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The effect of market structure, regulation, and risk on banks efficiency

Evidence from the Gulf cooperation council countries

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Abstract

Purpose – The purpose of this paper is to analyze the efficiency performance of the Gulf Cooperation Countries (GCC) banking sector. The primary focus is to assess whether market power, risk taking activities, and regulations have significant effects on GCC banks' efficiency performance.

Design/methodology/approach – The estimation and inference has been implemented using a double bootstrap procedure that simultaneously corrects for bias and validates inference on the influence of covariates. In the first stage, efficiency scores are estimated with data envelopment analysis (DEA). In the second stage, variation in the resulting efficiency scores is explained using a truncated regression model with inference based on a semi-parametric bootstrap routine.

Findings – The authors found compelling evidence that efficiency is not independent of the market structure, the bank's risk taking activities, and the regulatory environment. In particular, the Lerner Index provides evidence that market power decreases efficiency. The capital adequacy, the supervisory power and the market discipline were all found to improve efficiency. Additionally, when the risk is measured by the *Z*-Score or even by the ratio of non-performing loans to total loans, it adversely affects efficiency.

Research limitations/implications – The results of the current study have important implications for regulators and supervisors. Promoting banks' competitive environment in the GCC countries through reducing the information barriers to entry, encouraging bank privatization, and lowering the activities restrictions can potentially improve operational efficiency of banks. Also enhancing banks' diversification activities and risk management techniques may have the advantage of increasing operational efficiency. Furthermore, improvements in the regulatory conditions that enhance banking supervision and monitoring would also improve efficiency.

Originality/value – The main contributions of the paper are threefold: first, to the knowledge, this study is the first to employ by far the most comprehensive data set of GCC banks investigated to date. Second, the analysis focusses on the influence of a wide set of factors, most of them was not covered before in related economic literature on bank efficiency of the GCC countries. Third, the methodological innovation involves applying a double bootstrap procedure proposed by Simar and Wilson (2007).

Keywords Risk-taking, Regulations, Market power, Bank efficiency, GCC banks

Paper type Research paper

JEL Classification — C30, G21, G28

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1. Introduction

The spread of the financial crisis originating in the USA has revealed an increased inter-connectedness between financial markets and institutions. Many banks around the globe have failed, and banking sector profits plummeted. The financial turmoil has necessitated a major revision of policies and regulations related to deregulation, competition, and capital adequacy. The survival of banks in the current deregulated, free, open, and competitive markets depends on their performance and efficiency. Hence, the information on efficiency in financial institutions provides insights for bank management to improve performance. For instance, the knowledge on the influence of various risk-taking activities, diversification, size, and liquidity may be useful in revising policies that aim to improve performance and efficiency.

Following the recent global financial crisis, bank efficiency and exposures to external shocks were brought to the forefront in the Gulf Cooperation Countries (the GCC hereinafter)[1]. For instance, shortly after the global financial meltdown in August 2008, the Central Bank of Kuwait halted trading in the shares of the Gulf Bank, and appointed an auditor to monitor operations, after the bank suffered big losses in foreign currency derivative contracts. As banks were vulnerable, a sequence of events and policies to protect has also been followed. For instance, to shield against a run on banks, both the United Arab Emirates (UAE) and Kuwait moved to guarantee deposits. Moreover, the authorities in Saudi Arabia and the UAE pumped liquidity into the banking system to alleviate the liquidity stress in financial markets. In the meantime, Qatar has invested in its banks' stocks. The sequence of events did not stop, and a year after came the default of two large business groups in Saudi Arabia and the Dubai's debt crisis. All these events have raised doubts regarding potential problems and failures that may emerge in the banking sector and motivate a study of the determinants of efficiency in the GCC countries.

In this paper, we test the significance of traditional factors that may influence bank efficiency in the GCC countries. Our paper is supposed to fill a geographical gap in terms of the nature of association between a large group of variables and bank efficiency. Thus, our analysis is not restricted, and it covers a wide range of explanatory variables that was not investigated before in GCC banks. The previous literature on bank efficiency in the GCC is scant, and its main interest lies on measuring efficiency[2]; as opposed to investigating the determinants of efficiency, as we do in this paper. The only study found that established formally a relationship between market structure and efficiency is Al-Muharrami and Matthews (2009). However, this study did not control for some other relevant variables such as market discipline and supervisory power, and it used an inaccurate measure to estimate efficiency. The inference in this study is conducted in two steps: measuring efficiency in the first step; regression and inference on the determinants in the second step[3].

The two step methodology used in this paper to measure efficiency employs a double bootstrap procedure proposed by Simar and Wilson (2007) to ensure consistency of efficiency scores and estimated parameters. The procedure is applied to the truncated regression that uses the DEA measure. The first bootstrap draws efficiency simulates using the truncated regression results[4], and Monte Carlo draws from its innovations. These simulates are used to compute bias-corrected and consistent estimates of banks efficiency, that are then used (backwards) to re-generate simulated estimates of covariate parameters and their standard errors. The Monte Carlo experiments of Simar and Wilson (2007) have shown that the performance of this procedure is superb in terms of the coverage of the estimated confidence interval of efficiency, and of other slope parameters

of the truncated regression. In contrast to that, the plain vanilla two stage truncated procedure results were found to be catastrophic.

Our results clearly show that examined factors were strongly significant. Specifically, we found compelling evidence that efficiency is not independent of the market structure, the bank's risk taking activities, and the regulatory environment. Furthermore, the capital adequacy, the supervisory power and the market discipline were all found to improve efficiency. Finally, when the risk is measured by the *Z*-Score or even by the ratio of non-performing loans to total loans, it adversely affects efficiency.

The paper now proceeds as follows. The second section provides a brief background on the main bank efficiency determinants and surveys the related literature. Section 3 outlines the methodology used to measure efficiency and infer its relation with covariates. The fourth section describes the covariates included and their measurement. The details of the data set and the empirical results are included in Section 5. Finally, Section 6 contains some concluding remarks.

2. Background and related literature review

The literature on banking efficiency is extensive. Dating back to Hicks (1935) seminal article, it is well documented that greater market power is associated with deteriorating efficiency (for recent evidence see Casu and Girardone, 2006; Berger and Hannan, 1997; Delis and Tsionas, 2009; Fenn *et al.*, 2008; Turk-Ariss, 2010). The quiet life hypothesis of Hicks (1935) argues that under monopoly, the manager tends to relax, and to waste some economic profits through discretionary expenses. Similarly, and along the same lines, is the threat of liquidation hypothesis of Leibenstein (1966), which claims that increased competition may heighten pressures to reduce slack and increase efficiency.

The Hicks (1935) and the Leibenstein (1966) hypotheses stands in marked contrast to the relative market power hypothesis of Demsetz (1974), which emphasizes that bank market power is positively related to efficiency. The economies of scale and scope, the reduced funding costs, and savings in monitoring and assessment were all cited as factors expected to promote efficiency. The empirical evidence that supports this hypothesis is still scarce. For instance, Pruteanu-Podpiera and Weill (2008) have examined the effect of market power on efficiency in the Czech Republic, and found that greater market power is associated with greater efficiency. A similar story can be found in Maudos and DeGuevara (2007) for the case of the Spanish banking sector. These findings are serious as they raise skepticism regarding policies that aim at enhancing competition in the banking industry.

Another well-established fact is the effect of regulation and supervision environments on bank efficiency. This was investigated by Barth *et al.* (2004) who examined (among abroad range of other variables) capital adequacy, supervisory power[5], and market discipline. Their hypothesis assumes that increased capital requirement will reduce lending, enhance loan quality, and decrease monitoring costs. Supporting empirical evidence were the works of Pasiouras (2008a, b), Lozano-Vivas and Pasiouras (2010), and Barth *et al.* (2013). However, the results of Barth *et al.* (2004) himself were skeptical since no significant relation between capital and efficiency was recorded (see also Pasiouras *et al.*, 2009; Delis *et al.*, 2009, for similar skeptical evidence).

Moreover, Barth *et al.* (2004) showed that supervision effect was also weak, and that only those regulations which ensure accurate disclosure were effective. They claimed that failures in the banking market is a low-frequency event, and that the government

failure to correct is almost inevitable. Their empirical evidence is also consistent with that theory, and they concluded that empowering private monitoring, and market discipline would be more effective than relying on government intervention. The supporting literature of their findings includes Barth *et al.* (2006, 2007), Pasiouras (2008a, b), Delis *et al.* (2009), Pasiouras *et al.* (2009), Uchida and Satake (2009), Lozano-Vivas and Pasiouras (2010), and Barth *et al.* (2013).

On the other hand, under the Beck *et al.* (2003, 2006) version, official supervision enhances corporate governance and boosts efficiency. Contrary to their hypothesis, Beck *et al.* (2003, 2006) empirical results indicate that the relation between supervision and efficiency is weak. However, some supporting evidence of their version of the story can be found in Pasiouras (2008a, b), Chortareas *et al.* (2012), and Barth *et al.* (2013).

In addition to regulation, a factor that has received increasing attention in recent years was risk taking. The relation between bank risk taking and efficiency has been the focus of Berger and DeYoung (1997). Under the bad management hypothesis, additional monitoring costs associated with increased risk exposure of banks reduces efficiency. Similarly, the bad luck hypothesis expects efficiency to deteriorate in the aftermath of economic shocks due to dispersed management efforts and troubled loans. The evidence of the effect of risk on efficiency can be found in Berger and De Young (1997), Berger and Mester (1997), Kwan and Eisenbeis (1997), Sun and Chang (2011), Fiordelisia *et al.* (2011), and Chortareas *et al.* (2011). In these studies, a negative relationship was significant, and has been explained by the fact that poor performance is more likely to be associated with poor risk management. However, approval of these results is not universal. For instance, the skimping hypothesis predicts a positive relationship between risk and efficiency in the short run. The empirical evidence consistent with this hypothesis includes among others Isik and Hassan (2003), and Havrylchyk (2006).

3. Methodology

This paper uses DEA to calculate efficiency values. One of the well-known advantages of the DEA method is that it allows us to compare banking markets of different size with respect to a common frontier, and without imposing any specific parametric functional form. Hence, the DEA does not pre-specify a production technology. This is serious as we do not have to deal with any possible misspecications due to inappropriate functional form (see Pasiouras, 2008b). Moreover, in the DEA we do not need long time series data to carry out estimation compared to other parametric frontier methods such as the stochastic frontier analysis, the thick frontier approach, and/or the distribution free approach[6].

The DEA can be implemented using either an input or an output orientation. In the input orientation approach, the objective is to estimate the degree of potential input savings for a given realized output level of the unit (Bougnol *et al.*, 2010). However, under the output-orientation, we measure the extent to which output may have been expanded for the level of inputs used by the unit. To date, the theoretical literature in this field is somewhat inconclusive and controversial as to the best choice among the alternative orientations of measurement[7]. Following the most recent banking literature (e.g. Casu and Girardone, 2006; Delis, 2009; Chortareas *et al.*, 2012; Barth *et al.*, 2013), we chose the input-orientation model since banks are typically focussed on cost control rather than on output during transitional periods and following substantial reforms.

Due to space constraints, a short description of the DEA is given here[8]. Assume that $\hat{\theta}_i$ is the efficiency estimate[9] of bank i, that can be obtained by solving a linear programming problem of the type:

$$\hat{\theta}_i = \min_{\hat{\theta}_i \lambda} \left\{ \theta > 0 \left| \sum_{i=1}^{n} x_{ki} \lambda_i \leqslant \hat{\theta}_i x_k, \forall k; \sum_{i=1}^{n} y_{mi} \lambda_i \geqslant y_m, \forall m; \sum_{i=1}^{n} \lambda_i - 1, \lambda \geqslant 0, \forall i; \right. \right\} \quad (1)$$

where x_i and y_i denotes the sample input and output vectors, respectively, and n refers to the number of banks in the sample. Note also that λ_i is an nX1 vector of weights that sums to one. The vector forms a convexity constraint that ensures comparison against the same size. It also allows for variable returns to scale. The inference about the determinants of bank efficiency is derived by regressing the estimated efficiency scores in (1) on relevant explanatory variables using censored regression models[10]. This approach allows for the measurement of the combined effects and for testing the significance of various factors.

Despite its wide use, this inference procedure is subject to a number of drawbacks. First, efficiency estimates obtained in (1) are biased. Although the DEA measure rules out the possibility that the true frontier lies below the constructed frontier, it may still lie above, especially when the more efficient regions of the frontier are not covered by the sample points. Second, the two-stage procedure depends on factors that were not accounted for in estimating efficiency. This implies that the efficiency estimates in (1) are serially correlated. This is serious, as inference on the basis of inconsistent and correlated measure is invalid. Hence, in this paper we use a double bootstrap procedure that corrects the bias in efficiency scores, and takes into account the potential endogeneity problem caused by the omitted variable bias and the relationship between bank efficiency and its determinants through the use of the truncated regression. For more details information on this procedure see Simar and Wilson (2007 pp. 41-42)[11].

To date, the literature is inconclusive as to the proper definition and measures of inputs and outputs that has to be used in the production frontiers. Most studies, however, have followed either the production approach or the intermediation approach[12]. The production approach considers banks as producers of services that perform transactions on deposit accounts and process documents such as loans. Accordingly, it defines banks' inputs as the number of employees and physical capital; and outputs as number of accounts or its related transactions[13]. The intermediation approach on the other hand considers that banks mainly mobilize funds from savers to investors. In particular, banks collect purchased funds (deposits) and use labor and physical capital to transform these funds into interest-earning loans and other assets. Berger and Humphrey (1997) argue that the intermediation approach may be more appropriate for evaluating entire banks than the production approach, as it normally takes interest expense into account, which is a large proportion of a bank's total costs. Furthermore, they point out that the intermediation approach may be superior for evaluating the importance of frontier efficiency to the profitability of banks since minimization of total costs (not just production costs) is needed to maximize profits.

The review of the previous studies indicates that the intermediation approach is the most commonly used one[14]. Following these studies, we follow the "intermediation approach" for our estimation of banking efficiency. Accordingly, four inputs are considered; total deposits; interest expenses; operational expenses (non-interest expenses) net of personnel expenses; and personnel expenses[15]. On the output side, we used also four variables; performing loan[16]; other earning assets; interest revenue;

and non-interest revenue. While the first three outputs are fairly standard in the literature, the forth variable is included to control for the impact of non-traditional banking activities as in Isik (2008), Das and Ghosh (2009), Barth *et al.* (2013), among many others[17].

All data were deflated by the consumer price index and converted into constant 2001 dollars. Panel A of Table I shows a summary of statistics of the input and the output variables.

To examine the impact on bank efficiency, we estimate the following truncated panel specification:

$$\hat{\theta}_{it} = \beta_0 + \beta_1 Risk_{it} + \beta_1 Power_{it} + \sum_{k=1}^{n} y_k Reg_{kt} + \sum_{k=1}^{n} y_k Structure_{kt} + \sum_{k=1}^{n} \vartheta_{kt} X_{k,it} + \sum_{k=1}^{n} \vartheta_k Eco_{kt} + \varphi D_t + \varepsilon_{it},\ \varepsilon_{it} = v_i + u_{it} \tag{2}$$

where $\hat{\theta}_{it}$ is the technical efficiency of bank i in period t. The disturbance term, ε consists of a fixed effect v_i, and an identically and independently distributed idiosyncratic error term, u_{it}. The variables, *Risk* and *MARP* represent the bank risk-taking and the bank-specific market power proxies, respectively. *Reg* is time-dependent indices of bank regulation common to all banks in each country. We also include a set of control variables. *Structure* is the set of control variables that represents the market structure common to all banks in each country. X is a vector of bank-level variables reflecting the characteristics of each bank. The *Eco* variables are a vector that controls for the macroeconomic environment common to all banks in each country. Finally, the specification includes the dummy variable D. This variable is expected to capture the influence of the recent global nancial crisis. Following is a description of the measurement of these variables Table II[18].

4. Measuring determinants of bank efficiency

To estimate the degree of market power, we use the Lerner index. The index measures the distance between the price and marginal cost. The Lerner index is the markup of output price above marginal cost, and it is therefore used as an indicator of the degree of market power. The Lerner index measure is defined as $Lerner_{it} = P_{it}^{q} - MC_{it}/P_{it}^{q}$; where P_{it}^{q}, and MC_{jt} are the price of output and marginal cost of bank i at time t, respectively[19].

Following Maudos and DeGuevara (2007), Turk-Ariss (2010), and Agoraki *et al.* (2011), among many others we estimate marginal cost from a Translog frontier cost function. In that function, the total costs depend on the prices of three inputs: labor, physical capital, and funds. It also depends on the bank's output (measured as total earning assets) and trend. Specifically, we use the bank-level panel data for each country to estimate the following Trans log cost function:

$$LnC_{it} = \alpha_0 + \alpha_1 lnq_{it} + \frac{1}{2}\alpha_2 ln(q_{it})^2 + \sum_{k=1}^{3} \beta_{kt} \ln W_{k,it} + \frac{1}{2}\sum_{k=1}^{3}\sum_{j=1}^{3} \beta_{k,it} \ln W_{k,it} \ln w_{j,it} + \frac{1}{2}\sum_{k=1}^{3} \delta_k \ln q_{it} \ln W_{k,it} + \mu_1 Trend + \frac{1}{2}\mu_2 Trend^2 + \mu_3 Trend \times \ln q_{it} + \sum_{k=1}^{3} \rho_k Trend \times \ln W_{k,it} + \tau_{it}, \quad \tau_{it} = \omega_i + \varsigma_{it} \tag{3}$$

Variable	Bahrain		Kuwait		Oman		Qatar		Saudi Arabia		UAE		Full sample	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Panel A: input-output variables														
Inputs (in million US $)														
Interest expenses	222.13	355.90	255.05	246.62	52.64	58.32	133.40	214.01	384.76	270.65	169.80	259.76	214.844	218.265
Operational expenses	81.00	102.19	93.733	112.29	48.52	43.52	58.68	69.39	300.64	223.29	87.72	112.69	110.998	113.878
Personnel expenses	50.23	64.54	54.54	62.14	27.24	25.00	32.32	38.41	168.83	112.64	51.89	65.78	62.525	63.939
Total deposits	4,955.82	6,808.17	6,710.45	8,044.51	1,849.51	2,148.18	4,262.84	7,098.95	16,800.81	11,593.06	5,004.34	7,187.62	6,843.331	7,046.222
Outputs (in million US $)														
Performing loan	2,948.98	4,333.58	4,572.36	5,579.02	1,640.28	1,834.40	3,311.91	5,349.81	10,251.42	7,536.85	4,270.78	6,506.27	4,693.581	5,016.971
Other earning assets	3,592.83	4,952.45	4,182.96	3,559.96	563.97	735.32	1,867.07	2,674.88	8,207.27	6,123.82	1,930.13	2,825.19	3,490.060	3,420.275
Interest revenue	321.21	472.94	478.46	502.82	136.53	139.76	274.31	390.65	986.60	674.17	331.01	460.28	428.042	440.685
Non-interest revenue	69.047	81.44	128.18	146.59	32.59	43.11	76.04	111.11	283.36	234.81	98.83	151.62	118.646	126.153
Panel B: lerner index														
Dependent variable														
Total cost C_{it} (in million US $)	303.14	446.19	348.78	344.07	101.16	99.87	192.09	279.88	685.41	454.75	257.53	360.36	319.35	324.55
Input														
Total assets q_{it} (in million US $)	6,956.73	9,429.08	9,513.32	9,226.74	2,415.88	2,851.23	5,555.62	8,609.21	20,141.77	14,059.46	6,774.21	9,807.89	8,684.84	8,944.03
Personnel expenses/total assets $W_{1,it}$ (%)	1.22	0.92	0.70	0.46	1.26	0.33	0.86	0.50	0.90	0.27	1.08	0.73	0.773	0.728
Other operating expenses/fixed assets $W_{2,it}$ (%)	5.48	5.71	14.31	48.09	3.18	1.58	3.38	2.65	2.51	1.20	3.74	3.31	8.348	8.151
Interest expenses/total deposits $W_{3,it}$ (%)	2.48	1.91	1.64	1.08	3.14	1.41	2.03	1.03	2.04	0.65	2.42	1.48	1.803	1.712
Panel C: Z-Score variables														
Period-average of return on assets $\overline{ROA}_i$	0.70	2.19	2.70	2.11	2.33	0.78	3.47	0.84	2.51	0.83	4.21	0.73	2.061	2.064
Equity capital/total assets CAP_i	16.78	10.14	19.91	16.69	16.70	10.84	24.06	26.39	12.01	3.49	21.89	14.36	16.264	16.044
SD of return on assets σ_{ROAi}	4.38	5.61	3.28	4.43	1.01	0.76	1.51	0.72	1.12	1.03	2.00	3.27	2.350	2.249

Note: The table reports the descriptive statistics of the variables used in estimating efficiency scores, *Z*-Score, and Lerner index
Source: Bankscope and own calculations

Table I. Descriptive statistics of the variables used to measure efficiency, Z-Score, and market power by country

Table II.
Descriptive of the variables used in the regression analysis

Variable	Measure	Expected Effect	Source
Dependent variables			
Bank efficiency	Technical efficiency score estimated based on the DEA approach		Authors' calculations
Independent variables			
Bank risk-taking	Ratio of non-performing loans to total loans (NPLs)	−	Bankscope
	Z-Score	+	Authors' calculations
Market power	Lerner index proposed by Lerner (1934)	±	Authors' calculations
Regulatory variables			
Capital requirements	Index that measures the overall capital stringency. The indicator ranges between 0 and 9, with higher values indicating greater stringency	±	Barth *et al.* (2004, 2006, 2008)
Supervisory power	Index reveals the power of the supervisory agencies to take specific actions in relation to their authority against bank management and directors, shareholders, and bank auditors. The indicator ranges between 0 and 14, with higher values denoting greater supervisory power	±	Barth *et al.* (2004, 2006, 2008)
Market discipline	Index that measures the degree to which regulations enable the private sector to monitor banks. The indicator ranges between 0 and 8, with higher values indicating higher degree of disclose accurate information to the public and more incentives to increase private monitoring	+	Barth *et al.* (2004, 2006, 2008)
Activity restrictions	Index aggregates measures that indicate whether bank activities in the securities, insurance and real estate markets, ownership and control of non-financial firms are unrestricted, permitted, restricted, or prohibited. The aggregate indicator ranges between 0 to 16, with higher values indicating greater restrictions	±	Barth *et al.* (2004, 2006, 2008)
Bank-specific characteristics			
Bank size	Logarithm of total assets	+	Bankscope
Profitability	Net income to total assets	+	Bankscope
Intermediation	Loans to total assets	+	Bankscope

(*continued*)

Variable	Measure	Expected Effect	Source
Capitalization	Book value of equity to total assets	+	Bankscope
Diversification	Non-interest income/total operation income	±	Bankscope
Country-specific variables			
Public ownership	Fraction of the banking system's assets in banks that are 50% or more foreign owned	+	Barth *et al.* (2004, 2006, 2008)
Foreign ownership	Fraction of the banking system's assets in banks that are 50% or more foreign owned	−	Barth *et al.* (2004, 2006, 2008)
Economic conditions	Annual real GDP growth rate	+	International financial statistics
Inflation	Current period inflation rate (consumer prices)	−	International financial statistics
Global financial crisis	Dummy variable takes on values of 1 for crisis years (2007-2008) and 0 otherwise	−	

Note: This table details the definitions of variables used to estimate in our regression analysis to investigate the determinants of the GCC banks' efficiency

Table II.

where C_{it} is the total cost (financial and operating) of bank i at time t. Note that q_{it} refers to the total assets. Also the variables $W_{1,it}$, $W_{2,it}$, $W_{3,it}$ are, respectively, the cost of labor, the cost of physical capital, and the cost of loanable funds. The cost of labor is measured as the ratio of personnel expenses to total assets[20]. The ratio of operating expenses (net of labor cost) to fixed assets is used to proxy the cost of physical capital. The interest expense to total deposits was used to compute the cost of loanable funds. Panel B of Table I, presents summary statistics of the variables used to estimate the Trans log cost function. We include a time dummy variable (*Trend*) to capture the effect of technical changes, as well as any effects of omitted trending variables. The disturbance term τ_{it} includes an unobserved bank-specific effect ω_i, and an idiosyncratic error ς_{it}. The Equation (2) is estimated using the generalized method of moments[21]. Once Equation (2) is estimated, the marginal cost may be computed as:

$$MC_{it} = \frac{C_{it}}{q_{it}}\left[\alpha_1 + \alpha_2 lnq_{it} + \sum_{k=1}^{3}\beta_{kt} lnw_{k,it} + \mu_3 Trend\right] \quad (4)$$

The regulatory environment is summarized using four variables; capital requirement, the power of the supervisory agencies, market discipline, and activity restrictions. The variables above are measured using ready indices that exist in the World Bank database. The World Bank database was developed by Barth *et al.* (2001, 2006, 2008).

Each index corresponds to one of the regulatory variables, and its value can be obtained by summing the number of positive answers (or negative answers) of a pre-defined relevant qualitative question set. The question set describes the various dimensions of the related variable. For instance, the questions on capital requirement, relates to its consistency with Basel II, the deductions before computing regulatory capital, and the sources of funds that may be used as capital. Similarly, for other variables there is another set of related questions. Additional information on the computation of these indices is available on the World Bank web site[22].

We proxy the risk-taking behavior of banks using two alternative measures; the ratio of non-performing loans to total loans (NPL) and the *Z*-Score. The first measure reflects the current credit risk of the bank. As banks improve their screening, assessment and monitoring activities, the quality of written assets improves and efficiency increases. The second measure is the *Z*-Score, which is defined as $\overline{ROA_i} + CAP_i/\sigma_{ROAi}$, where $\overline{ROA_i}$ and σ_{ROAi} are the average and the standard deviation of returns on assets and CAP_i is the equity ratio. The standard deviation (volatility) of *ROA* is estimated as a three-year moving average. The score above is monotonically related to the default risk of the bank. In particular, the wider the equity base, the higher and more certain the bank's profitability, the greater the value of the index and the less likely default is[23]. Panel C of Table I, presents summary statistics of the inputs used to compute the *Z*-Score.

In addition to the variables described above, we incorporate market-specific ($Structure_{kt}$), bank-specific ($X_{k,it}$), and macroeconomic variables (Eco_{kt}) that are expected to impact bank efficiency[24]. First, we control for cross-country differences in the market structure using the following two variables: the degree of foreign ownership, and the degree of government ownership. These variables were measured by the fraction of the banking system's assets in banks that are 50 percent or more government owned (public ownership), and the fraction of the banking system's assets in banks that are 50 percent or more (foreign ownership).

Second, at the bank level, we control for five bank characteristics. The size is controlled for by using the log of bank total assets. The square of the size variable was also included in the regressions to control for any existing non-linear relation with efficiency. The bank's profitability is controlled by including the return on assets. For controlling the level of intermediation, we use the ratio of loans to total assets. The bank capital was controlled for by capital adequacy ratio, which is computed as the book value of shareholder's equity to total assets[25]. Finally, diversification is measured by the ratio of non-interest income to total operating income.

Third, we control for the general economic conditions by including two variables: GDP growth and inflation rates. The GDP growth is used as a proxy for the phase of business cycle. The economic cyclicality may affect the short-term efficiency of banks. For instance, as aggregate income expands, profitability ratios improve, the probability of default drops, and the bank is expected to show improved efficiency. Similarly, inflation is considered to have negative impact on the medium and the long-term contracts of the bank. Finally, to control for the effect of the recent global financial crisis, we include a dummy variable takes on values of 1 for crisis years (2007-2008) and 0 otherwise.

5. Empirical analysis

5.1 Data set

The sample is composed of annual observations that cover all the GCC countries. The bank data set was obtained from Bank Scope database provided by Fitch-IBCA[26]. In the sample, we include all the banks in the database that have ten years of data available between 2000 and 2009. The filtered sample includes 70 banks. All data were deflated with the consumer price index to convert into real, in constant 2001 dollars. The data of the regulatory indices was obtained from the World Bank databases on Bank Regulation and Supervision[27]. In particular, we get the indices for 2000 by using the 2001 database, and we obtain the indices for the years 2001-2004, from the 2003 database, and finally we use for the years from 2005 to 2009, the 2007 database. The data for the macroeconomic variables were collected from the International Financial Statistics of the International Monetary Fund.

5.2 Efficiency estimates

We estimate the banks' efficiency scores relative to a common best-practice frontier by pooling the data across countries. Table III presents the bootstrap efficiency estimates of each of the GCC countries from 2000 to 2009[28].

As can be seen in the table, the average efficiency for all countries over the study period was 86 percent. This level of efficiency compares nicely with the levels reported by previous studies that covered the GCC (see Turk-Ariss *et al.*, 2007; Ramanathan, 2007; Mustafa, 2007; Srairi, 2010). It is also close to the level of efficiency measured for North American and European banks (see Tortosa-Ausina *et al.*, 2008; Siriopoulos and Tziogkidis, 2010; Lozano-Vivas and Pasiouras, 2010; Chortareas *et al.*, 2013). However, it is higher than the levels reported for developing and transition economies' banks (see Isik and Hassan, 2003; Kyj and Isik, 2008; Pasiouras, 2008b; Delis, 2009; Sufian, 2009; Hsiao *et al.*, 2010; Staub *et al.*, 2010; Fukuyama and Matousek, 2011).

Table III also clearly indicates that efficiency has increased until 2003. The average efficiency in 2003 was around 92 percent. This was not surprising, as during that period the GCC countries implemented significant financial reforms, which aimed at promoting financial markets, and increasing competition. The macroeconomic

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
2000	85.36140	90.66814	89.03085	83.44465	92.16120	81.47799
2001	87.75537	90.34520	91.60666	89.61684	94.07403	92.00292
2002	98.22664	90.32153	98.20643	95.45579	98.95518	95.24164
2003	96.43715	84.34558	96.42711	92.34568	96.65488	91.39029
2004	82.36709	90.18582	93.00247	91.42680	92.06667	92.05141
2005	77.95399	87.83153	88.70509	90.35714	90.56563	86.32908
2006	81.46725	85.89634	83.03674	90.26636	89.93887	84.10470
2007	75.02899	81.92992	80.31038	90.85997	89.05457	85.37164
2008	53.63552	76.06607	74.48264	82.73199	81.60383	74.56463
2009	72.23067	82.43436	68.91655	83.33761	82.77205	78.07425

Table III.
Average bootstrap efficiency scores 2000 and 2009

Notes: Technically efficient (TE) DEA scores estimated based on the output-oriented approach. Efficiency scores were estimated using the double bootstrap procedure introduced by Simar and Wilson (2007) with 2,000 bootstrap draws

stability, and the removal of interest rate controls, may have also contributed to improved technical efficiency during the period. Following 2003, efficiency deteriorated. The drop marked clearly the years: 2004, 2005, and 2006. The economic environment in these years was characterized by high inflation[29], which may have caused fluctuations and instability in factor prices. Add also to that the increase in risk appetite as reflected by the big expansion in credit. Moreover, banks have also invested heavily in technology during the period, and this may have forced efficiency to drop[30]. The efficiency level reached 84 percent in 2006.

The drop in efficiency has continued to the years 2007 and 2008. Compared to the 2006 levels, the 2007 were 10 percent less. This may be attributed to the credit crunch that followed the global financial crisis. The adverse impact of the financial crisis on bank efficiency was more pronounced in 2008, where efficiency fell by another 12 percent. On the contrary, the 2009 efficiency estimates demonstrated substantial recovery and increased by 5 percent. This implies that the devastating impact of the global crisis was absorbed in 2009, and that the banking sector has started to recover. These estimates also appear to be in line with recorded banks recovery in other parts of the world during 2009 (for instance see Siriopoulos and Tziogkidis, 2010; Banker *et al.*, 2010; Manlagnit, 2011).

5.3 Summary statistics of key variables

Table IV, Panel A, reports the mean and the standard error for each of the variables used in the model. The table shows that the explanatory variables significantly differ among individual countries. The Saudi and Qatari banks are the most efficient. The estimated efficiency is 91 percent and 89 percent for both countries, respectively. In contrast, the Bahrain banks were the least efficient in the sample with an estimated efficiency of 81 percent. The average ratio of non-performing loans to total loans was 5.02 percent for the whole of the GCC region. Its country value ranges from 3.9 percent in the case of Oman, to 12.4 percent in Bahrain. The relatively high ratio of non-performing loans points to the poor quality of underwritten loans in the GCC countries. This may be confirmed by the *Z*-Score, which indicates higher risk compared to developed, developing, and transitional economies. The average *Z*-Score stands at 1.698 for the whole region, which is higher than that observed in either transitional or developing countries (see Turk-Ariss, 2010; Agoraki *et al.*, 2011).

Variable	Bahrain		Kuwait		Oman		Qatar		Saudi Arabia		UAE		Full sample	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dependent variable														
Bank efficiency	81.046	12.134	86.002	4.593	86.372	9.050	88.984	4.102	90.785	5.175	86.061	6.366	86.542	6.903
Independent variables														
Bank-risk taking														
NPLs	12.394	17.474	6.930	4.376	5.406	3.902	5.723	7.457	4.967	4.777	5.270	5.404	5.200	9.001
Z-Score	1.384	1.742	0.678	0.896	2.930	4.771	2.798	4.776	0.874	4.415	1.523	1.956	1.698	3.260
Banking market structure														
Market power	0.788	0.158	0.316	0.056	0.349	0.029	0.366	0.166	0.382	0.051	0.402	0.088	0.436	0.294
Regulatory variables														
Capital requirements	3.667	1.247	5.333	0.471	6.733	0.189	5.500	2.500	4.333	0.943	5.000	0.000	5.094	0.892
Supervisory power	14.667	1.247	10.667	2.055	12.333	2.494	11.667	2.625	12.333	1.886	12.000	0.000	12.278	1.718
Market discipline	8.000	0.816	9.000	1.414	7.000	0.816	8.000	0.000	8.333	1.247	9.000	0.000	8.222	0.716
Activity restrictions	9.667	0.471	9.000	1.414	12.000	0.816	8.500	2.500	11.333	0.471	8.000	0.000	9.750	0.945
Bank-specific characteristics														
Bank size	3.365	0.7218	3.715	0.541	3.125	0.503	3.336	0.399	4.180	0.366	3.479	0.604	3.533	0.522
Profitability	1.409	8.437	2.346	4.203	2.337	1.374	2.845	0.662	2.665	1.883	2.308	2.882	2.318	3.240
Intermediation	37.479	21.268	40.009	21.536	72.729	11.378	51.933	1.712	49.390	9.136	59.578	15.624	51.853	13.442
Capitalization	16.681	10.603	22.942	20.995	16.131	7.329	23.858	17.474	12.014	3.487	20.020	12.579	18.608	12.078
Diversification	16.681	10.603	22.942	20.995	16.131	7.329	23.858	17.474	12.014	3.487	20.020	12.579	18.608	12.078
Country-specific variables														
Public ownership	60.680	23.438	0.000	0.000	15.333	5.431	7.450	7.450	10.350	10.350	27.000	0.000	20.135	7.696
Foreign ownership	2.767	3.231	0.000	0.000	0.000	0.000	45.133	1.226	13.733	9.733	35.000	0.000	16.105	2.365
Economic conditions (GDP growth)	6.023	1.515	5.300	6.033	4.880	3.181	13.155	7.966	3.403	2.403	6.394	4.493	6.526	4.265
Inflation	1.575	1.643	3.331	2.856	2.580	3.971	5.701	6.231	2.091	3.240	5.531	3.841	3.468	3.630

Notes: See Table II for detailed definition of each variable. Computed by authors using data from BankScope, Barth *et al.* (2004, 2006, 2008), International Monetary Fund(2011)'s International Financial Statistics (IFS). All variables are expressed in percentage except Bank Size

Table IV.
Summary statistics of the regression variables

The Lerner index indicates that the banking market in the GCC is not competitive. Its average for the whole of the GCC was 43.7 percent. However, it showed a significant variation; from 31.6 to 78.8 percent for both Kuwait and Bahrain, respectively. Panel B of Table IV, reports the annual Lerner index of the GCC countries. Table IV also includes the indices used to proxy the regulatory environment. These indices show some variations across countries. The capital requirements index ranges between 3.67 and 6.73 for Bahrain and Oman, respectively. Compared to the whole region (the value is 5.09) the capital requirements are more stringent in Oman than in Bahrain. The supervisory power and the market discipline indices were relatively similar across countries. However, the activity restrictions index showed that the banking activities in countries like Qatar and Oman is relatively restricted, when compared to either the UAE, or the whole of the GCC region.

The ownership structure is also reported in Table IV. The numbers show that 20.3 percent of the GCC banking system is owned by foreigners. The foreign ownership in the GCC during the period of the study was as follows: 60.7 percent in Bahrain, 27 percent in the UAE, 15.3 percent in Oman, 10.35 percent in Saudi Arabia, 7.45 percent in Qatar, and there is no foreign owned banks in Kuwait. Table V also shows that 16.1 percent of the GCC banking sector is owned by the government. The government ownership across countries was as follows: 45.1 percent in Qatar, 35 percent in the UAE, 13.7 percent in Saudi Arabia, and 2.8 percent in Bahrain. There were no banks owned by the government in Oman and Kuwait.

5.4 Analysis of the determinants of efficiency

The inference on efficiency determinants is based on the parameters and the *t*-values of the truncated regression, that was bootstrapped using the double algorithm. In particular, we implemented the bootstrap algorithm to estimate four nested models. The results are presented in Table IV. The table reports regression results derived from the estimation of five models.

The first column (Model 1) presents the basic regression model that includes market power (the Lerner index) and it's squared, the bank regulatory and supervisory variables (the capital requirement; the supervisory power; the market discipline; and the activity restrictions), the risk-taking variable (the ratio of non-performing loans to total loans, NPL), the other bank characteristics control variables (size and its squared; profitability measured by the return on assets; intermediation measured by the ratio of loans to total asset; capitalization measured by the book value of equity to total assets; and diversification measured by the ratio of non-interest income to operating income). Model 2 adds the percentage of foreign ownership, and government ownership, to the first model. Model 3 accounts for the effect of economic condition, the GDP growth and inflation rates. Model 4 is the biggest model and it includes all variables plus a dummy that captures the recent global financial crisis. The last four models (Models 5-8) correspond to re-estimating Models 1-4 using the *Z*-Score instead the risk of insolvency.

Our results indicate that the ratio of non-performing loans to total loans (NPL) is negatively related to efficiency at the 5 percent significant level. The results are robust to the risk measure. Models 5-8 use the *Z*-Score instead, and report similar results. Particularly, it is found that the effect of the *Z*-Score on bank efficiency is positive and significant at the 5 percent level, meaning that a bank with lower probability to default (i.e. less risk taking) is more efficient than its peers. Similar empirical evidence on the relation between risk and efficiency was provided by Berger and DeYoung (1997), Kwan and Eisenbeis (1997), Delis (2009), Sun and Chang (2011), Fiordelisia *et al.* (2011),

Table V.
Truncated bootstrapped two-stage regression

Variables	Model specification (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	1.5046***	1.3159***	1.3672***	1.2720***	1.3633***	1.1944***	1.2889***	1.2185***
	(11.1244)	(8.5402)	(9.0946)	(9.0868)	(10.7571)	(8.4080)	(9.3139)	(9.2989)
Bank-risk taking								
NPLs	−0.2074***	−0.1982***	−0.1974***	−0.2254***				
	(−3.6319)	(−3.5132)	(−3.6272)	(−4.4526)				
Z-Score					0.0335*	0.0309*	0.0317*	0.0340**
					(1.8506)	(1.7062)	(1.8159)	(2.0656)
Banking market structure								
Market power	−0.0078**	−0.0062**	−0.0052**	−0.0049*	−0.0063**	−0.0044**	−0.0028*	−0.0025*
	(−2.6225)	(−2.3447)	(−1.9444)	(−1.6925)	(−2.5117)	(−2.2837)	(−1.8411)	(−1.6756)
Market power^2	−0.0068***	−0.0069***	−0.0066***	−0.0054***	−0.0061***	−0.0061***	−0.0057***	−0.0043**
	(−3.3226)	(−3.4022)	(−3.4139)	(−3.0072)	(−2.9729)	(−3.0361)	(−2.9196)	(−2.3243)
Inflection point	−0.5735	−0.4493	−0.3939	−0.5735	−0.5164	−0.3607	−0.2456	−0.2907
Sign of relationship	–	–	–	–	–	–	–	–
Regulatory variables								
Capital requirements	0.0071**	0.0056**	0.0041*	0.0020 (1.5403)	0.0081**	0.0071**	0.0064**	0.0052*
	(2.0217)	2.0395	(1.8409)		(2.4660)	(2.3010)	(2.0859)	(1.9292)
Supervisory power	0.0062***	0.0053**	0.0045*	0.0035*	0.0079***	0.0045**	0.0058***	0.0039*
	(3.3564)	(1.8427)	(1.8655)	(1.6704)	(4.2789)	(1.9511)	(2.6308)	(1. 8378)
Market discipline	0.0051**	0.0173***	0.0094**	0.0073**	0.0062**	0.0172***	0.0087**	0.0052*
	(1.9751)	(4.3544)	(2.3071)	(1.9514)	(2.2901)	(4.5569)	(2.2434)	(1.9265)
Activity restrictions	−0.0070***	−0.0078**	−0.0064*	−0.0051*	−0.0061**	−0.0080*	−0.0054	−0.0046
	(−2.6048)	(−1.9326)	(−1.893)	(−1.7512)	(−2.2381)	(−1.8052)	(−1.2958)	(−1.1448)
Bank-specific characteristics								
Bank size	−0.3704***	−0.3574***	−0.3345***	−0.2882***	−0.3444***	−0.3313***	−0.3197***	−0.2890***
	(−5.5512)	(−5.2293)	(−5.0632)	(−4.6823)	(−5.5195)	(−5.2284)	(−5.2381)	(−5.0015)
Bank size^2	0.0509***	0.0481***	0.0472***	0.0443***	0.0492***	0.0463**	0.0469***	0.0457***
	(5.4226)	(5.0319)	(5.1141)	(5.1549)	(5.5450)	(5.1527)	(5.4180)	(5.5912)
Inflection point	3.6385	3.7152	3.6385	3.6385	3.5000	3.5778	3.4083	3.1619

(*continued*)

Table V.

Variables	Model specification (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sign of relationship	−	−	−	−	−	−	−	±
Profitability	0.5044***	0.5248***	0.4901***	0.2793**	0.7071***	0.7153***	0.6709***	0.5090***
	(3.3231)	(3.5232)	(3.3847)	(2.0489)	(5.2005)	(5.3563)	(5.1739)	(4.1042)
Intermediation	−0.0591**	−0.0322	−0.0082	−0.0278	−0.0344	−0.0096	−0.0113	−0.0344
	(−1.9577)	(−1.0216)	(−0.1592)	(−0.9676)	(−1.2349)	(−0.3358)	(−0.4090)	(−1.3096)
Capitalization	−0.1781***	−0.1709***	−0.1128**	−0.0941)**	−0.1520***	−0.1449***	−0.0951**	−0.0820**
	(−3.9646)	(−3.7782)	−(2.5349)	(−2.1053)	(−3.6120)	(−3.4473)	(−2.3181)	(−2.0524)
Diversification	0.0459****	0.0469***	0.0379**	0.0295**	0.0545***	0.0520***	0.0444***	0.0396***
	(3.1109)	(3.2119)	(2.6746)	(2.2396)	(3.8130)	(3.6721)	(3.2462)	(3.0611)
Country-specific variables								
Public ownership		−0.1532***	−0.1077***	−0.0528*		−0.1506***	−0.0980**	−0.0485
		(−4.1819)	(−2.9880)	(−1.5542)		(−4.2042)	(−2.7803)	(−1.4329)
Foreign ownership		−0.1202***	−0.0911**	−0.1176***		−0.1000***	−0.0689*	−0.0948***
		(−2.8283)	(−2.1759)	(−3.0172)		(−2.4560)	(−1.7323)	(−2.5126)
Economic conditions			−0.1569*	−0.0308			0.1428	0.0276
			(1.6299)	(−0.3364)			(1.4801)	(0.2954)
Inflation			−0.8256***	−0.6296***			−0.8660***	−0.3096**
			(−6.4824)	(−4.7144)			(−6.8727)	(−2.2744)
Global financial crisis				−0.1063***				−0.0965***
				(−9.5004)				(−8.4396)
Sigma ($\widehat{\sigma_c}$)	0.1032***	0.1007***	0.0971***	0.0902***	0.1055	0.10325***	0.0993***	0.0938***
	(34.1760)	(33.6749)	(33.6750)	(33.6750)	(34.9571)	(34.4674)	(34.4675)	(34.4675)

Notes: This table shows the truncated bootstrapped two-stage results with the technical efficiency as the dependent variable. The estimations are conducted on observations from 70 banks for the years 2000-2009. The *t*-statistics are in the parentheses. Inference is based on confidence intervals obtained from 2000 bootstrap draws. Bootstrapped confidence intervals of coefficients estimated (not reported) are available under request. *,**,***Significant at the 10, 5 and 1 percent levels, respectively, according to bootstrap confidence intervals

Chortareas *et al.* (2011, 2012). These studies have pointed out the negative influence of risk taking activities on bank efficiency.

The evidence on the relation between risk and efficiency is enough to support the bad management hypothesis of Berger and DeYoung (1997). The hypothesis refers to the reduced efficiency following an increase in risk taking activity, due to additional costs of managing troubled loans and monitoring performance. It also blends well with the bad luck hypothesis that tries to explain inefficiency in terms of dispersed managerial efforts in the aftermath of unexpected bad economic conditions. However, these findings stand at marked distance from the skimping hypothesis that expects a positive relationship between risk taking and efficiency over the short run. According to this hypothesis, if banks choose to allocate fewer resources to monitoring loans, it may appear to be more efficient due to the drop in its operating expenses.

The role of market power was also negative and significant at conventional levels. Table V shows that the parameters associated with the levels, and the squares, of the Lerner index were all negative and significant. The relation between bank market power and efficiency is negative and non-linear. In order to determine the type of the relation, we computed the inflection point of each of the quadratic models in Table V, and compared it with the distribution of the data. For instance, the inflection point of Model 1 was −0.5735, which covers approximately the second percentile of the Lerner index distribution. This implies that more than 98 percent of market power data lies above the inflection point.

The result on the effect of market power validates the quiet life hypothesis of Hicks (1935). The hypothesis argues that greater market power is associated with less managerial effort. Similarly, it stands well close to Leibenstein (1966), who claimed that inefficiencies are eliminated by increased competition. According to his threat of liquidation hypothesis, an increase in competition provides a direct incentive for managers to increase efforts to operate closely to their production frontier, and also provides the principals with relevant information to monitor the agents' activities. However, our results stand contrary to the Demsetz (1974) relative power hypothesis, which predicts a reverse causality between competition and efficiency.

From the recent evidence, we contradict Maudos and DeGuevara (2007), who reported evidence on the EU banking sector. However, we are consistent with Berger and Hannan (1997), Fenn *et al.* (2008), Casu and Girardone (2006) and Delis and Tsionas (2009) who provided results on the US and the EU markets. We are also in line with the findings of Turk-Ariss (2010) on developing economies. All these studies have reported a negative relationship between market power and efficiency.

The theoretical prediction as well as the empirical evidence on the effect of the stringency of capital requirements is mixed. For instance, higher capital proportions may reduce bank lending and the associated costs and hence, increase efficiency. However, a higher capital proportion may raise the funding cost as capital is expensive, and this may adversely affect efficiency. Moreover, as the capital requirement against loans becomes stringent, banks arbitrage by investing in different asset classes which may in turn affect their efficiency.

As can be seen in Table V, the capital requirement variable was found to have a positive significant effect on efficiency. A strict capital standard may have substantial positive influence on the efficiency of banks in the GCC countries. This result supports the arguments that higher capital requirements may result in lowering the probability of bankruptcy, improving the information availability, which in turn increases the efficient operation of banks (Berger and Bonaccorsi di Patti, 2006;

Chortareas *et al.*, 2012). Similar evidence on the effect of capital was found in Pasiouras (2008a, b), Lozano-Vivas and Pasiouras (2010), Barth *et al.* (2013)[31]. Contradicting evidence was reported by Barth *et al.* (2004), Pasiouras *et al.* (2009), Delis *et al.* (2009).

The effect of supervisory power on efficiency was also positive, suggesting that official supervision can improve the efficient operation of banks. This contradicts Barth *et al.* (2004), Delis *et al.* (2009), and Lozano-Vivas and Pasiouras (2010), who found that supervision was not significant. This difference in finding may be explained by the weak corporate governance standards and practices that characterize banks in the GCC countries. Hence, a stronger role of the supervisor to monitor corruption, and bad practices may compensate for weak corporate governance and improves efficiency (Pasiouras *et al.*, 2009; Chortareas *et al.*, 2012; Barth *et al.*, 2013).

Consistent with previous studies[32], the market discipline was found to be positive and significant across all models. This finding suggests that improving the information disclosure requirements will mitigate information asymmetry and transaction costs and allow private agents to monitor banks more effectively which in turn increase their operational efficiency. Similarly, a negative association between the activity restriction variable and efficiency was recorded across all models. The lifting of restrictions on bank activities and markets may have increased efficiency through diversification, growth, and economies of scope. The result stands in line with the empirical studies of Pasiouras *et al.* (2009), Lozano-Vivas and Pasiouras (2010), and Barth *et al.* (2013). Contradicting evidence was reported by Barth *et al.* (2004) and Chortareas *et al.* (2012).

This paper proceeds to discuss the empirical results of control variables. The government ownership effect on efficiency was found to be negative and significant. This indicates that a higher proportion of government owned banks is bad for efficiency. The result goes well with the general argument that government owned banks are occasionally concerned with national policy goals that may negatively influence efficiency. Findings of the most previous empirical studies is consistent with the negative effect of government ownership on efficiency, for instance see Pasiouras (2008a, b), Pasiouras *et al.* (2009), Delis (2009), Delis *et al.* (2009), among others.

Regarding the foreign ownership variable we found a negative impact on bank efficiency. A result that contradicts Havrylchyk (2006), Isik (2008), Pasiouras *et al.* (2009), Delis (2009), but conforms well with Berger *et al.* (2000), Berger (2007), Fukuyama and Matousek (2011) and Sufian (2011). Our result is consistent with the home field advantage hypothesis of Berger *et al.* (2000), which pointed to the relative weaknesses of foreign-owned banks due to cultural barriers, and the disadvantages of distant monitoring and management. Another supporting story of our evidence is the version of Weill (2003), who states that foreign banks are subject to substantial information disadvantages compared to local banks. The managers of foreign banks are exposed to substantial asymmetric information and adverse selection problems. They lack the experience to deal with morale hazard, and they have less knowledge about domestic markets and legal environment.

Turning to the bank-specific control variables, the size was found to be significant at the 1 percent level. The associated parameters were negative at the levels and positive at the squares. The inflection point for Model 1 of Table V was 3.64, above which 67 percent of the size distribution lies. Because the sign of the parameter of the quadratic term is positive, the estimated function is concave and rises upward after the inflection point. This implies that larger banks are more efficient than

smaller counterparts. However, the smaller banks are more likely to enjoy gains from economies of scale.

As expected, we find that profitability is positively associated with efficiency. A higher profitability enhances efficiency in accordance with Isik and Hassan (2003), Fukuyama and Matousek (2011), Chortareas *et al.* (2013), and others. On the contrary, the ratio of loans to total assets exhibits a negative relationship with bank efficiency; however, the associated parameter is not significant at conventional levels. The book value of equity to total assets exhibits a negative and statistically significant relationship with bank efficiency. This lies broadly in line with the findings of Lozano-Vivas and Pasiouras (2010), and Sufian (2011). It suggests that efficient banks, Ceteris Paribus, use less equity. The finding is consistent with the argument that an increase in capital equity reduces technical efficiency, due to higher costs. The coefficient associated with diversification was also positive and significant. This finding is consistent with previous studies on other countries (e.g. Cesari and Daltung, 2000; Bos and Kolari, 2005; Rossi *et al.*, 2009). It implies that diversification enhances efficiency through less idiosyncratic risk and increased incentives to monitoring.

The effect of the economic environment was inconclusive. While the growth of GDP does not appear to impact efficiency, the effect of inflation is negative and significant. The inflation may increase labor price, interest rates, and asset prices, thereby reducing bank efficiency. Finally, the dummy variable which was included to capture the possible influence of the global financial crises during the period 2007-2009, was found to be negative and significant.

6. Conclusion

This paper contributes to the existing literature by testing the significance of traditional determinants of bank efficiency in the GCC countries. The inference in this study is conducted in two steps: measuring efficiency in the first step; regression and inference on the determinants in the second step. Hence, in this paper we measure efficiency using a recent double bootstrap methodology that yields more accurate estimates than the non-parametric methods of Charnes *et al.* (1978) and Banker *et al.* (1984) used in the most previous literature. Furthermore, our methodologies is one step in measuring efficiency, and inferring its determinants, and hence, compared to others who used two step methods, our results are more accurate, and free from pre-test bias.

We found significant evidence that market power is associated with inefficient banks. This conforms to the quiet life hypothesis of Hicks (1935), and to the threat of liquidation hypothesis of Leibenstein (1966), but contradicts the Demsetz (1974) efficient structure hypothesis. On the regulatory variables, there is compelling evidence that a stringent capital requirement, a strong supervisory review, transparency, and market discipline promote efficiency. However, the restrictions on bank activity were found to reduce efficiency. These variables were not investigated before for the case of GCC banks. However, the bulk of international evidence is consistent with these findings except for a strong supervisory review. For instance, see Barth *et al.* (2004), Pasiouras *et al.* (2009), Lozano-Vivas and Pasiouras (2010), and Barth *et al.* (2010) on similar evidence on capital requirements and market discipline. The same work has also provided a contradictory evidence of the supervisory review. These results point that while the international evidence supports a lenient supervision to increase efficiency, this may not be true in our case where a strong supervisory role proves to be indispensable to promote efficiency in GCC banks.

Furthermore, our results indicate that risk is negatively related to efficiency. Similar empirical evidence on the relation between risk and efficiency was provided by Berger and DeYoung (1997), Kwan and Eisenbeis (1997), Delis (2009), Sun and Chang (2011), Fiordelisia *et al.* (2011), and Chortareas *et al.* (2011). These studies have pointed out the negative influence of risk taking activities on bank efficiency. Finally, we found that big, privately owned banks were more efficient. Foreign banks were also found to be inefficient. These results support the home field advantage hypothesis of Berger *et al.* (2000) as well as the information disadvantage hypothesis of Weill (2003).

The results of the current study have important implications for regulators and supervisors. Promoting banks' competitive environment in the GCC countries through reducing the information barriers to entry, encouraging bank privatization, and lowering the activities restrictions can potentially improve operational efficiency of banks. Also enhancing banks' diversification activities and risk management techniques may have the advantage of increasing operational efficiency. Furthermore, improvements in the regulatory conditions that enhance banking supervision and monitoring would also improve efficiency. It is worth reiterating that we found that the GCC banks experienced relative efficiency demolishes during the recent financial crises. A possible policy conclusion from this result is that further enhancement in the regulatory and supervisory framework would improve efficiency and increase stability of the banking sectors in the GCC countries; just in case of any "bad luck" scenario occurred to the global economy and spilled on the GCC.

Finally, we should note that our empirical work did not investigate the difference in determinants of bank efficiency between Islamic and non-Islamic banks in the sample. This might be an interesting topic to handle in the future. Moreover, the financial meltdown in 2008 might have affected the nature of association and the empirical findings and hence, pre-crisis and post-crisis investigation of the nature of association is another area that could be approached in future research[33].

Notes

1. The GCC countries consist of the following countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE.
2. See for example Mustafa (2007), Al-Muharrami (2007), Al-Tamimi and Lootah (2007), Ramanathan, 2007, and Turk-Ariss *et al.* (2007).
3. In Al-Muharrami and Matthews (2009), efficiency is measured non-parametrically in one step, and then the inference is derived in a second step using regression techniques. Hence, the inference in the second step depends on the accuracy with which efficiency is measured in the first step.
4. The linear programming DEA measure is regressed on covariates in a truncated regression. The results from this regression will provide the initial inputs to start the whole procedure.
5. The supervisory power includes the degree of independence, the speed of corrective actions, loan classifications and provisioning standards, and the diversification guidelines.
6. For more detail on these methods see Berger and Humphrey (1997); and Fethi and Pasiouras (2010).
7. It is worth noting here that these two models yield exactly same values under Constant Return to Scale, but not when Variable Returns to Scale is assumed (Thanassoulis, 2001).
8. More detailed can be found in Thanassoulis (2001) and Coelli *et al.* (2005).

9. The efficiency estimate is bounded between 0 and 1. It is 1 if the bank lies on the frontier. Note also that the optimization problem is solved once for each bank in the sample, giving the efficiency score for each bank.
10. As efficiency is bounded by one, a truncated regression is suitable. The most commonly used in related literature is the Tobit model. Other inference methods also exist, but these methods suffer from severe draw backs and hence, considered inferior to the Tobit model (See Coelli *et al.*, 2005; and Simar and Wilson, 2007).
11. It should be worth noting here that that Maghyereh and Awartani (2012, 2014) used the same procedure and sample to estimate bank efficiency in the GCC countries.
12. For more details see Berger and Humphrey (1997), and Fethi and Pasiouras (2010).
13. Berger and Humphrey (1997) point out that the production approach may be somewhat better for evaluating the efficiencies of bank branches.
14. See Berger and Mester (1997); Hsiao *et al.* (2010); Halkos and Tzeremes (2013); among others.
15. Operational expenses net of personnel expenses is used as a proxy for capital expenses and personnel expenses is used as a proxy for labor expenses.
16. As a measure of output, performing loans is a better indicator than total loans because only performing loans contribute to the revenue of banks (Ray and Das, 2010).
17. Off-balance sheet activities would be more appropriate to measure non-traditional activities. However, BankScope does not include comprehensive information on the off-balance sheet activities for the GCC countries.
18. See Table II for a summary of the variables.
19. Maghyereh and Awartani (2013) used the exact procedure to estimate market power of GCC banks over the period 2001-2011.
20. A better measurement of labor price is the ratio of personnel expense to the number of bank employees. Unfortunately, BankScope does not include comprehensive information on the number of bank employees for the GCC countries.
21. We correct for simultaneity bias by using instrumental variables.
22. The number of questions that describe the capital requirement, the power of supervisory agencies, the market discipline and the restriction on activity indices is nine, 14, 10, and 16, respectively. Hence, the capital requirement may assume values from 0 to 9, the power of the supervisory agencies from 0 to 14, the market discipline from 0 to 10, and finally the activity restrictions from 0 to 16.
23. Another version of the *Z*-Score that incorporates temporal changes may be written as:

$$\frac{ROA_{it} + CAP_{it}}{\left|ROA_{it} - \overline{ROA_i}\right|}$$

The results using this version were not any different, and so were not reported in the paper.
24. These variables were selected on the basis previous empirical studies on determinants of banks' efficiency and of data availability.
25. An alternative measure of capital adequacy ratio is the capital to risk weighted assets (CRAR). Unfortunately, BankScope does not include a comprehensive information on the CRAR of the GCC countries. Furthermore, capital adequacy variable is included as explanatory variable not as an input measure in the DEA as it occasionly influence banks' risk profiles and the extent of their risk-taking activities.
26. IBCA stands for the International Bank of Credit Analysis Ltd.

27. The World Bank databases includes three versions: the 2001 version, the 2003 version and the 2007 version. The data are available at: http://go.worldbank.org/SNUSW978P0
28. The bootstrap estimates were computed using 2000 replications.
29. Inflationary pressures have emerged since 2004 in all of the GCC countries. The sharp increases in oil prices, the peg to the weakening US dollar, the global shocks related to high food prices, and the local supply shortages related to rents have fueled the inflation figures. The average inflation for the whole of the GCC has increased from 1.7 percent in 2003 to 8 percent in 2007.
30. During this period, the GCC banking sectors have invested heavily in advanced technologies such as ATMs, credit and debit cards, points of sale networks, home banking, telephone banking and online banking (for more details see Srairi, 2010).
31. See VanHoose (2007) for a comprehensive review of the theoretical literature on the effect of capital requirements on banks behavior.
32. This conclusion is consistent with what was reported by Barth *et al.* (2004, 2006), Pasiouras (2008a, b), Delis *et al.* (2009), Barth *et al.* (2007), Pasiouras *et al.* (2009), Uchida and Satake (2009), Lozano-Vivas and Pasiouras (2010), and Barth *et al.* (2013).
33. This idea has been suggested to us thankfully by one of the referees 8. More detailed can be found in Thanassoulis (2001) and Coelli *et al.* (2005).

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