periods t and $t+1$ respectively. The Malmquist productivity change index is defined as (Coelli et al 2005):

$$M_O(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_O^t(x^{t+1}, y^{t+1})}{D_O^t(x^t, y^t)} \right) * \left(\frac{D_O^{t+1}(x^{t+1}, y^{t+1})}{D_O^{t+1}(x^t, y^t)} \right) \right]^{1/2} \tag{5}$$

where:

$$D_O^t(x^{t+1}, y^{t+1}) = \min\{\theta : x^{t+1}, y^{t+1}/\theta) \in P^t\} \tag{6}$$

and

$$D_O^{t+1}(x^t, y^t) = \min\{\theta : x^t, y^t/\theta) \in P^{t+1}\} \tag{7}$$

Values of the Malmquist productivity change index above unity indicate that there has been an improvement in productivity between t and t+1. Values less than 1 imply the converse. The index can be further decomposed as follows (Coelli et al 2005):

$$M_O(x^{t+1}, y^{t+1}, x^t, y^t) = E.T =$$
$$\left(\frac{D_O^{t+1}(x^{t+1}, y^{t+1})}{D_O^t(x^t, y^t)}\right) * \left[\left(\frac{D_O^t(x^{t+1}, y^{t+1})}{D_O^{t+1}(x^{t+1}, y^{t+1})}\right) * \left(\frac{D_O^t(x^t, y^t)}{D_O^{t+1}(x^t, y^t)}\right)\right]^{1/2} \quad (8)$$

The component (E) measures the change in technical efficiency, and shows whether the DMUs are getting closer to their production frontiers over time, implying that banks are using existing resources more efficiently, holding technology constant. The component (T) measures change in technology over the period, and indicates whether the production frontier is shifting over time. Values of either of these components of greater (less) than unity suggest improvement (deterioration).

5 Sample data and DEA model

The sample data for both the FRA and the DEA are derived for banks in the 6 GCC countries from Bankscope for the period 2004 to 2007. Only banks which have a full set of values for all required variables (for the FRA and the DEA) for all 4 years of the study are included. This is a relatively short time span, but, given the rapid growth and the political instability in the Gulf region, this is likely to be an advantage. Since most banks' financial accounts were reported in their own currency, figures were converted to US dollars using exchange rates of 1st September 2008 provided by the Financial Times[12]. In addition, all variables were converted to 2007 prices using appropriate deflators[13]. The number and type of banks included in the sample and population is shown in Table 3.

[Table 3 here]

In order to conduct a DEA we need first to specify the inputs and outputs. Typically, either a production or intermediation approach is taken when conducting an analysis of banking efficiency. In the production ap-

[12] 1$ = 0.37686BHR(Bahrain) = 0.27283KWD(Kuwait) = 0.38495OMR(Oman) = 3.63871QAR(Qatar) = 3.74736SAR(Saudi Arabia) = 3.67249AED(UAE)

[13] These were calculated from data in World Economic Outlook 2008

proach the bank is treated as a firm that provides services, such as loans, through the use of capital and labour inputs. Output is generally represented by the number of deposit accounts or transactions and inputs are defined as number of employees (labour) and capital expenditures on fixed assets (capital). In the intermediation approach, banks perform an intermediary role between borrowers and depositors and hence accept deposits and other funds in order to provide loans and alternative investments. Output is measured by interest income, total loans, total deposits and non-interest income, while inputs are usually represented by operating and interest costs. The latter is the more common approach in bank studies. The production approach is considered to be more appropriate when calculating branch efficiency, but the intermediation approach is a more appropriate reflection of banking activities when considered at the bank (rather than branch) level (Pasiouras 2006). Most previous studies have fallen into the latter category. This study is no exception and hence the intermediation approach is used.

The choice of outputs is informed by previous literature (Abdul-Majid et al 2008a; 2008b; Casu and Girardone 2004; Casu et al 2004) and by data availability. They are:

- Total loans
- Other earning assets

The inputs are defined as:

- Deposits and short term funding
- Fixed assets
- General and administration expenses
- Equity

A similar set of inputs is used in previous studies (Drake and Hall 2003; Kamaruddin et al 2008). General and administration expenses are used as a proxy for labour input. While it may not be an absolutely accurate reflection of labour input, it is more easily available than better measures (eg

employee numbers or expenditure on wages) and has been used in previous studies (Drake and Hall 2003) where it is argued that personnel expenses make up a large proportion of general and administration expenses.

Equity is included as an input in order to reflect risk-taking in the banking sector. Charnes et al (1990) first suggested that an indicator of risk-taking should explicitly be incorporated into any model of banking efficiency by the inclusion of loan-loss provision as an input. Data on loan-loss provision are difficult to derive, and the sample can be much reduced by its inclusion. This is particularly relevant here where we wish to retain as many Islamic banks in the sample as possible. We therefore include as an input an alternative measure of risk namely, equity. This variable is easily obtainable (from Bankscope) for all types of banks and has been included to reflect risk in previous studies (Abdul-Majid et al 2008a; Alam 2001; Mostafa 2007). In the context of Islamic banking, one would expect a difference in risk behaviour between Islamic and conventional banks, and hence the inclusion or otherwise of a risk variable could make a difference to results. Indeed, Sufian (2006) finds that the efficiency of Islamic banks is considerably higher with risk (measured by loan-loss provision) as an input compared to when it is not included. In order to check the sensitivity of the results and conclusions to the inclusion of this variable, the DEA will also be run without equity as an input.

Descriptive statistics for the DEA variables are shown in Table 4. The upward trend in banking business is clear for both types of banks. Total loans, for example, have grown by around 90% (in real terms) over the 4-year period. For conventional banks the growth is a little above 90% while for Islamic banks it is a little below. The table also indicates that the average size of an Islamic bank (at least in terms of total loans) is around half the size of a conventional bank. Note, however, that Islamic banks have higher fixed assets, on average, than conventional banks.

[Table 4 here]

6 Results

6.1 Financial ratio analysis

The chronological evolution of cost, revenue and profit efficiency of conventional and Islamic banks can be seen in Figures 4a and 4b and Table 5. The cost-to-income and non-interest-expenses-to-average-assets ratios are generally higher for Islamic banks compared to conventional banks, and the difference is significant in the case of the non-interest-expenses-to-average-assets ratio[14]. This should not come as a surprise as Islamic banks face costs which conventional banks do not have. For example, in order to achieve Shariah compliance Islamic banks might incur high salaries for maintaining a Shariah board, high legal costs because of the de facto higher complexity of Islamic products, and the legal ramifications for compliance of Islamic financial products with foreign laws. In addition, the development of what are essentially bespoke products is a highly manual process (Willison 2009). Finally, cost efficiency requires a critical size of a bank necessary for economies of scale and scope to emerge. Islamic banks are smaller than conventional ones in terms of assets and the products they offer. There is, however, evidence that the gap between the two types of banks may be narrowing over time. This may be partly because Islamic banks are learning the way of doing business and partly because of increases in size which allow gains in terms of cost efficiency as time passes.

[Figures 4a and 4b here]

[Table 5 here]

The return-on-average-assets ratio is consistently higher for Islamic than conventional banks, and the difference is significant for the pooled data and for 2006 and 2007. This could be the result of investing more in real assets rather than in debt contracts (for example, Certificates of Deposit, Bonds) as is conventional. A closer relationship between the banking sector

[14] It is possible that the results testing for significance differences between financial ratio means are affected by the small size of the samples of Islamic and conventional banks. The analysis was redone using the bootstrap procedure of Desagné et al (1997). Significant differences between Islamic and conventional banks indicated in Table 5 are confirmed as significant by the bootstrapping results with the exception of ROA in 2006.

and the real economy is evidenced here and this may be one reason why Islamic banks have been resistant to the recent financial crisis as they have less exposure to debt instruments. The return-on-average-equity ratio is generally the same for both types of banks.

Revenue ratios indicate that Islamic banks are more efficient than conventional banks. The other-operating-income-to-average-assets ratio is higher for Islamic banks throughout the examined period indicating that Islamic banks have higher returns on their investments, and the difference is significant for the pooled data and for 2006 and 2007. The net-interest-margin ratio is also higher for Islamic banks, although the difference between Islamic and conventional banks is not significant, and in any case varies across the study period. Higher returns on investments mainly in real assets could be explained by the economic boom in the Gulf region over the period and the PLS basis that Islamic banks operate. Figure 1 shows that Gulf countries are developing very fast with an average real GDP growth of 8.1% for the study period and 6.9% for the first decade of the 21st century. In a period of economic boom PLS operates as a form of equity for the investor without capping his potential revenues.

6.2 DEA results

The results of the DEA[15] are derived using, respectively, CRS and VRS models[16]. The CRS efficiency results provide a measure of overall technical efficiency, while the VRS efficiencies measure pure technical efficiency (having factored out scale inefficiencies). A measure of scale efficiency can be obtained by calculating the ratio of CRS to VRS efficiency. In addition, the assumption is made that production conditions vary over time. Given the political instability of the region and the expanding populations and markets, this is likely to be a valid assumption. In practical terms, this means

[15] In order to check whether the results presented here are affected by the presence of outliers, a super-efficiency analysis (Andersen and Peterson 1993) was performed. A small number of Islamic and conventional banks were identified as potential outliers. When the analysis was rerun without these banks, differences between conventional and Islamic banks in terms of all types of efficiency remained the same. The results are therefore presented here including all banks.

[16] The DEA efficiencies and subsequent productivity indexes are calculated using the software package Limdep.

that the DEA is performed for each year separately[17]. Table 6 and Figures 5a and 5b display the DEA results based on the model with two outputs and four inputs (including equity) identified in section 4. The results from excluding equity from the DEA model are displayed in the appendix[18].

[Table 6 here]

[Figures 5a and 5b here]

Looking first at the pooled efficiencies, gross overall (CRS) efficiency is significantly higher, on average, for conventional banks compared to Islamic banks by around 5 percentage points. An examination of the VRS and scale efficiency results suggest that this difference is largely a consequence of pure technical efficiency (VRS results) where conventional banks outperform Islamic banks, on average, by 4 percentage points. Scale efficiency is also higher for conventional banks compared to Islamic banks, but the difference is not significant. The broad conclusions are the same when equity is excluded from the model (see appendix), although the absolute values of efficiency are lower (this is in line with Sufian 2006).

Differences between Islamic and conventional banks are much smaller when net efficiency is the measure (Table 6b). Indeed, pure technical efficiency is higher amongst Islamic than conventional banks. The final decomposition of gross efficiency into type efficiency (Table 6c) shows that the conventional type of banking is more efficient on average than the Islamic type. Thus the significant differences in gross technical efficiency observed in Table 6a are mainly a consequence of the rules under which the banks must operate rather than managerial inadequacies. This is similar to results for Malaysia (Abdul-Majid et al 2008b).

It should be noted that these results are sensitive to whether or not risk-taking is explicitly included in the DEA model. When equity is excluded, the difference in gross efficiency is a consequence of both the rules under which the banks operate (since conventional banks have generally higher type efficiency than Islamic banks, and some of these differences

[17] For comparison, the efficiencies were also generated on the assumption that production conditions do not vary over time. In practical terms, this means that the DEA is performed on the pooled data. Broad conclusions are identical to those reported here.

[18] Table 10a-c in the Appendix

are significant) and managerial inadequacies (since net efficiency is generally significantly higher for conventional banks than for Islamic banks). The inclination towards risk-taking activity in banking lies with managers and so it is no surprise that the model which does not capture risk-taking attributes a greater proportion of inefficiency to managerial shortcoming than the model which incorporates risk-taking activity. We believe, however, that the model which explicitly incorporates risk-taking is a more appropriate reflection of production in the banking sector. The results of this model are therefore to be preferred.

Turning now to the results presented by year of study, we can see that there is a general picture (for all types of efficiency) of efficiency declining in the first three years of the study followed by a small rise in the final year. This may be because the early years of the study are affected by the political instability in the region, Perhaps the increase at the end of the period is a signal that efficiency will increase as the region enjoys greater political and economic stability. Whilst the broad patterns observed for the pooled data are also observed for the individual years, differences are rarely significant.

Mean DEA efficiency scores are presented for each country in Table 7. For comparison, financial ratios are also presented by country. These results should be interpreted with a large degree of caution because of inter-country variations in bank size and type (i.e. conventional and Islamic). Gross efficiency is highest, on average, in the UAE, Qatar and Bahrain. The comparatively low average efficiency for Saudi Arabia is somewhat surprising given the relatively large level of GDP and population in that country, as well as the competitive environment faced by its banking sector (see Table 1). Indeed there is no obvious pattern of relationship between efficiency and market structure.

[Table 7 here]

This section concludes with a note on the comparison between the FRA and the DEA results. A Spearman's rank correlation analysis of all DEA efficiency scores and the six financial ratios (both pooled and separately by

year) is presented in Table 8. The main result is that bank rankings calculated from gross DEA efficiency (both CRS and VRS) are significantly positively related to bank rankings derived only from the two cost ratios. There is no evidence of any significant positive relationship in the rankings derived from any other pairs of DEA efficiencies and financial ratios. It has been suggested that banks that are inefficient under the DEA approach could be more profitable than DEA-efficient ones (Taylor et al 1997), and the Spearman's correlations between the DEA efficiencies and the two profit ratios support this contention. The correlation evidence therefore suggests that FRA (particularly those ratios reflecting revenue and profit efficiency) and DEA should generally be viewed as complementary rather than competing, and should be used together when evaluating performance of organisations since they answer different questions.

[Table 8 here]

6.3 Malmquist productivity analysis

The Malmquist productivity index and its components are reported in Table 9. The indexes are calculated for the 4-year interval 2004 to 2007, under both CRS and VRS assumptions. The equivalent annual average productivity index is shown in parentheses. Over the whole 4-year period, Malmquist productivity (based on CRS estimation) has risen by just over 1% for all banks. This is equivalent to an annual average increase of 0.3%. This small increase in productivity over the period conceals considerable changes in efficiency and technology. Efficiency, for example, has decreased by over 7% (which is equivalent to an annual average decrease of just under 2%), while technology has increased by 9.4% (or at an annual average rate of 2.3%). The pattern of productivity growth and its components is broadly similar when VRS are assumed[19]. This is similar to the finding for banks in Malaysia over the period 1996 to 2002 (Al-Majid et al 2008b) and banks in the USA over the period 1990 to 1993 (Devaney and Weber

[19] The model excluding equity displays similar productivity patterns under VRS. Under CRS, productivity growth is more a consequence of efficiency change than technology change.

2000). The considerable growth in the business of the banking sector of the GCC region (see Figure 2) has therefore been accompanied by relatively large increases in technology (i.e. a shifting out of the production possibility frontier) whilst there has been a detrimental effect on efficiency. This finding that substantial growth in a sector has a positive effect on technology but a negative effect on efficiency has also been observed in the higher education sector (Johnes 2008).

[Table 9 here]

The apparent large increase in technology over the period is worthy of further examination. The main drivers for innovation in a financial context are (Willison 2009):

- product innovation
- customer service
- operational efficiency
- risk management and control
- regulation

The study period is one which has seen considerable product innovation and operational improvements made possible by rapid improvements in communications. Historically, the Islamic banking sector has had a poor record of R & D and innovations because the banks are small and products and systems have been unstandardised (Khan and Bhatti 2008). Indeed, a study of productivity change covering the period 1996-2002 (in Malaysian banking) found Islamic banks to have the lowest productivity and technology change of all types of banks in the study (Abdul-Majid et al 2008b). But the recent increase in size and coverage of market has provided particularly strong motivation for change. The global financial crisis has forced conventional customers to look elsewhere and so there has been pressure on Islamic finance to develop products which appeal to a wider customer base (Willison 2009). Increasing customer numbers and the proliferation

of Shariah-compliant products has put pressure on the development of operational efficiency, and this is likely to increase in coming years. It is no surprise, therefore, that conventional and Islamic banks have experienced different changes in productivity: Islamic banks have seen an increase in productivity of 8% over the whole period, whereas conventional banks have experienced a fall in overall productivity of around 1% over the same period. For both types of banks there has been negative efficiency change and positive technology change, but these have been much bigger in magnitude in the Islamic banking sector. Thus efficiency in Islamic banks has decreased by nearly 10% over the 4-year period (equivalent to an annual average fall of 2.6%) and technology has increased by nearly 18% (equivalent to an annual average increase of 4.2%). This latter result is no doubt a consequence of the product and operational innovations in the Islamic banking sector which have been more marked than in the conventional banking sector. Where growth and change are greater (i.e. the Islamic banking sector), there is therefore a greater detrimental effect on efficiency and a larger positive effect on technology than where growth and change are lower (in the conventional banking sector).

7 Conclusion

The purpose of this paper has been to provide an in-depth analysis using FRA and DEA of a consistent sample of Islamic and conventional banks located in the GCC region over the period 2004 to 2007. The paper contributes to the literature by

- introducing to the financial literature a method for decomposing the difference in DEA efficiency (between Islamic and conventional banks) into a component which is due to managerial inadequacies and one which is a consequence of the different rules under which the organisations operate;
- comparing the FRA and DEA approaches;
- investigating the drivers of productivity growth in the Islamic

and conventional banking sectors.

The FRA suggests that Islamic banks are less cost efficient and more revenue and profit efficient than conventional banks. Four of the six ratios (calculated across the pooled data set) indicate that the differences between Islamic and conventional banks are significant at the 5% significance level using a combination of parametric and non-parametric significance tests. The results are confirmed using bootstrapping methods.

The DEA results, which incorporate risk-taking activity in the model, provide evidence that gross efficiency is significantly higher, on average, amongst conventional compared to Islamic banks, and the difference is significant for both pure technical and overall technical efficiency across the pooled set of efficiencies. Net efficiency (which takes out the inefficiency caused by bank type) is generally not significantly different, on average, between the two groups. The results suggest that the difference between types of banks in gross performance is more a consequence of the constraints caused by bank type than managerial inadequacies. Thus the rules under which Islamic banks operate are an important barrier to efficiency. In order to become more efficient, the Islamic banking sector therefore needs to examine the rules, regulations and procedures under which it operates. The rules underlying Islamic banking are not globally uniform (The Economist 2009a); banks must go through various processes to obtain approval for products, and these vary according to geographical location. Within the Gulf region, the rules should be harmonised under the auspices of a Financial Services Authority operating at the GCC level. Certification of products by such an Authority should be recognised by Financial Services Authorities within each of the member countries.

The correlations between the measures of performance derived using, respectively, FRA and DEA are significantly positive only in the case of the cost ratios. While significant, however, the correlations are not particularly high. The conclusion from this is that the DEA and financial ratio measures (particularly the revenue and profit ratios) offer different information, and the methods are therefore complements rather than substitutes.

Parties interested in bank performance would do well to look at measures of efficiency based on both approaches.

A brief examination of productivity change shows that productivity has grown only slightly over the four-year period. However, examination of the components reveals that efficiency change is negative while technology change is positive. It should be noted that the period 2004 to 2007 has been one of rapid change: the high price of oil has meant that oil revenues have been large; there has been a large rise in both GDP and population in the GCC region; and the period has been marked by rising economic and political stability. Growth has been particularly strong in the Islamic banking sector, and this has led to increased product innovation and improved operational efficiency to deal with higher customer and product numbers. As a consequence, the magnitude of the components of productivity change is particularly large for Islamic banks. The stimulus for innovation in the Islamic banking sector is likely to lead to the very changes (such as standardisation of products and operational improvements) which are most likely to improve the efficiency of Islamic banks.

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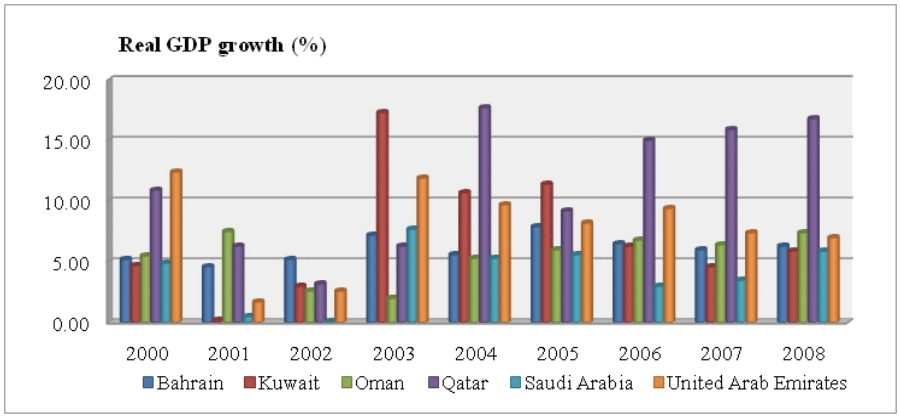
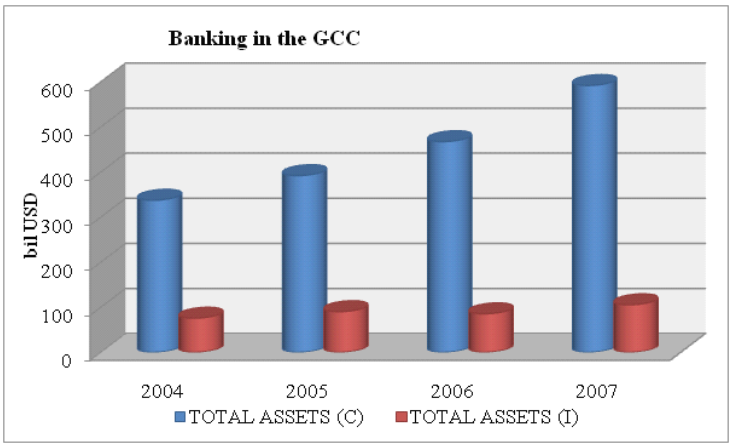
8 Appendix

Figure 1: Real GDP Growth (Annual Percentage Change) in the GCC region



Source: International Monetary Fund

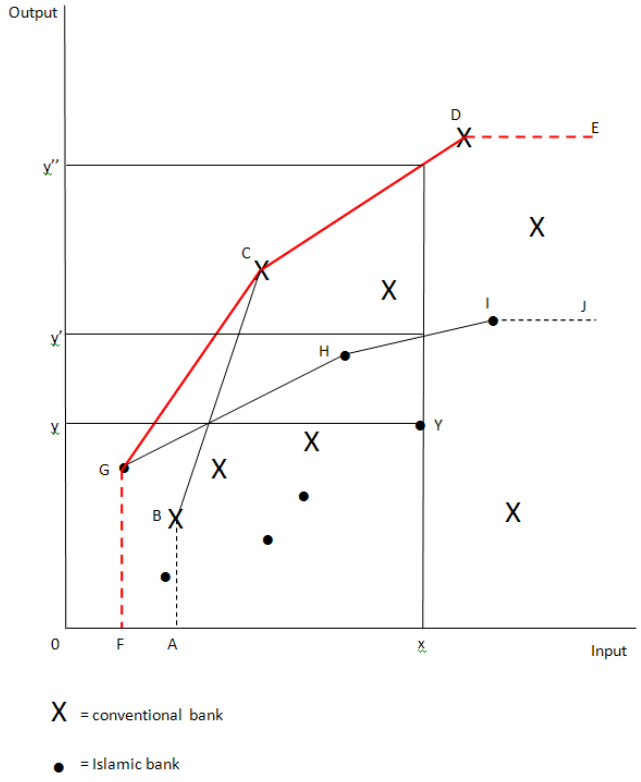
Figure 2: Total assets of conventional and Islamic banks the GCC region



Source: Bankscope

Note: The figures are based on the 50 conventional and 19 Islamic banks which form the basis of the analysis. See section 4 for sample details.

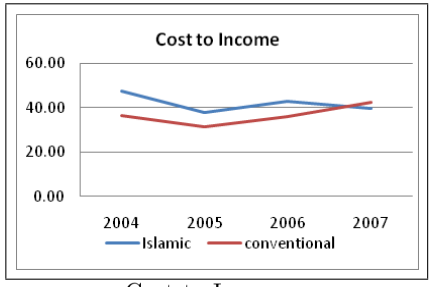
Figure 3: DEA efficiency – Derivation of Gross, Net and Type efficiency



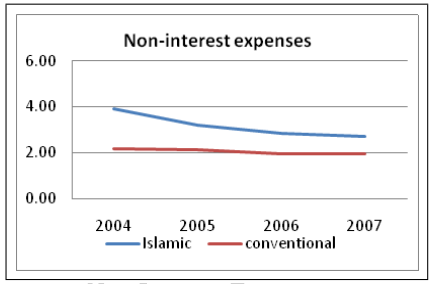
Source: Authors' calculations

Figure 4a-b: Evolution of Financial Ratios - Mean and Median Values

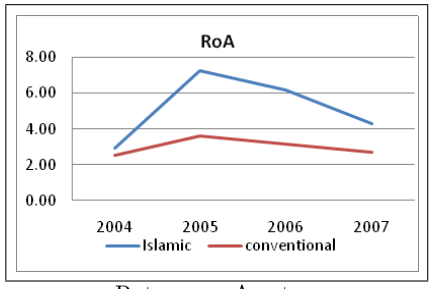
a) Means



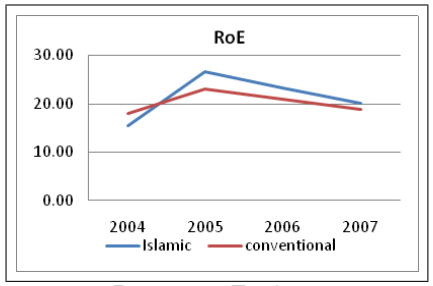
Cost to Income



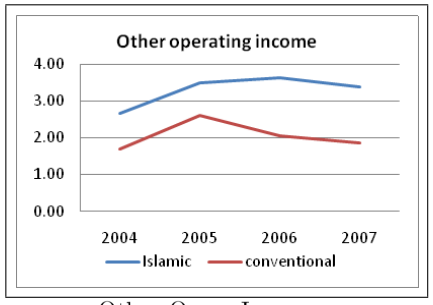
Non Interest Expenses



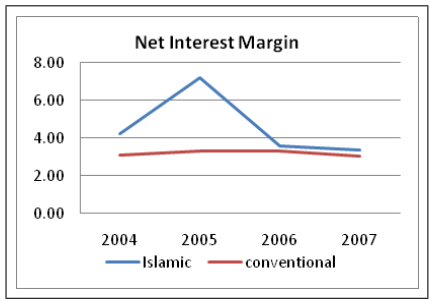
Return on Assets



Return on Equity

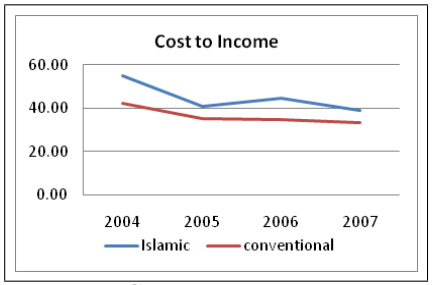


Other Oper. Income

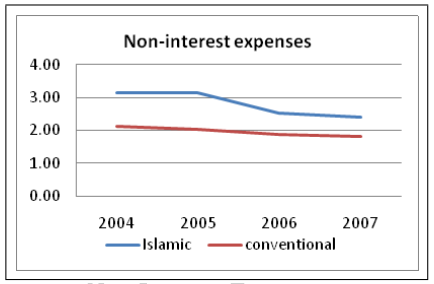


Net Interest Margin

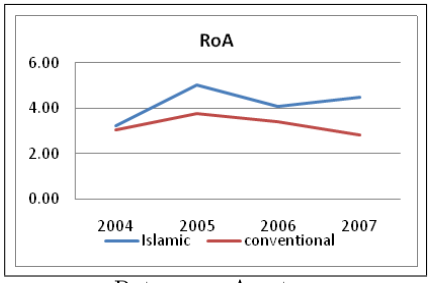
b) Medians



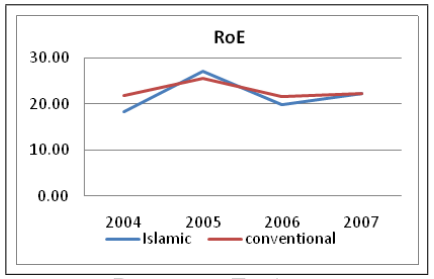
Cost to Income



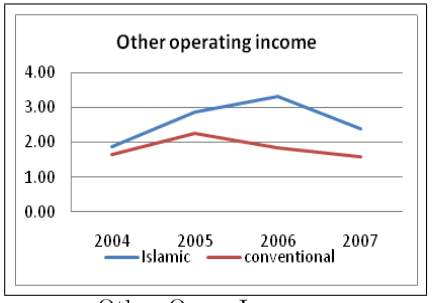
Non Interest Expenses



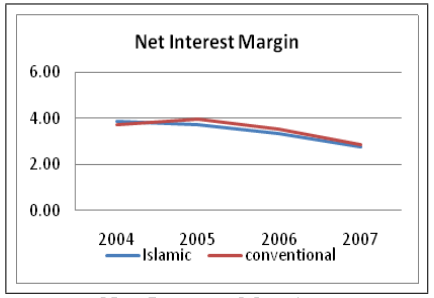
Return on Assets



Return on Equity



Other Oper. Income

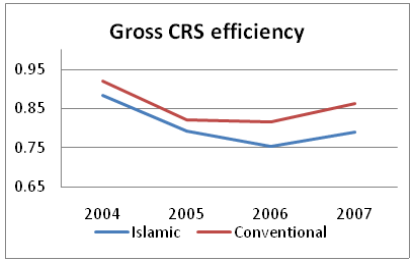


Net Interest Margin

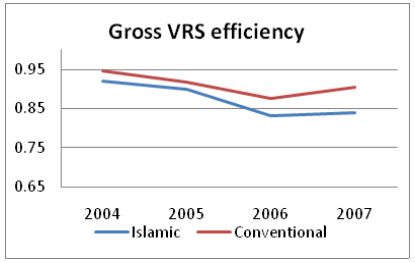
Note: Cost efficiency is represented by Cost-to-Income and Non-Interest-Expenses. Profit efficiency is represented by Return on Assets (RoA) and Return on. Equity (RoE). Revenue efficiency is represented by Net-Interest-Margin and Other-Operating-Income.

Figure 5a-b: Evolution of DEA Efficiencies - Mean and Median Values

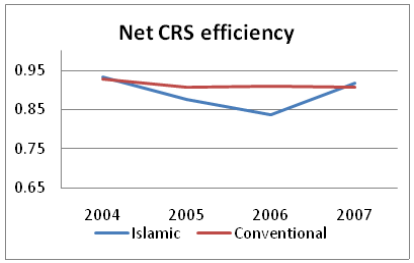
a) Means



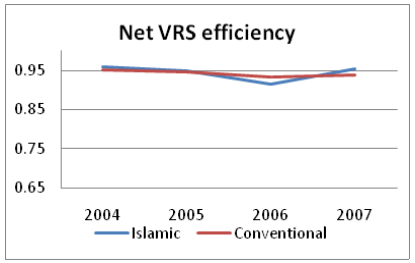
Gross CRS Efficiency



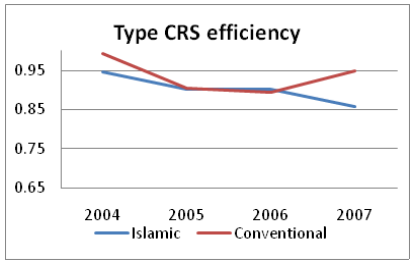
Gross VRS Efficiency



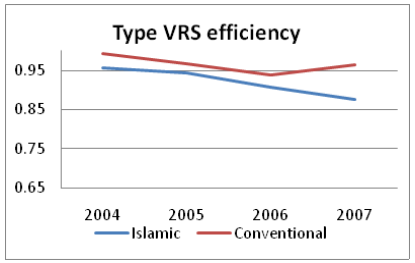
Net CRS Efficiency



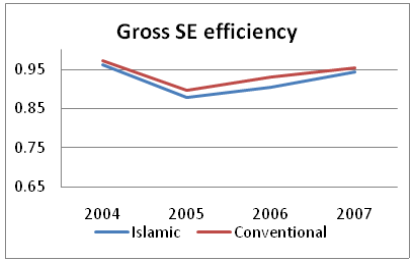
Net VRS Efficiency



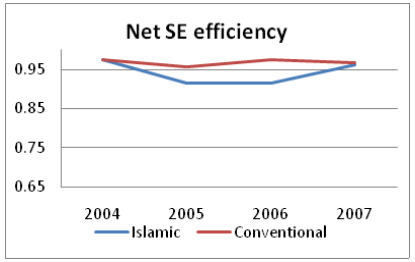
Type CRS Efficiency



Type VRS Efficiency

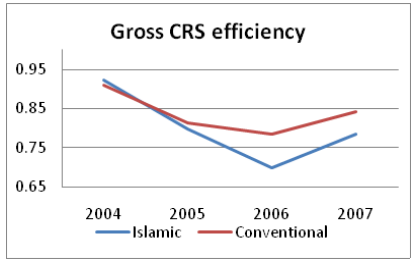


Gross SE Efficiency

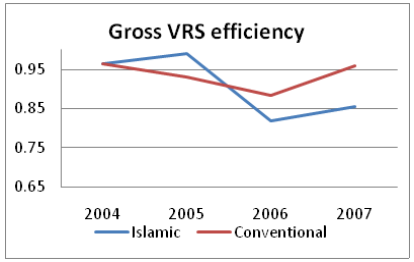


Net SE Efficiency

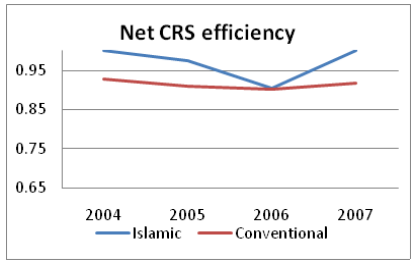
b) Medians



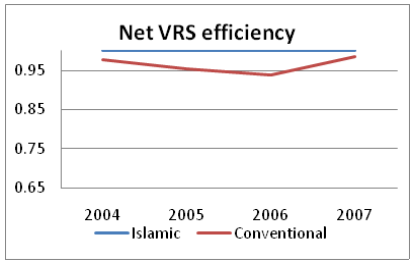
Gross CRS Efficiency



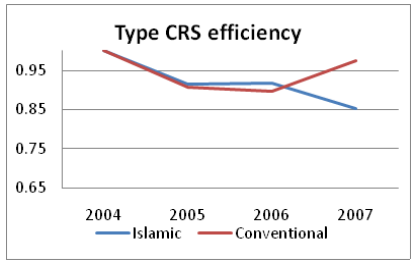
Gross VRS Efficiency



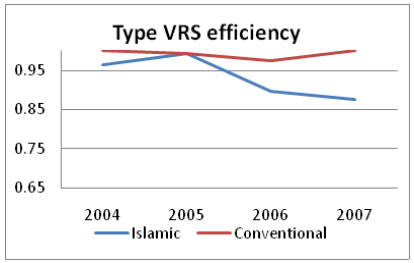
Net CRS Efficiency



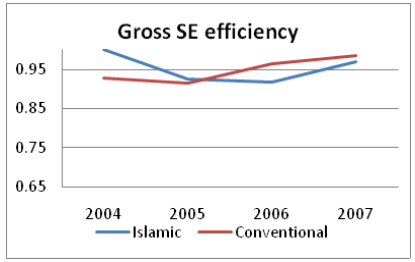
Net VRS Efficiency



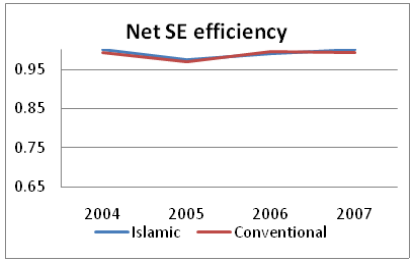
Type CRS Efficiency



Type VRS Efficiency



Gross SE Efficiency



Net SE Efficiency

Table 1: Market Structure in the GCC banking sector

	2004	**2005**	**2006**	**2007**
Bahrain	0.150	0.148	0.140	0.141
Kuwait	0.090	0.092	0.084	0.096
Oman	0.079	0.071	0.127	0.138
Qatar	0.192	0.160	0.196	0.186
Saudi Arabia	0.030	0.034	0.032	0.035
UAE	0.057	0.054	0.053	0.051

Source: US Department of Justice
Note that HI*<0.1 => competitive market
0.1<HI*<0.18 => moderately concentrated market
HI*>0.18 =>highly concentrated market.

Table 2: Definitions of Financial Ratios according to Bankscope

Cost Efficiency Ratios

Cost to Income CTI $= \left[\frac{\text{Overheads}}{\text{Net Interest Revenue + Other income}}\right] * 100$

Non Interest Expenses to Average Assets NIE $= \left[\frac{\text{Overheads + Loan Loss Provisions}}{\text{Average Total assets}}\right] * 100$

Profit Efficiency Ratios

Return on Average Assets ROA $= \left[\frac{\text{Net Income}}{\text{Average Total Assets}}\right] * 100$

Return on Average Equity ROE $= \left[\frac{\text{Net Income}}{\text{Average Equity}}\right] * 100$

Revenue Efficiency Ratios

Net Interest Margin NIM $= \left[\frac{\text{Net Interest Revenue}}{\text{Average Total Earning Assets}}\right] * 100$

Other Operating Income to Average Assets OOI $= \left[\frac{\text{Other Operating Income}}{\text{Average Total Assets}}\right] * 100$

Table 3: Number of banks in the sample

Country	**Sample**			**Population (2007)**		
	Islamic	Conventional	**Sum**	Islamic	Conventional	**Sum**
Bahrain	6	8	14	17	13	30
Kuwait	4	6	10	6	7	13
Oman	0	5	5	0	6	6
Qatar	2	6	8	5	6	11
Saudi Arabia	1	9	10	3	9	12
UAE	6	16	22	7	15	22
Sum	19	50	69	38	56	94

Source: Authors' calculations

Table 4: Descriptive Statistics for the DEA input and output variables

	Conventional			Islamic			All		
2004	**Mean**	**Median**	**SD**	**Mean**	**Median**	**SD**	**Mean**	**Median**	**SD**
Total loans	4254	2789	4146	2454	741	4440	3758	2049	4273
Other earning assets	3489	1995	4063	912	364	1289	2780	1265	3699
Deposits and short term	6747	3830	7067	3083	934	4819	5738	3335	6697
Fixed assets	73	45	85	59	15	93	69	37	87
Overheads	106	70	113	69	34	112	95	61	113
Equity	1005	753	909	527	283	680	873	507	874
2005									
Total loans	5447	3447	5375	3208	1016	5590	4830	2261	5486
Other earning assets	3883	2683	4122	1241	928	1527	3155	1530	3778
Deposits and short term	7842	5039	7779	3831	1243	5817	6737	3573	7470
Fixed assets	82	54	91	84	21	127	82	47	101
Overheads	129	83	130	96	49	139	120	75	132
Equity	1346	930	1213	745	545	947	1180	714	1171
2006									
Total loans	6586	4721	6201	3721	1131	6205	5797	2595	6290
Other earning assets	4351	2679	4615	1727	874	2261	3629	2002	4254
Deposits and short term	9349	6351	8861	4500	1364	6670	8013	3945	8551
Fixed assets	93	68	99	167	37	340	113	57	197
Overheads	152	106	146	122	45	173	143	87	153
Equity	1472	1052	1325	1057	535	1362	1358	904	1338
2007									
Total loans	8236	5914	7606	4633	1696	7254	7244	3209	7632
Other earning assets	5258	2740	5989	2016	975	2592	4365	2079	5454
Deposits and short term	11840	8138	11410	5549	2241	7831	10108	4364	10866
Fixed assets	111	81	112	172	43	340	128	76	201
Overheads	202	134	217	140	60	183	185	116	209
Equity	1700	1242	1567	1302	557	1638	1591	1093	1585
All Years									
Total loans	6131	3815	6101	3504	1074	5894	5407	2574	6148
Other earning assets	4245	2481	4771	1474	838	1995	3482	1612	4370
Deposits and short term	8944	5712	9069	4241	1412	6318	7649	3646	8651
Fixed assets	90	61	98	120	23	253	98	50	157
Overheads	147	91	160	107	45	154	136	76	159
Equity	1381	946	1291	908	506	1226	1251	716	1289

Note: All variables are reported in US $ at 2007 prices.

Table 5: Results of the financial ratio analysis. Mean and median values

	CTI			NIE			ROA			ROE			NIM			OOI		
Pooled	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**
Mean	40.38	46.45	46.10	2.28	3.28	3.06	3.35	6.03	3.88	22.36	24.52	21.07	3.55	5.20	4.55	2.30	3.60	2.50
T-test	0.048**																	
Median	36.42	43.38	37.73	1.92	2.66	2.14	3.12	4.13	3.32	22.46	22.12	22.42	3.48	3.59	3.50	1.77	2.50	1.87
M-W	0.005***			0.000***			0.000***			0.916			0.015**			0.001***		
K-S	0.006***			0.000***			0.018**			0.557			0.115			0.001***		
2004																		
Mean	36.40	47.70	39.30	2.16	3.90	2.64	2.54	2.93	2.65	18.04	15.48	17.33	3.08	4.23	3.39	1.69	2.67	1.95
T-test	(0.024)**			(0.040)**			(0.716)			(0.379)			(0.169)			(0.191)		
Median	42.30	54.78	44.01	2.12	3.14	2.21	3.07	3.21	3.08	21.88	18.22	21.46	3.71	3.88	3.75	1.66	1.88	1.66
M-W	(0.047)**			(0.007)***			(0.554)			(0.493)			(0.274)			(0.641)		
K-S	(0.021)**			(0.091)*			(0.180)			(0.133)			(0.700)			(0.784)		
2005																		
Mean	31.66	37.94	33.39	2.11	3.21	2.41	3.60	7.23	4.60	23.02	26.74	24.01	3.34	7.18	4.40	2.61	3.49	2.85
T-test	(0.165)			(0.003)***			(0.185)			(0.433)			(0.247)			(0.259)		
Median	35.37	40.92	35.95	2.04	3.14	2.28	3.77	5.05	3.82	25.49	27.15	25.57	3.94	3.71	3.89	2.25	2.86	2.43
M-W	(0.212)			(0.000)***			(0.154)			(0.957)			(0.662)			(0.307)		
K-S	(0.171)			(0.000)***			(0.081)*			(0.400)			(0.202)			(0.216)		
2006																		
Mean	36.16	43.02	38.08	1.96	2.84	2.21	3.15	6.18	3.99	20.89	23.33	21.57	3.29	3.56	3.37	2.06	3.64	2.51
T-test	(0.145)			(0.006)**			(0.099)*			(0.535)			(0.571)			(0.021)**		
Median	34.50	44.38	37.17	1.89	2.54	1.96	3.41	4.08	3.44	21.65	19.82	21.60	3.53	3.32	3.39	1.83	3.33	1.90
M-W	(0.079)*			(0.001)***			(0.064)*			(0.800)			(0.940)			(0.012)**		
K-S	(0.094)*			(0.002)***			(0.025)**			(0.471)			(0.579)			(0.011)**		
2007																		
Mean	42.47	39.76	41.73	1.97	2.69	2.18	2.72	4.30	3.17	18.93	20.14	19.27	3.05	3.36	3.13	1.87	3.39	2.30
T-test	(0.449)			(0.028)**			(0.102			(0.607)			(0.312)			(0.027)**		
Median	33.53	38.96	35.53	1.83	2.40	1.98	2.84	4.51	2.96	21.22	22.19	21.37	2.85	2.74	2.77	1.58	2.38	1.77
M-W	(0.420)			(0.006)**			(0.008)**			(0.432)			(0.911)			(0.026)**		
K-S	(0.498)			(0.019)**			(0.000)**			(0.637)			(0.187)			(0.031)**		

*=significant at 10% significance level; **=significant at 5% significance level; ***=significant at 1% significance level
t test tests the null hypothesis that the means of the two samples are equal (equal variances are not assumed)
M-W is the Mann Whitney U test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location)
KS is the Kolmogorov-Smirnov 2-sample test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location and shape)

Table 6a-c: Gross Efficiency DEA Results by year. Mean and median values

	a) Gross Efficiency									b) Net Efficiency									c) Bank Type Efficiency					
	CRS			VRS			SE			CRS			VRS			SE			CRS			VRS		
Pooled	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**
Mean	0.855	0.806	0.806	0.911	0.872	0.900	0.939	0.922	0.934	0.912	0.891	0.906	0.942	0.944	0.942	0.969	0.942	0.961	0.935	0.902	0.926	0.966	0.922	0.954
T-test	(0.020)**			(0.036)**			(0.186)			(0.231)			(0.870)			(0.015)**			(0.006)***			(0.000)***		
Median	0.862	0.803	0.852	0.930	0.893	0.924	0.974	0.969	0.972	0.914	0.985	0.923	0.970	1.000	0.987	0.986	0.997	0.990	0.972	0.917	0.948	0.998	0.962	0.996
M-W	(0.049)**			(0.247)			(0.422)			(0.303)			(0.006)***			(0.390)			(0.010)***			(0.002)***		
K-S	(0.006)***			(0.042)**			(0.451)			(0.004)***			(0.001)***			(0.006)***			(0.008)***			(0.000)***		
2004																								
Mean	0.919	0.885	0.910	0.945	0.919	0.938	0.973	0.963	0.971	0.927	0.934	0.929	0.951	0.958	0.953	0.976	0.974	0.975	0.992	0.946	0.979	0.994	0.957	0.984
T-test	(0.229)			(0.312)			(0.476)			(0.765)			(0.719)			(0.918)			(0.000)***			(0.003)***		
Median	0.909	0.922	0.913	0.964	0.964	0.964	0.995	0.984	0.988	0.927	1.000	0.942	0.978	1.000	1.000	0.994	1.000	0.997	1.000	0.932	0.999	1.000	0.964	1.000
M-W	(0.609)			(0.707)			(0.527)			(0.160)			(0.135)			(0.256)			(0.000)***			(0.004)***		
K-S	(0.329)			(0.575)			(0.384)			(0.156)			(0.177)			(0.283)			(0.000)***			(0.002)***		
2005																								
Mean	0.822	0.794	0.815	0.917	0.899	0.912	0.896	0.879	0.891	0.906	0.875	0.897	0.947	0.950	0.948	0.957	0.916	0.945	0.905	0.903	0.904	0.968	0.943	0.961
T-test	(0.535)			(0.589)			(0.578)			(0.426)			(0.878)			(0.109)			(0.933)			(0.232)		
Median	0.813	0.797	0.811	0.930	0.991	0.938	0.914	0.926	0.915	0.911	0.975	0.914	0.953	1.000	0.979	0.967	0.975	0.967	0.908	0.916	0.912	0.993	0.994	0.994
M-W	(0.604)			(0.667)			(0.930)			(0.807)			(0.143)			(0.786)			(0.798)			(0.852)		
K-S	(0.400)			(0.481)			(0.680)			(0.209)			(0.156)			(0.180)			(0.788)			(0.499)		
2006																								
Mean	0.815	0.754	0.798	0.875	0.831	0.863	0.931	0.904	0.924	0.909	0.836	0.889	0.932	0.915	0.927	0.976	0.914	0.959	0.894	0.901	0.896	0.938	0.908	0.930
T-test	(0.233)			(0.321)			(0.346)			(0.131)			(0.682)			(0.045)**			(0.783)			(0.233)		
Median	0.786	0.698	0.782	0.885	0.819	0.877	0.964	0.918	0.960	0.901	0.905	0.904	0.939	1.000	0.972	0.995	0.991	0.994	0.898	0.917	0.898	0.975	0.897	0.967
M-W	(0.144)			(0.569)			(0.598)			(0.419)			(0.225)			(0.556)			(0.625)			(0.343)		
K-S	(0.107)			(0.524)			(0.440)			(0.048)**			(0.192)			(0.202)			(0.977)			(0.151)		
2007																								
Mean	0.863	0.790	0.843	0.905	0.840	0.887	0.954	0.943	0.951	0.907	0.917	0.910	0.938	0.953	0.942	0.967	0.962	0.966	0.949	0.858	0.924	0.964	0.877	0.940
T-test	(0.053)*			(0.095)*			(0.504)			(0.731)			(0.552)			(0.773)			(0.000)***			(0.003)***		
Median	0.842	0.785	0.824	0.958	0.856	0.903	0.986	0.969	0.981	0.918	1.000	0.929	0.984	1.000	1.000	0.992	1.000	0.995	0.976			1.000	0.875	0.988
M-W	0.049**			(0.147)			(0.161)			(0.252)			(0.212)			(0.205)			(0.000)***			(0.005)***		
K-S	0.133			(0.363)			(0.192)			(0.151)			(0.250)			(0.151)			(0.000)***			(0.001)***		

*=significant at 10% significance level; **=significant at 5% significance level; ***=significant at 1% significance level
t test tests the null hypothesis that the means of the two samples are equal (equal variances are not assumed)
M-W is the Mann Whitney U test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location)
KS is the Kolmogorov-Smirnov 2-sample test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location and shape)

Table 7a-b: Mean DEA Efficiencies and Financial Ratios by country

		Bahrain	Kuwait	Oman	Qatar	S.Arabia	UAE
a) DEA Efficiencies							
Gross	**CRS**	0.855	0.779	0.826	0.866	0.799	0.875
	VRS	0.910	0.858	0.870	0.917	0.913	0.908
	SE	0.940	0.906	0.948	0.945	0.875	0.963
Net	**CRS**	0.928	0.837	0.897	0.926	0.874	0.934
	VRS	0.958	0.900	0.922	0.961	0.927	0.957
	SE	0.966	0.931	0.974	0.964	0.945	0.976
Type	**CRS**	0.922	0.925	0.917	0.934	0.912	0.935
	VRS	0.949	0.950	0.942	0.954	0.984	0.947
b) Financial Ratios							
	CTI	54.05	39.16	48.88	36.56	29.29	42.65
	NIE	3.28	2.63	3.35	2.17	2.48	2.68
	ROA	3.83	4.50	2.86	5.33	4.94	4.45
	ROE	13.72	25.36	20.84	32.12	34.95	22.43
	NIM	4.30	3.47	4.73	5.35	5.49	3.77
	OOI	3.07	3.14	1.54	2.30	2.38	2.90

Note: See Table 2 for definitions of financial ratios.

Table 8: Spearman's correlations (ρ) between DEA efficiencies and financial ratios

		CTI		NIE		ROA		ROE		NIM		OOI	
Gross CRS	Pooled	0.126	(0.019)**	0.304	(0.000)***	-0.271	(1.000)	-0.109	(0.964)	-0.111	(0.966)	-0.389	(1.000)
	2004	0.271	(0.013)**	0.211	(0.041)**	-0.008	(0.527)	0.058	(0.318)	-0.030	(0.596)	-0.221	(0.965)
	2005	0.260	(0.015)**	0.411	(0.000)***	-0.224	(0.968)	-0.098	(0.788)	-0.087	(0.761)	-0.318	(0.996)
	2006	0.185	(0.065)*	0.433	(0.000)***	-0.322	(0.996)	-0.120	(0.835)	-0.083	(0.750)	-0.484	(1.000)
	2007	0.230	(0.032)	0.431	(0.000)***	-0.347	(0.998)	-0.035	(0.611)	-0.434	(1.000)	-0.446	(1.000)
Gross VRS	Pooled	0.176	(0.002)***	0.239	(0.000)***	-0.159	(0.996)	-0.006	(0.537)	-0.099	(0.948)	-0.279	(1.000)
	2004	0.290	(0.008)***	0.220	(0.035)**	-0.046	(0.354)	0.047	(0.351)	0.035	(0.388)	-0.326	(0.997)
	2005	0.208	(0.043)**	0.248	(0.020)**	-0.049	(0.655)	-0.022	(0.572)	-0.174	(0.924)	-0.106	(0.807)
	2006	0.224	(0.033)**	0.290	(0.008)***	-0.147	(0.884)	0.065	(0.298)	-0.056	(0.676)	-0.280	(0.990)
	2007	0.247	(0.023)**	0.330	(0.003)***	-0.325	(0.996)	-0.025	(0.578)	-0.343	(0.998)	-0.386	(0.999)
Net CRS	Pooled	0.066	(0.141)	0.173	(0.002)***	-0.177	(0.998)	-0.138	(0.989)	-0.119	(0.975)	-0.253	(1.000)
	2004	0.194	(0.056)*	0.130	(0.143)	-0.012	(0.539)	-0.006	(0.521)	0.039	(0.374)	-0.198	(0.948)
	2005	0.192	(0.057)*	0.181	(0.068)*	-0.080	(0.742)	-0.061	(0.691)	0.008	(0.475)	-0.132	(0.860)
	2006	0.029	(0.406)	0.235	(0.027)**	-0.245	(0.978)	-0.232	(0.972)	-0.077	(0.735)	-0.358	(0.999)
	2007	0.035	(0.390)	0.216	(0.039)**	-0.292	(0.992)	-0.154	(0.894)	-0.531	(1.000)	-0.277	(0.988)
Net VRS	Pooled	0.097	(0.056)*	0.085	(0.082)*	-0.044	(0.763)	-0.029	(0.683)	-0.076	(0.895)	-0.128	(0.982)
	2004	0.170	(0.083)*	0.127	(0.150)	-0.022	(0.573)	-0.017	(0.556)	0.122	(0.159)	-0.323	(0.996)
	2005	0.234	(0.026)**	0.060	(0.312)	0.114	(0.176)	0.031	(0.400)	0.036	(0.384)	0.051	(0.338)
	2006	-0.011	(0.537)	-0.011	(0.534)	-0.059	(0.684)	-0.032	(0.603)	-0.108	(0.810)	-0.088	(0.761)
	2007	0.121	(0.166)	0.178	(0.074)*	-0.154	(0.893)	-0.058	(0.680)	-0.393	(0.999)	-0.132	(0.856)
Type CRS	Pooled	0.081	(0.092)*	0.249	(0.000)***	-0.272	(1.000)	-0.071	(0.879)	-0.103	(0.956)	-0.347	(1.000)
	2004	0.271	(0.013)**	0.227	(0.030)**	-0.069	(0.712)	0.150	(0.109)	-0.001	(0.503)	-0.185	(0.934)
	2005	0.127	(0.149)	0.408	(0.000)***	-0.357	(0.999)	-0.178	(0.929)	-0.157	(0.901)	-0.400	(1.000)
	2006	0.193	(0.058)*	0.298	(0.007)***	-0.179	(0.928)	-0.009	(0.529)	-0.173	(0.921)	-0.294	(0.993)
	2007	0.214	(0.042)**	0.394	(0.000)***	-0.345	(0.998)	0.040	(0.375)	-0.199	(0.947)	-0.464	(1.000)
Type VRS	Pooled	0.189	(0.001)***	0.279	(0.000)***	-0.185	(0.999)	0.034	(0.289)	-0.102	(0.953)	-0.289	(1.000)
	2004	0.371	(0.001)***	0.279	(0.010)***	-0.115	(0.826)	0.107	(0.190)	-0.109	(0.813)	-0.199	(0.948)
	2005	0.186	(0.063)*	0.366	(0.001)***	-0.077	(0.735)	0.001	(0.495)	-0.224	(0.968)	-0.184	(0.935)
	2006	0.345	(0.002)***	0.348	(0.002)***	-0.053	(0.667)	0.148	(0.114)	-0.002	(0.505)	-0.233	(0.972)
	2007	0.253	(0.020)**	0.363	(0.001)***	-0.374	(0.999)	0.006	(0.479)	-0.232	(0.971)	-0.473	(1.000)

P-values are given in parenthesis. Null hypothesis is that $\rho = 0$ against the alternative $\rho > 0$.
*,**,*** indicate significance at the 90%, 95% and 99% significance level.

Table 9a-b: Results of the Malmquist Productivity analysis

	Malmquist index				**Efficiency change index (E)**				**Technology change index (T)**			
	2004-2007		E.A.A.I.		2004-2007		E.A.A.I.		2004-2007		E.A.A.I.	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
a) CRS												
Conventional	0.989	0.992	0.997	0.998	0.939	0.947	0.984	0.986	1.061	1.082	1.015	1.020
Islamic	1.077	0.968	1.019	0.992	0.901	0.859	0.974	0.963	1.179	1.152	1.042	1.036
All	1.013	0.988	1.003	0.997	0.928	0.925	0.981	0.981	1.094	1.098	1.023	1.024
T-test	(0.404)				(0.401)				(0.136)			
MW test	(0.768)				(0.134)				(0.041)**			
KS test	(0.440)				(0.019)**				(0.111)			
b) VRS												
Conventional	0.990	0.996	0.998	0.999	0.958	1.000	0.989	1.000	1.040	1.071	1.010	1.017
Islamic	1.108	0.976	1.026	0.994	0.915	0.904	0.978	0.975	1.204	1.134	1.048	1.032
All	1.023	0.994	1.006	0.999	0.946	0.997	0.986	0.999	1.085	1.078	1.021	1.019
T-test	(0.289)				(0.235)				(0.109)			
MW-test	(0.883)				(0.210)				(0.122)			
KS-test	(0.634)				(0.374)				(0.180)			

*,**,*** indicate significance at the 90%, 95% and 99% significance level.
Numbers in parentesis are p-values for the statistical tests
T-test tests the null hypothesis that the means of the two samples are equal (equal variances are not assumed)
M-W is the Mann Whitney U test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location)
KS is the Kolmogorov-Smirnov 2-sample test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location and shape)
E.A.A.I. = Equivalent Annual Average Index

Table 10a-c: Gross, Net and Type Dea efficiencies for the model without the equity. Mean and median values

	a) Gross Efficiency									b) Net Efficiency									c) Bank Type Efficiency					
	CRS			VRS			SE			CRS			VRS			SE			CRS			VRS		
Pooled	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**	**Conv**	**Isl**	**All**
Mean	0.689	0.628	0.672	0.871	0.830	0.860	0.790	0.745	0.778	0.823	0.756	0.805	0.915	0.907	0.913	0.898	0.818	0.876	0.829	0.831	0.829	0.950	0.917	0.941
T-test	(0.051)			0.051			(0.101)			(0.027)**			(0.657)			(0.001)***			(0.905)			(0.005)***		
Median	0.670	0.609	0.661	0.885	0.848	0.882	0.814	0.741	0.797	0.818	0.803	0.816	0.926	1.000	0.955	0.913	0.890	0.876	0.845	0.834	0.840	0.999	0.945	0.995
M-W	(0.057)			0.168			(0.245)			(0.392)			(0.028)**			(0.203)			(0.734)			(0.005)***		
K-S	(0.095)			0.181			(0.361)			(0.000)***			(0.002)***			(0.000)***			(0.562)			(0.010)***		
2004																								
Mean	0.555	0.486	0.536	0.912	0.856	0.896	0.605	0.553	0.591	0.759	0.739	0.754	0.922	0.923	0.922	0.824	0.782	0.812	0.727	0.663	0.709	0.989	0.928	0.972
T-test	(0.051)*			(0.103)			(0.316)			(0.763)			(0.978)			(0.450)			(0.122)			(0.000)***		
Median	0.523	0.469	0.512	0.921	0.889	0.915	0.562	0.500	0.561	0.750	0.896	0.751	0.924	1.000	0.959	0.819	0.896	0.820	0.744	0.649	0.706	1.000	0.924	1.000
M-W	(0.057)*			(0.135)			(0.104)			(0.946)			(0.276)			(0.989)			(0.045)**			(0.000)***		
K-S	(0.095)			(0.103)			(0.107)			(0.015)**			(0.192)			(0.028)**			(0.022)**			(0.000)***		
2005																								
Mean	0.703	0.666	0.693	0.885	0.863	0.879	0.792	0.764	0.784	0.853	0.736	0.821	0.927	0.923	0.923	0.919	0.788	0.883	0.815	0.913	0.842	0.953	0.937	0.948
T-test	(0.508)			(0.553)			(0.560)			(0.046)**			(0.898)			(0.010)***			(0.002)***			(0.485)		
Median	0.690	0.651	0.676	0.890	0.831	0.889	0.801	0.731	0.795	0.847	0.651	0.843	0.939	1.000	0.963	0.918	0.795	0.910	0.821	0.961	0.849	0.985	0.996	0.990
M-W	(0.427)			(0.817)			(0.600)			(0.124)			(0.256)			(0.111)			(0.003)***			(0.916)		
K-S	(0.660)			(0.481)			(0.892)			(0.002)***			(0.262)			(0.004)***			(0.001)***			(0.788)		
2006																								
Mean	0.723	0.662	0.706	0.825	0.783	0.813	0.877	0.824	0.862	0.834	0.740	0.808	0.901	0.877	0.894	0.926	0.825	0.898	0.863	0.894	0.872	0.914	0.895	0.909
T-test	(0.337)			(0.415)			(0.232)			(0.136)			(0.627)			(0.024)**			(0.315)			(0.524)		
Median	0.692	0.638	0.686	0.820	0.816	0.816	0.950	0.893	0.905	0.825	0.811	0.817	0.909	1.000	0.921	0.934	0.859	0.925	0.915	0.867	0.898	0.971	0.906	0.966
M-W	(0.266)			(0.665)			(0.430)			(0.337)			(0.346)			(0.123)			(0.480)			(0.762)		
K-S	(0.133)			(0.469)			(0.338)			(0.037)**			(0.314)			(0.013)**			(0.595)			(0.801)		
2007																								
Mean	0.774	0.699	0.753	0.865	0.817	0.851	0.888	0.837	0.874	0.845	0.810	0.835	0.910	0.903	0.908	0.923	0.879	0.911	0.908	0.853	0.893	0.944	0.907	0.934
T-test	(0.202)			(0.312)			(0.280)			(0.536)			(0.861)			(0.268)			(0.034)**			(0.122)		
Median	0.779	0.708	0.770	0.889	0.856	0.863	0.951	0.869	0.949	0.869	0.808	0.856	0.969	1.000	0.979	0.968	0.977	0.969	0.938	0.832	0.906	0.994	0.897	0.981
M-W	(0.216)			(0.486)			(0.428)			(0.893)			(0.316)			(0.861)			(0.024)**			(0.128)		
K-S	(0.588)			(0.788)			(0.411)			(0.726)			(0.647)			(0.202)			(0.008)***			(0.374)		

*=significant at 10% significance level; **=significant at 5% significance level; ***=significant at 1% significance level
t test tests the null hypothesis that the means of the two samples are equal (equal variances are not assumed)
M-W is the Mann Whitney U test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location)
KS is the Kolmogorov-Smirnov 2-sample test which tests the null hypothesis that the two samples are drawn from different distributions
(against the alternative that their distributions differ in location and shape)