**Banking Efficiency in Gulf Cooperation Council (GCC) Countries:**

**A Comparative Study**

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**Abstract**

We measure cost and profit efficiency of banks operating in six GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) for the period 1999-2010 using heteroskedastic stochastic frontier (HSF) models. We obtain measures of cost and profit efficiency and compare them across six GCC countries after allowing for heterogeneity in the inefficient component of error term as well as in the random noise term. We investigate the effects of bank size, equity capital-to-asset ratio, types of banks (Islamic versus non-Islamic banks) and ownership structure after allowing for differences in the inefficiency due to host countries’ regulatory and macro-environmental variables by using country dummies. Despite ongoing banking deregulations and reforms in GCC countries over the past two decades, the results of our study show that there is no discernible upward trend on cost or profit efficiency of banks during the 1999-2010 period. We find that Islamic banks are more likely to be less cost efficient but more profit efficient than non-Islamic banks. Banks operating in Saudi Arabia and Bahrain are more cost efficient than those that operate in Kuwait, Oman, Qatar, and the United Arab Emirates.

*JEL Classification*: G21, G28, G34, F23, F33

*Key Words: Stochastic Frontier, Cost Efficiency, Profit Efficiency*

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**A Comparative Study**

**I. Introduction**

Over the past two decades, the Gulf Cooperation Council(GCC) region[[1]](#footnote-1) has undergone rapid economic, demographic and social changes. During the last decade, the world attention has focused on GCC economies not only as exporters of oil and gas, but as investment destinations with major infrastructure projects, booming tourism, and financial services sectors. The financial systems in the Gulf region are primarily bank-based and capital markets are relatively underdeveloped. Since 1990s, several reform policies have been undertaken to liberalize financial markets, deregulate the banking sector, promote efficiency in the GCC financial systems, and achieve regional economic integration.[[2]](#footnote-2) In addition, policymakers in GCC countries have been working together toward the goal of establishing a single market and a single currency by implementing monetary union among member states. The financial sector reforms were aimed at promoting competitive, stable, and better- performing operating environment of commercial banks that dominate GCC financial systems. In response to the globalization of financial markets and institutions, commercial banks operating in GCC countries have been emulating strategies of their Western counterparts by adopting new technology, implementing advanced risk management systems, diversifying their product mix, and adhering to international risk-based capital standards (Basel I, II and III ). As noted earlier, a major policy objective of financial sector reforms in GCC countries is to enhance economic integration among member states and promote an efficient banking system.[[3]](#footnote-3) Inextricably linked to this policy objective is the improvement of the banking efficiency in GCC countries.

However, there has been relatively little research on banking efficiency in general and a comparative study of banking efficiency in GCC countries, in particular.[[4]](#footnote-4) Therefore, the central aim of this paper is to undertake a systematic and comparative study of cost and profit efficiency of banks in GCC countries. We undertake a comparative study of cost and profit efficiency of banks across six GCC countries using bank level quarterly data over the 1999-2010 period for several reasons. First, as stated earlier, GCC countries had undergone a series of bank reforms since early 1990s which dramatically changed the competitive structure and operating environment of the banking industry in the gulf region. Second, while GCC countries achieved significant economic development and integration throughout the 1990s and 2000s, there remain substantial differences across individual economies. The macro- economic environment in which GCC banking systems find themselves operating over the past decade vary greatly not only over time, but also across six different member states. Third, Berger et al. (2000) emphasize the importance of estimating both cost and profit efficiencies of banks in evaluating bank performances.[[5]](#footnote-5) The evolution of banking sector reforms provides a unique opportunity for the measurement of cost and profit efficiencies of individual banks operating in GCC countries. Finally, to our knowledge, this is the first comprehensive study that examines both cost and profit efficiencies of individual banks operating in GCC countries using a hetroskedastic Stochastic Frontier Analysis (SFA)[[6]](#footnote-6) based on panel data[[7]](#footnote-7).

The remainder of the paper is organized as follows: Section 2 compares the Islamic versus conventional banking in GCC countries. Section 3 reviews the literature on banking efficiency. Section 4 develops a theoretical foundation for estimations of cost and profit efficiencies of banks using a single-step heteroskedastic stochastic frontier (HSF) model. Section 5 describes data and variables used in the study. Section 6 discusses empirical results, and Section 7 concludes with a summary of findings of the study.

**2. Islamic Banking versus Conventional Banking in GCC Countries**

GCC countries own abundant sources of crude oil so they have accumulated huge amount of foreign currencies. They have been known as major crude oil exporters and wealthy countries worldwide. Islamic banking is an important feature of the financial sectors in GCC countries. Indeed some Muslim countries have considered converting their entire banking sector to Islamic principles. Islamic banking is guided by *Shariah*[[8]](#footnote-8) principles which prohibit interest payment (riba). Islamic banks use profit-and-loss sharing (PLS) instruments[[9]](#footnote-9) which do not guarantee a pre-determined profit to depositors, and Islamic banks offer some fee-based services.[[10]](#footnote-10) 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.

Demand for Islamic financial products grew as a consequence of the wealth accruing to Muslims during the 1970s oil boom. The first Islamic bank founded (the Dubai Islamic Bank) in 1975 offered only the most fundamental contracts such as safekeeping accounts, sale and PLS contracts. The first Islamic equity funds were launched in the early 1990s. 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 insurance to millions of Muslims. 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. These days, many Islamic banks offer credit cards and allow their customers to have overdraft facility despite the fact that it was considered completely unlawful a few years ago. Moreover, Islamic banks have been investing significant resources in the implementation of Internet, mobile phone and telephone banking. 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).

Furthermore, the traditional values of Islamic finance have had an increasing appeal to Western investors who were disillusioned with the banking practices of conventional banks in the wake of the global financial crisis. Islamic banks are therefore no longer only a feature of traditional Muslim regions. Today, there are more than 300 Islamic financial institutions spread across 70 countries of the world. Thus, increased globalization coupled with growing attraction of Islamic finance worldwide has led to direct competition between Islamic and conventional banks. Since the growth, efficiency and competitive environment of the financial sector are vital for economic integration and development of GCC countries, it is important to assess efficiency of Islamic banking compared to conventional banking across six GCC member states in gulf region. Of particular importance of our study is the source of any efficiency difference between conventional banks and Islamic banks.

**3. Literature Review**

A large body of literature spanning over the past three decades addresses banking efficiency in the United States (e.g., Berger and Humphrey, 1997; Berger and Strahan, 1998) and Europe (e.g., Allen and Rai, 1996; Pastor, Perez, and Quesada, 1997; Altunbas, Gardener, Molyneux, and Moore, 2001), and more recently, literature on banking efficiency in the Asia-Pacific region is developing (see Bhattacharya, Lovell, and Sahay, 1997, for India; Rezvanian and Mehdian, 2002, for Singapore; Sathye, 2003 for India; Berger, Hasan, and Zhou, 2010; and Lin and Zhang, 2009 for China). Prior studies examine effects of bank reforms on efficiency in transitional economies (e.g., Bonin, Hasan and Wachtel, 2005, for transition countries in Eastern Europe; Havrylchyk, 2006, for Poland; Yildirim and Philippatis, 2007, for transition countries in Eastern Europe; Hasan and Marton, 2003, for Hungary). The empirical literature provides mixed evidence regarding the impact of bank reforms on cost and profit efficiency of banks in emerging markets. For example, Bonin, Hasan and Wachtel (2005) find that domestically owned private banks are not significantly more efficient than government owned banks in Central and Eastern European countries. In contrast, Yildirim and Philippataos (2007) report that domestically owned private banks and state-owned banks are less cost efficient, but more profit efficient relative to foreign banks in transition countries. El-Gamal and Inanoglu (2005) investigate efficiency of Turkish banks over 1990-2000 period and find that efficiency of conventional banks are similar to Islamic banks. Havrylchyk (2006) finds that foreign banks that acquired domestic banks do not enhance efficiency. Berger, Hasan and Zhou (2010) and Lin and Zhang (2009) find that the Big Four state-owned banks are less profit efficient.

However, the literature evaluating the effects of financial sector reforms on banking efficiency in GCC countries is relatively scant. Darrat et al. (2003) estimate efficiency of banks operating in Kuwait over the 1994-1997 period, using the Data Envelopment Analysis (DEA) approach. Their study finds that the overall efficiency of banks in Kuwait is on average 68% and the source of inefficiency is attributed to a combination of allocative and technical efficiency. Grigorian and Manole (2005) examine the technical efficiency of four of six GCC countries: Baharain, Kuwait, Qatar, and UAE relative to their Singapore counterparts. Their study finds that bank in Bahrain on average are more technically efficient compared to GCC countries. Ariss, Rezvanian, and Mehdian (2007) compare and contrast the cost efficiency, technological progress and productivity growth of banks in GCC countries using a non-parametric frontier approach for the 1999-2004 period. Their results show that bank in Oman on average, have been the most efficient among GCC countries followed by banks from Bahrain and to a lesser extent by banks from Kuwait.

**4. Methodology**

Although several methods are available to measure efficiency in banking, the Stochastic Frontier (SF) approach introduced by Aigner, Lovell, and Schmidt (1977) and Meeusen and van dan Broeck (1977) has received increased attention among researchers over the last two decades (e.g., Cebenoyan, 1990; Ferrier and Lovell, 1990; Greene, 1993; LeCompte and Smith, 1990; Bauer, 1990; Berger and Humphrey, 1991; Weiss, 1991; Berger, 1993; Mester, 1993; Allen and Rai, 1996; Mester, 1996; Rai, 1996; Resti, 1997). Using the SF approach, we investigate the effects of bank size, equity capital-to-asset ratio, types of banks (Islamic versus non-Islamic banks) and ownership (private versus government) and credit quality of investment portfolios on cost and profit efficiency of banks operating in six gulf countries.

We recognize that we need to use appropriate stochastic frontier models to estimate either cost or profit efficiency of banks after allowing for differences in Islamic banks and conventional banks operating in GCC countries. It is likely that Islamic banks may have different objectives and operational characteristics from conventional banks. For example, the prohibition of conventional interest bearing financial instruments and loans can limit certain banking activities which may have an adverse effect on potential outputs and banking efficiency. In addition, Islamic banks use the equity participation principle indicating that Islamic banks depend on equity as a major source of funding. Following Abdul-Majid, Saal, and Battisti (2010), we include equity-to-asset ratio as an input variable and we control for Islamic banking as a bank-specific characteristic that may directly influence the estimated cost or profit inefficiency.

Next, we consider the specification of an appropriate SF model to estimate cross-country banking efficiency. While some studies don’t control for any environmental variables (Allen and Rai, 1996; and Altunbas et al., 2001), other studies do account for environmental factors (e.g., Bonin et al., 2005 and Carvallo and Kasman, 2005). Following Fries and Taci, 2005; and Williams and Nguyen (2005), we argue that environmental variables are influenced by country-specific regulatory environment and macro-economic conditions, including the level of economic development across six countries. Thus, a common stochastic frontier without controls for country-specific factors is likely to be misspecified due to varying degree of bank regulation and the use of different banking technology.[[11]](#footnote-11) In this paper, we use country dummies in our model to control for country-specific factors.

In the following section, we focus specifically on methodological approaches employed in stochastic frontier analysis (SFA). The stochastic cost frontier model uses a parametric approach which requires a separation of random errors from the systematic error component of a specified cost function. This entails the specification of a particular distribution form. The basic model assumes that a firm’s observed cost deviates from the optimal cost due to a random noise, , and an inefficiency component , . Thus, the cost function for N firms in the sample is written as:

, i = 1……………..N, (1)

Whereis a two-sided error term representing the statistical noise and is a one-sided error term that measures inefficiency of a firm that represents the individual firm’s deviation from the efficient cost frontier. It serves as a proxy for both technical and allocative inefficiency.  is the logarithm of the observed cost of banks; is a vector of outputs; is a vector of input prices;**** is a vector of parameters. The predicted log cost function of a cost-minimizing firm,  is assumed to be operating at output level  and input prices. The basic SF model (1) assumes that the noise term is independently and identically distributed and  is distributed independently of . Further, it is assumed that is normally distributed with a mean zero and constant variance, , and the  is half-normally distributed, meaning the  is the absolute value of a variable that is normally distributed with a mean zero and constant variance, . With these distributional assumptions, the basic stochastic econometric cost frontier model can be estimated using maximum likelihood techniques. Once the model is estimated, inefficiency measures can be estimated using the conditional mean of the inefficiency term,, as proposed by Jondrow et al. (1982) or Greene (1993). A vast number of studies on measuring efficiency in banking rely on the basic stochastic cost efficiency frontier model (1) described above and use a “two-step” approach (see Murray and White, 1983; Mester, 1987 and 1993; Cebenoyan, 1990; LeCompte and Smith, 1990; Berger and Humphrey, 1991; Weiss, 1991; Allen and Rai, 1996; Rai, 1996; Resti, 1997; among others) and document that estimated cost efficiencies of banks are correlated with bank-specific as well as environmental factors.

There are several issues associated with estimates of standard stochastic econometric cost frontier model (the basic SF model described above). First, the estimation based on model (1) can lead to incorrect inferences because it doesn’t account for heteroskedasticity in the inefficiency component of the error term,  (e.g., Caudill and Ford (1993), Caudill, Ford, and Gropper (1995) and Mester (1997). Second, it is likely that the inefficiency error term () depends on firm characteristics such as size, equity-to-asset ratio, type of banks (Islamic or conventional banks), ownership (private versus public), loan quality, as well as country-specific environmental factors. Third, prior studies that estimate cost or profit efficiency using a two-step procedure[[12]](#footnote-12) are likely to have produced biased estimates (e.g., Huang and Liu, 1994; Battese and Coelli, 1995; Wang and Schmidt, 2002).[[13]](#footnote-13)

In the following section, we develop a generalized stochastic dynamic frontier model to account for heteroskedasticity in the inefficiency component as well as the error term. Then we use a single-step estimation strategy to circumvent the above-mentioned problems associated with traditional SF models.

**4.1 Heteroskedastic Stochastic Frontier Model for Estimating Cost Efficiency**

In this study, we propose a two-equation generalized stochastic frontier model that accounts for heteroskedasticity. Consistent with Battese and Coelli (1995) and Wang and Schmidt (2002) studies we follow the single-step estimation of the parameters of the cost function as follows:

, and (2.1)

 (2.2)

 (2.3)

 (2.4)

 (2.5)

 (2.6)

Where zit is a broad set of bank-specific factors and α, ω and θ are corresponding coefficient vectors.

Our generalized stochastic dynamic model, which aims at minimizing model mis-specifications differs from Battese and Coelli (1995) and Wang and Schmidt (2002) in two ways. First, we incorporate the firm-specific time effects in the model using a cross-sectional time series or panel data. The vector in the Equation (2.4) represents a wide range of factors including firm-specific factors (Mester, 1993; Allen and Rai, 1996; Rai, 996; Miller and Noulas, 1997; Shao and Lin, 2000).[[14]](#footnote-14) Second, we use a flexible distribution (see equations 2.2 to 2.6) for the inefficiency component of the error term () to account for heteroskedasticity in  and . While heteroskedasticity may only affect estimation efficiency in a linear regression model, it leads to biased estimates in the SF model because part of the error term () is asymmetrically distributed (e.g., Caudill and Ford, 1993; Caudill, Ford, and Gropper, 1995). In our equation (2.2), has a truncated normal distribution with a non-constant variance. The variance of is a function of firm-specific variables and it varies with time. Thus, our model allows the variance of  to be observation-specific. The specification of our model based on equations (2.1) to (2.6), represents an important and significant departure from the previous research. In particular, our approach makes the inefficiency measure a dynamic and stochastic variable. The model allows us to use panel data at the firm-level to study if and how the cost inefficiency responds to the elements of.

**4.2 Heteroskedastic Stochastic Frontier Model for Estimating Profit Efficiency**

In the case of the profit function, the selection of output price variables depends on whether we assume the existence of market power of a bank in setting of output price (e.g., Berger and Mester, 1997; and Akhavein, Berger, and , 1997). The standard profit frontier model assumes the existence of perfect competition in the markets for outputs and inputs; and in principle, the model requires information on the prices of the output vector, which in most cases is not available. Hence, most studies estimate an alternative profit frontier similar to the one developed by Berger et al. (2000). The alternative profit frontier model assumes that an imperfect competition exists with a given quantity of outputs and price of inputs. The goal of the bank is to maximize profits by adjusting the quantity of outputs and the price of inputs. The return on equity (net profit to equity capital) serves as the dependent variable, a measure of profitability. Consequently, profit function and profit inefficiency are similar to cost function and cost inefficiency. The basic profit frontier model is featured with a half-normally distributed inefficiency m and a normally distributed error term e. The equations (3.1) to (3.3) indicate this.

*ln*, and (3.1)

 (3.2)

 (3.3)

However, the sign of the inefficiency term now becomes negative. Analogous to the production frontier of Wang and Schmidt (2002) and Wang (2002), the generalized profit frontier model is specified as follows:

*ln*, and (4.1)

 (4.2)

 (4.3)

 (4.4)

 (4.5)

 (4.6)

Where = a broad set of bank-specific factors, and β = vector of unknown coefficients to account for profit inefficiency,.  and are the estimated coefficients for the heteroskedasticity of e and m, respectively.

**4. 3 Empirical Specifications of Bank Costs, Outputs and Inputs**

There is considerable disagreement in prior literature on the definition of cost, outputs, and inputs for a bank. Two approaches have been suggested: an “intermediation approach” and a “production approach”.[[15]](#footnote-15) We use the intermediation approach for several reasons. First, commercial banks are considered financial intermediaries. Second, the intermediation approach is relevant to the measurement of cost (profit) efficiency because an efficient bank would minimize the total operating costs for any given output (maximize total profit for a given level of total operating costs). Finally, the intermediation approach is consistent with Islamic banks which rely on profit-sharing contracts (investments) via an equity participation principle with depositors (savers). Therefore, an Islamic bank can be perceived as an intermediary by transforming deposits made by savers into investment contracts.

The dependent variables for cost frontier and profit frontier are TC (total costs) and NI (Net income). Three output variables Y1, Y2, and Y3 (net loans, security investments, and other earning assets respectively) are used in this study. Three input price variables p1, p2, and p3 (cost of funds, cost of labor, and cost of fixed costs respectively) are considered. To allow for variation in the banking sector reform and related institutional developments across banks, several firm-specific factors are included as control variables in our model. Following prior literature, we use following firm-specific control variables: NPL (the ratio of non-performing loans to total gross loans) as a proxy for credit risk, TIER1 (Tier-1 risk-based capital ratio) as proxy for insolvency ratio, CAPITAL (the ratio of the total capital reserves to total loans), ASSET (total assets) as a proxy for bank size, BORROW (total borrowed funds excluding borrowing from banks) and EA (the total equity to total asset ratio) as proxy for leverage ratio (e.g., Allen and Rai, 1996) as well as source of funding for Islamic banks. (e.g., Abdul-Majid, Sall, and Battisti, 2010).

Seven dummy variables are used as proxies for environmental variables. The ISLAM dummy equal to one indicates a bank fully or partially follows Islamic rules. Otherwise, ISLAM equals zero. PRIVATE is one for a bank is classified as privately owned; otherwise, PRIVATE=0 (e.g., Altunbas, Evans, and Molyneux, 2001; Berger, Hasan, and Zhou, 2010); The dummies BR, KU, OM, QA, and SA equal to one to represent the country (Bahrain, Kuwait, Omen, Qatar, and Saudi Arabia) where a bank is located. When the all five country dummies equal zero for a bank, the bank is located in the UAE (the base country). Similarly, the UAE serves as the base country when we estimate our efficiency results based on stochastic frontier analysis.

In addition to country dummy variables, year dummy variables are included to control for the economic impact attributed to different periods respectively. The cost function of equation (2) takes a translog form, so the f-function is 

. (5)

Where D is the year dummy variable.

Finally, cost inefficiency,, is not a good measure. Consistent with Berger et al. (1993), this study calculates the cost efficiency () via as follows:

, (6)

Where  is the minimal  and is used as the benchmark to calculate the comparative efficiency for t=1, …, T (periods) and i= 1, …, N (banks). All estimates of the cost efficiency calculated from equation (6) fall between zero and one. Similarly, the profit function can be specified:



. (7)

The specification (7) has been defined in Berger et al. (2000). Profit efficiency () is

defined as: = exp(-m). (8)

We pool cross-sectional and time-series data for our sample banks to measure cost and profit efficiency of banks operating in six GCC countries. We estimate the generalized stochastic cost frontier model (equations 2.1 to 2.6) and the profit frontier model (equations 4.1 to 4.6) based on a “single-step” method using the LIMDEP program developed by Greene (1993) and the STATA program developed by Wang and Schmidt (2002).

**5. Data**

Our sample includes data (ended at December 31 for each year) for 45 banks from six GCC countries (Bahrain, Kuwait, Omen, Qatar, Saudi Arabia, and the United Emirates of Arab). Annual bank-level data are collected from the *BankScope* database for the period 1999-2010 resulting in an unbalanced panel of 504 observations*,* with 42 of these observations being for Islamic banks.[[16]](#footnote-16) However, the length of the time period for individual bank varies from bank to bank depending on the availability of data. Table 1 lists the sample distribution of banks by type of bank (Islamic, conventional or mixed), and by type of ownership (private, government, or mixed) for each of the six gulf countries. In our sample, only Bahrain Saudi Bank , Qatar International Islamic Bank, Bank Al-Jazira, and National Commercial Bank are Islamic, while National bank of Bahrain , Alahli Bank of Kuwait, Burgan Bank, Gulf Bank, National Bank of Kuwait, Bank Dhofar , Bank Muscat, National Bank of Oman, Oman International Bank, Qatar Development Bank, Arab Bank for Investment & Foreign Trade, and Bank of Sharjah are conventional. All other banks are mixed with Islamic and conventional banks. Most banks in our sample are privately owned except Qatar Development Bank. However, the governments (local or central) are major owners for several banks in these countries. For instance, National Bank of Abu Dhabi is featured with 70.6% government ownership, National Bank of Dubai Public Joint Co. with 55.6%, National Bank of Fujairah with 54.41%, National Bank of Umm Al-Qaiwain with 30%, according to Bankscope.

[Table 1 about here]

Table 2 lists dependent variables, input and output variables, bank-specific factors, and dummy variables. The interaction terms in the translog functional form are provided in Table 2.

[Table 2 about here]

**6. Empirical Results**

We find that our sample banks operating in Gulf countries include conventional (i.e., Western style); Islamic or mixed banks. As mentioned earlier, the major difference between Islamic banking and conventional banking is the application of the “usury law”. Typically, conventional banks profit from interest spread between deposits and loans, which is forbidden in the Islamic law. Islamic law allows banks to collect fees and make profit from the difference of the purchase price and sale price of securities. But it prohibits them from earning money by collecting interest on loans. Therefore, it is likely that characteristics of sample banks will vary not only across countries within the Gulf region, but also between sample of Islamic banks and non-Islamic banks.

Table 3 presents means and standard deviations of selected output and input variables, input prices and bank-specific characteristics for all GCC banks as well as individual GCC countries. The average size of banks measured by total assets differs considerably across GCC countries. Saudi banks are the largest among GCC countries followed by Bahrain, and UAE. The banks in Saudi Arabia are also largest among banks in our sample in terms of outputs and total costs. They also enjoy lowest cost of funds (P1). The average cost of funds for Saudi banks is 2.68% while the average cost of funds for banks in Bahrain is 5.20%, highest among all GCC countries. NPL(non-performing loan ratio) represents the credit risk of the loan assets. Banks in Saudi Arabia also enjoys lowest NPL(5.07%) among six nations while Oman has highest NPL (13.27%) followed by Bahrain (9.05%) indicating that on average, banks in Oman have the highest level of credit risk exposure among six GCC countries.

Saudi Arabia also has highest EQUITY, BORROW and NI. These results indicate that the bank size is correlated with higher level of equity participation, borrowed funds, net income. Qatar is featured with highest CAPITAL and TIER1. These results suggest that on average, the loan and securities portfolio held by banks in Qatar are the riskiest among all six countries. Results reported in Table 3 suggest that on average, banks in Oman have the lowest loan loss reserve ratio (CAPITAL) and the lowest tier1 risk-based capital ratio (TIER1) sample. Overall, banks in Oman appear to be riskiest because they have the highest NPL with the least Tier1 risk-based capital ratio and the least loan loss reserve ratio among all GCC countries.

[ Table 3 about here ]

The average size of banks in Oman is the smallest among six GCC countries. Oman has the lowest mean of TC ($153.05 million) and the lowest mean of NI ($68.31 million). Also, output variables (Y1, Y2 and Y3) for Oman are the smallest. Its ASSETS is $1377.16 million, which is also the lowest across these six Gulf nations. The UAE is the “average” country in this study. Its means of the output variables, TC, and input prices are very close to those variables for the whole sample.

Table 3 also compares the differences between Islamic banks and non-Islamic banks. The mean of TC for Islamic banks is $518 million over that for non-Islamic banks. For the three output variables, the means of them in the Islamic bank group are more than those in the non-Islamic bank group (Y1, 8467.01 vs. 4447.23; Y2, 8067.31 vs. 4786.12; and Y3, 5241.59 vs. 1518.37; all in million dollars). In addition, Islamic banks enjoy lower cost of funds, cost of labor, and cost of fixed assets (P1, P2, and P3). For P1, Islamic bank claims lower cost at 3.53% below the counter part of non-Islamic bank, 3.96%. Nevertheless, the standard deviations for both bank groups are large and the difference of means between them is insignificant. The cost of labor (p2) for the Islamic bank is in general lower (1.26% vs. 2.42%) than that of non-Islamic banks.

The comparison between government-owned and non-government owned banks is also displayed in Table 3. In terms of TC, Y1, Y2 and Y3, government-owned banks are smaller than the non-government counterparts. In other words, in the GCC countries, non-government owned banks may have on average higher total costs, total loans and security investments than the government owned ones. Nevertheless, among government owned banks, the amounts of TC, Y1 and Y2 vary a lot when the standard deviations of these three variables are pretty large. Similarly, the ASSET, BORROW and NI for government owned banks are smaller than those for non-government owned ones. Overall, government-owned banks are smaller than non-government owned banks in those variables.

In addition, the government owned banks are featured with higher NPL (8.20% vs. 7.47%) and higher TIER1 and CAPITAL (32.40% and 33.46% vs. 16.07% and 18.67% for non-government ones). That is, in comparison with non-government owned banks, government-owned banks are likely to have higher proportion of non-performing loans, but they keep the high capital reserves to buffer for the potential credit risks. This result is not surprising because the objective function of government-owned banks is likely to be different from private on non-government owned banks.

Table 4 presents a summary statistics of cost efficiency indices for each of the six GCC countries in each year over the 1999-2010 period. Over the same period, the Table 4 also displays the mean of cost efficiency indices for all six countries in the Gulf region for each year. For example, the mean of overall efficiency scores for all banks in GCC countries in 1999 was 79.16%, while the same in 2010 was 73.56%, indicating that GCC banks on average could have saved 26.44% of their actual total costs in the year 2010 had they have been operating on the common efficient frontier. Cost efficiency scores reported in panel A of Table 4 suggest that cost efficiency of banks vary across six countries and over time during 1999-2010. However, we do not observe a discernible trend (upward or downward) in cost efficiency scores of any of the six GCC countries over the 1999-2010 period.

[ Table 4 about here ]

In Panel B (Table 4), we also observe mixed patterns among Islamic, conventional, and mixed bank groups. From 1999 to 2001 and 2006 to 2007, Islamic banks are more cost efficient than the conventional and mixed banks. However, from 2008 to 2010, conventional banks become the most cost-efficient among three groups. The results reported in Panel C of Table 4 show that government owned banks outperform non-government owned ones in terms of cost efficiency except for the year 2000.

Table 5 displays the time varying patterns of profit efficiencies of banks for each country and for the Gulf region. Cost efficiency indices reported in Table 5 (Panel A) indicate that banks in Oman have been the most profit efficient among GCC countries during 1999-2010. Over the same period, Saudi banks have been the least profit efficient among six Gulf nations.

[ Table 5 about here ]

Panel B in Table 5 depicts the differences among Islamic and conventional banks and mixed banks. Conventional banks are the most profit efficient group among these three except for the years 2006 and 2008. Most banks profitability as well as their profit efficiencies declined from 2007 to 2008 because of the occurrence and the spillover of the financial crisis from the US in 2008. As can be seen in Table 5 (Panel B), the profit efficiency of conventional banks fell quickly from 94% to 41% between 2006 and 2008, and then recovered back to 90% during 2009-2010. Both Islamic and mixed banks also suffered from the decline in lending due to global financial crisis, but the profit efficiency bounced back during 2009-2010. Nevertheless, profit efficiencies of Islamic banks did not fall as deeply as that of the conventional banks. Panel C in Table 5 shows that government owned banks are more profit efficient than non-government owned banks. It is worth noting that the profit efficiency of the non-government owned banks dropped dramatically during 2007- 2008 crisis period from 87% to 63% while the profit efficiency of the government owned banks are quite stable over the whole time period under study.

Table 6 shows the single step heteroskedastic SF results. Since the estimation of frontiers is sensitive to the specifications of the models, two different sets of variables in z are used with a common stochastic frontier. Except for the constant terms, the lnP3 is the only common significant estimator among output variables. That is, the total cost increases with an increase in the amount of total loans. Generally speaking, even though the estimators from the first specification differ from the second one, the directions of impact and statistical significance are the same for the cost functions. The major differences between two specifications exist in the country dummies and the z variables (i.e., components of the mean of u and components of the variance of u).

[ Table 6 about here ]

In the first specification, EA (equity to asset ratio) is negatively related to the cost inefficiency u. Hence, the higher EA a firm has, the less the cost efficiency a firm will enjoy. The equity-to-asset ratio (EA) is also significantly positively related to variance of inefficiency, (u). Among the country dummies, only SA (Saudi Arabia) is positively related to the variance of u, indicating greater volatility of the cost inefficiency of Saudi banks. In addition, the size proxy is negatively related to the variance of cost inefficiency (u), so larger firms more likely to enjoy lower volatility in cost inefficiency.

The second specification shows ISLAM (proxy for Islamic banks) is positively related to the mean of cost inefficiency (u) and it is significant at 1% level. While the use of Islamic banking may lead to higher cost efficiency, it may not significantly increase its volatility of the cost inefficiency. Moreover, SA (Saudi Arabia) is significantly negatively related to the mean of u (at the 1% level) so the cost efficiency of the banks in SA may be higher than those from the other five countries. Lambda and Sigma, both the main parameters of u, are also significant at the 5% and 1% level of significance, which signals the cost inefficiency term u is well defined.

The profit frontiers and efficiencies are estimated via the single step heteroskedastic stochastic frontier approach. The results are displayed in Table 7. In the first specification, we observe that the mean of profit inefficiency (u) is negatively associated with equity-to-asset ratio (EA) and positively related to the TIER1. That is, the higher EA helps increase the profit efficiency and the core capital risk-based ratio (TIER1). Higher equity ratio can lead a bank to achieve low leverage risk, and greater profit efficiency. NPL and SIZE variables are significantly positively related to the variance of profit inefficiency, indicating that larger banks with higher credit risk are more likely to experience high volatility in their profit inefficiency. On the other hand, the equity-to-asset ratio is significantly negatively related to the variance of profit inefficiency. This implies that banks with higher EA will have lower risk of insolvency.

[ Table 7 about here ]

Finally, we estimate cost efficiency and profit efficiency for each bank in GCC countries and list the results in Table 8. The measure of cost efficiency ranges from 0.5645 (National Bank of Dubai Public Joint Co.) to 0.9999 (Arab Bank of Investment & Foreign Trade). The estimation of profit efficiency ranges between 0.3547 (Gulf Bank) and 0.9629 (Bank of Sharjah). We find that most cost efficient banks don’t necessarily enjoy higher level of profit efficiency. Table 8 lists rankings of banks based on the cost efficiency (see column 3) as well as on the profit efficiency (see column 5). For instance, Ahli United Bank BSC enjoys high profit efficiency (0.9323) and is ranked No. 8; but it has much lower cost efficiency (0.7258) with a low rank (No. 41).

[ Table 8 about here ]

In contrast, Gulf bank which is ranked high (No. 4) in terms of cost efficiency is ranked the lowest (No. 45) in terms of profit efficiency. Prior studies on bank efficiency suggest that it is important to consider rankings of both cost and profit efficiencies (see Berger et al., 2008). For example, some banks can be more profitable by providing financial services that are costly but generate higher net revenue. The Column (6) in Table 8 shows the rankings of bank efficiency based on the sum of ranks for the cost efficiency and the profit efficiency. As seen in Table 8, considering both profit and cost efficiency, the most efficient bank in the Gulf region is the Bank of Sharjah, a conventional bank located in the UAE with a combined rank of ‘6’ followed by Arab Bank of Investment and Foreign trade, another conventional bank located in the UAE with a combined rank of ‘10’.

**7. Conclusion**

We measure cost and profit efficiency of banks operating in six GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) for the period of 1999-2010 using heteroskedastic stochastic frontier (HSF) models. We also estimate cost and profit efficiency of Islamic banks, conventional banks, mixed banks, privately owned and government owned banks operating in GCC countries. The results of our study show that there is no discernible upward trend on cost or profit efficiency of banks over the 1999-2010 period. We analyze the effects of size, equity capital-to-asset ratio, types of banks (Islamic versus non-Islamic banks) and ownership structure on bank inefficiency after allowing for differences in the inefficiency due to host countries’ regulatory and macro-environmental variables using country dummies. We find that Islamic banks are likely to be less cost efficient but more profit efficient than non-Islamic banks. Banks operating in Saudi Arabia and Bahrain are more cost efficient than those that operate in Kuwait, Oman, Qatar, and the United Arab Emirates. We also report rankings of both cost and profit efficiencies of our sample banks operating in the GCC countries over the 1999-2010 period. From a policy perspective, this study highlights the importance of enhancing cost and profit efficiency of banking industry as well as of individual banks in GCC countries.

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Table 1**. Sample of Banks by Country, by Types, and by Ownership (1999- 2010).**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bank** | **Year** | **obs** | **Country** | **Islamic** | **Conventional** | **Mixed Banks** | **Government** | **Private** | **Mixed owned Banks** |
|
| Ahli United Bank | 1999-2009 | 11 | Bahrain |  |  | Y |  | Y |  |
| Arab Banking | 2002-2010 | 9 | Bahrain |  |  | Y |  | Y |  |
| Bahrain Saudi Bank BSC | 2005-2010 | 6 | Bahrain | Y |  |  |  | Y |  |
| BBK | 2005-2010 | 6 | Bahrain |  |  | Y |  | Y |  |
| Gulf International Bank | 1999-2010 | 12 | Bahrain |  |  | Y |  | Y |  |
| National bank of Bahrain | 1999-2010 | 12 | Bahrain |  | Y |  |  | Y |  |
| Alahli Bank of Kuwait | 1999-2010 | 12 | Kuwait |  | Y |  |  | Y |  |
| Burgan Bank | 2000-2010 | 11 | Kuwait |  | Y |  |  | Y |  |
| Gulf Bank | 1999-2010 | 12 | Kuwait |  | Y |  |  | Y |  |
| National Bank of Kuwait | 2001-2010 | 10 | Kuwait |  | Y |  |  | Y |  |
| Commercial Bank of Kuwait SAK | 1999-2010 | 12 | Kuwait |  |  | Y |  | Y |  |
| Bank Dhofar | 1999-2010 | 12 | Oman |  | Y |  |  | Y |  |
| Bank Muscat | 1999-2010 | 12 | Oman |  | Y |  |  | Y |  |
| National Bank of Oman | 1999-2010 | 12 | Oman |  | Y |  |  |  | Y |
| Oman Arab Bank | 1999-2010 | 12 | Oman |  |  | Y |  | Y |  |
| Oman International Bank | 1999-2010 | 12 | Oman |  | Y |  |  | Y |  |
| Ahli Bank QSC | 1999-2010 | 12 | Qatar |  |  | Y |  | Y |  |
| Commercial bank of Qatar | 1999-2010 | 12 | Qatar |  |  | Y |  | Y |  |

Table 1 (Contd.) **Sample of Banks by Country, by Types, and by Ownership (1999- 2010)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bank** | **Year** | **obs** | **Country** | **Islamic** | **Conventional** | **Mixed Banks** | **Government** | **Private** | **Mixed owned Banks** |
|
| Doha Bank | 2001-2010 | 10 | Qatar |  |  | Y |  | Y |  |
| International Bank of Qatar | 2002-2010 | 9 | Qatar |  |  | Y |  | Y |  |
| Qatar Development Bank | 2000-2009 | 10 | Qatar |  | Y |  | Y |  |  |
| Qatar National Bank | 1999-2010 | 12 | Qatar |  |  | Y |  |  | Y |
| Qatar International Islamic Bank | 1999-2010 | 12 | Qatar | Y |  |  |  | Y |  |
| Arab National Bank | 1999-2010 | 12 | Saudi |  |  | Y |  | Y |  |
| Bank Al-Jazira | 1999-2010 | 12 | Saudi | Y |  |  |  | Y |  |
| Banque Saudi Fransi | 1999-2010 | 12 | Saudi |  |  | Y |  | Y |  |
| National Commercial Bank | 1999-2010 | 12 | Saudi | Y |  |  |  | Y |  |
| Riyad Bank | 1999-2010 | 12 | Saudi |  |  | Y |  | Y |  |
| Samba Financial Group | 1999-2010 | 12 | Saudi |  |  | Y |  | Y |  |
| Saudi British Bank | 1999-2010 | 12 | Saudi |  |  | Y |  | Y |  |
| Saudi Hollandi Bank | 1999-2010 | 12 | Saudi |  |  | Y |  | Y |  |
| Abu Dhabi Commercial Bank | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |
| Arab Bank for Investment & Foreign Trade | 1999-2010 | 12 | UAE |  | Y |  |  |  | Y |
| Bank of Sharjah | 1999-2010 | 12 | UAE |  | Y |  |  |  | Y |
| Commercial Bank of PSC | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |

Table 1 (Contd.) **Sample of Banks by Country, by Types, and by Ownership (1999- 2010)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bank** | **Year** | **obs** | **Country** | **Islamic** | **Conventional** | **Mixed Banks** | **Government** | **Private** | **Mixed owned Banks** |
|
| Emirates Bank International | 1999-2008 | 10 | UAE |  |  | Y |  | Y |  |
| First Gulf Bank | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |
| Mashreq bank | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |
| National Bank of Abu Dhabi | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |
| National Bank of Dubai Public Joint Company | 1999-2002 | 4 | UAE |  |  | Y |  | Y |  |
| National Bank of Fujairah | 1999-2010 | 12 | UAE |  |  | Y |  |  | Y |
| National Bank of Umm Al-Qaiwain | 1999-2010 | 12 | UAE |  |  | Y |  |  | Y |
| National Bank of Ras Al-Khaimah | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |
| Union National Bank | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |
| United Arab Bank | 1999-2010 | 12 | UAE |  |  | Y |  | Y |  |
| Total 45 banks |  | 504 |  |  |  |  |  |  |  |

Table 2 Definitions of Variables and Cross-Product Terms

|  |  |
| --- | --- |
| **Variable** | **Description** |
| *Dependent Variables* | |
| TC | total costs=interest expenses, cost of premises and fixed cost in million US dollars. |
| NI | Net income in million US dollars. |
| *Output Variables* | |
| Y1 | total amount of net loans in million US dollars. |
| Y2 | total amount of security investments in million US dollars. |
| Y3 | Other earning assets in million US dollars. |
| *Input Prices* |  |
| P1 | cost of funds in percentage=ratio of interest expense to borrowed funds. |
| P2 | cost of labor proxy=employee expenses/total assets in percentage. |
| P3 | cost of fixed cost proxy=fixed cost/total Assets |
| *Other Variables* | |
| EQUITY | total amount of equities in million US dollars. |
| NPL | non-performing loans/total gross loans in percentage. |
| TIER1 | Basel II tier-1 capital/total loans in percentage. |
| CAPITAL | capital ratio=total capital reserves/ total loans in percentage |
| ASSET | the amount of total assets in million US dollars. |
| SIZE | The proxy of the size of a bank. It is the natural logrithm of the amount of total assets in million US dollars. |
| BORROW | borrowed funds in million US dollars. |
| EA | The total equity to total asset ratio. |
| **Table 2 (Contd.) Definitions of Variables and Cross-Product Terms**  *Dummy Variables* | |
| ISLAM | The dummy variable indicates a bank fully or partially follows Islamic rules. |
|  | For Islamic banking, ISLAM=1; otherwise, ISLAM=0. |
| PRVATE | The dummy variable indicates a bank is classified as private owned or not privately owned; |
|  | for fully or partially privately owned banks, PRIVATE=1; otherwise PRIVATE=0. |
| BR | The dummy indicates a bank located in Bahrain. For a bank in Bahrain, BR=1; otherwise BR=0. |
| KU | The dummy indicates a bank located in Kuwait. For a bank in Kuwait, KU=1; otherwise KU=0. |
| OM | The dummy indicates a bank located in Omen. For a bank in Omen, OM=1; otherwise OM=0. |
| QA | The dummy indicates a bank located in Qatar. For a bank in Qatar, QA=1; otherwise QA=0. |
| SA | The dummy indicates a bank located in Saudi Arabia. For a bank in Saudi Arabia SA=1; otherwise SA=0. |
| *Variables in Frontiers* | |
| lnP1 | The natural logarithm of P1. |
| lnP2 | The natural logarithm of P2. |
| lnP3 | The natural logarithm of P3. |
| lnY1 | The natural logarithm of Y1. |
| lnY2 | The natural logarithm of Y2. |
| lnY3 | The natural logarithm of Y3. |
| 1/2\*lnP1\*lnP1 | Squared LnP1 divided by 2. |
| 1/2\*lnP2\*lnP2 | Squared LnP2 divided by 2. |
| 1/2\*lnP3\*lnP3 | Squared LnP3 divided by 2. |
| lnP1\*lnP2 | The product of lnP1 and LnP2 |
| lnP2\*lnP3 | The product of lnP2 and LnP3 |
| lnY1\*lnP1 | The product of lnY1 and LnP1 |
| lnY1\*lnP2 | The product of lnY1 and LnP2 |
| lnY1\*lnP3 | The product of lnY1 and LnP3 |
| lnY2\*lnP1 | The product of lnY2 and LnP1 |
| lnY2\*lnP2 | The product of lnY2 and LnP2 |
| lnY2\*lnP3 | The product of lnY2 and LnP3 |
| lnY3\*lnP1 | The product of lnY3 and LnP1 |
| lnY3\*lnP2 | The product of lnY3 and LnP2 |
| lnY3\*lnP3 | The product of lnY3 and LnP3 |
| lnY1\*lnY2 | The product of lnY1 and LnY2 |
| lnY1\*lnY3 | The product of lnY1 and LnY3 |
| lnY2\*lnY3 | The product of lnY2 and LnY3 |
| 1/2\*lnY1\*lnY1 | Squared LnY1 divided by 2. |
| 1/2\*lnY2\*lnY2 | Squared LnY2 divided by 2. |
| 1/2\*lnY3\*lnY3 | Squared LnY3 divided by 2. |

**Table 3 Summary Statistics of Inputs and Outputs Variables by Country, by Bank Types, and by Ownership (1999-2010)**



**Table 4: Measures of Cost Efficiency of GCC banks for the 1999-2010 period**.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |  |
| Panel A: All Banks |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bahrain | 0.7302 | 0.7395 | 0.7304 | 0.7162 | 0.8157 | 0.8029 | 0.8079 | 0.8559 | 0.7645 | 0.8558 | 0.7623 | 0.8018 |  |
| Kuwait | 0.8768 | 0.8292 | 0.7704 | 0.6857 | 0.6915 | 0.7866 | 0.8233 | 0.8423 | 0.7767 | 0.7633 | 0.8150 | 0.6480 |  |
| Oman | 0.7594 | 0.7824 | 0.6887 | 0.8799 | 0.7083 | 0.7716 | 0.7425 | 0.8275 | 0.6566 | 1.0000 | 0.8081 | 0.7538 |  |
| Qatar | 0.8221 | 0.7263 | 0.8367 | 0.7993 | 0.7950 | 0.7789 | 0.7465 | 0.8834 | 0.7152 | 0.7202 | 0.8067 | 0.7874 |  |
| Saudi Arabia | 0.8508 | 0.6625 | 0.7831 | 0.8082 | 0.8474 | 0.9391 | 0.9006 | 0.8273 | 0.8270 | 0.7182 | 0.7605 | 0.8428 |  |
| UAE | 0.7103 | 0.7453 | 0.6716 | 0.8060 | 0.7273 | 0.7093 | 0.8302 | 0.5518 | 0.5624 | 0.5565 | 0.5674 | 0.5796 |  |
| All Bank | 0.7916 | 0.7475 | 0.7468 | 0.7825 | 0.7642 | 0.7981 | 0.8085 | 0.7981 | 0.7171 | 0.7690 | 0.7533 | 0.7356 |  |
| Panel B: Bank Type |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Islamic Bank | 0.8159 | 0.8133 | 0.8301 | 0.7696 | 0.7871 | 0.8107 | 0.7975 | 0.9999 | 0.8595 | 0.8361 | 0.7735 | 0.8117 |  |
| Conventional Bank | 0.7612 | 0.7571 | 0.8201 | 0.8151 | 0.8765 | 0.8904 | 0.8919 | 0.8540 | 0.8373 | 0.9038 | 0.9042 | 0.8823 |  |
| Mixed Bank | 0.7775 | 0.7514 | 0.7652 | 0.7570 | 0.8241 | 0.8490 | 0.8653 | 0.8670 | 0.8649 | 0.8657 | 0.8242 | 0.7885 |  |
| Panel C: Ownership |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Privately Owned | 0.7873 | 0.7770 | 0.7881 | 0.7831 | 0.8382 | 0.8659 | 0.8709 | 0.8849 | 0.8669 | 0.8675 | 0.8335 | 0.8252 |  |
| Government Owned | 0.7985 | 0.7386 | 0.8496 | 0.8031 | 0.9084 | 0.9014 | 0.9309 | 0.9106 | 0.8910 | 0.9999 | 0.9710 | 0.8456 |  |

**Table 5: Measures of Cost Efficiency of GCC banks for the 1999-2010 period**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Year | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |  |
| Panel A: All Banks |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bahrain | 0.9057 | 0.9368 | 0.9171 | 0.8542 | 0.8789 | 0.9155 | 0.8936 | 0.8917 | 0.8079 | 0.7540 | 0.8339 | 0.8596 |  |
| Kuwait | 0.8923 | 0.9210 | 0.8918 | 0.8730 | 0.8779 | 0.9134 | 0.9440 | 0.9541 | 0.9747 | 0.7400 | 0.7948 | 0.8343 |  |
| Oman | 0.9387 | 0.9678 | 0.9505 | 0.9545 | 0.9153 | 0.9258 | 0.9456 | 0.9551 | 0.9515 | 0.9559 | 0.9394 | 0.9521 |  |
| Qatar | 0.9142 | 0.8849 | 0.9037 | 0.8353 | 0.8697 | 0.8732 | 0.8840 | 0.8915 | 0.8624 | 0.8705 | 0.8647 | 0.9000 |  |
| Saudi Arabia | 0.6746 | 0.7557 | 0.7583 | 0.7512 | 0.7533 | 0.7761 | 0.8557 | 0.9045 | 0.8185 | 0.7498 | 0.7392 | 0.7533 |  |
| UAE | 0.9093 | 0.9236 | 0.9191 | 0.9004 | 0.9017 | 0.9059 | 0.9533 | 0.9075 | 0.9053 | 0.8839 | 0.8437 | 0.8649 |  |
| All Bank | 0.8725 | 0.8983 | 0.8901 | 0.8614 | 0.8661 | 0.8850 | 0.9127 | 0.9174 | 0.8867 | 0.8257 | 0.8359 | 0.8607 |  |
| Panel B: Bank Type |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Islamic Bank | -- | 0.8043 | 0.8404 | 0.8263 | 0.8350 | 0.8433 | 0.9288 | 0.9876 | 0.8888 | 0.7533 | 0.7073 | 0.7528 |  |
| Conventional Bank | 0.9343 | 0.9410 | 0.9225 | 0.8829 | 0.8887 | 0.9125 | 0.9378 | 0.9408 | 0.9402 | 0.4081 | 0.9018 | 0.9029 |  |
| Mixed Bank | 0.8586 | 0.8723 | 0.8677 | 0.8498 | 0.8537 | 0.8672 | 0.9028 | 0.8911 | 0.8421 | 0.8075 | 0.8082 | 0.8403 |  |
| Panel C: Ownership |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Privately Owned | 0.8051 | 0.8773 | 0.8747 | 0.8571 | 0.8604 | 0.8739 | 0.9118 | 0.9117 | 0.8652 | 0.6252 | 0.8035 | 0.8315 |  |
| Government Owned | 0.9126 | 0.9248 | 0.9143 | 0.8576 | 0.8711 | 0.8998 | 0.9294 | 0.9193 | 0.9092 | 0.9319 | 0.9308 | 0.9469 |  |

**Table 6 Single-step Heteroskedastic SF estimates for Cost Efficiency**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Coefficient | t-ratio |  | Coefficient | t-ratio |  |
| Constant | -3.7964 | -11.02 | \*\*\* | -2.9944 | -9.00 | \*\*\* |
| lnP1 | 0.1251 | 1.50 |  | -0.0766 | -1.11 |  |
| lnP2 | 0.2288 | 1.72 | \* | 0.1376 | 1.05 |  |
| lnP3 | -0.1402 | -0.90 |  | -0.2129 | -1.26 |  |
| lnY1 | 1.0700 | 6.05 | \*\*\* | 0.5436 | 3.67 | \*\*\* |
| lnY2 | -0.0018 | -0.01 |  | 0.0051 | 0.05 |  |
| lnY3 | 0.1120 | 1.43 |  | 0.3937 | 5.03 | \*\*\* |
| 1/2\*lnP1\*lnP1 | 0.1575 | 7.74 | \*\*\* | 0.2201 | 13.21 | \*\*\* |
| 1/2\*lnP2\*lnP2 | 0.2168 | 4.00 | \*\*\* | 0.2613 | 5.82 | \*\*\* |
| 1/2\*lnP3\*lnP3 | -0.0460 | -0.86 |  | -0.0298 | -0.47 |  |
| lnP1\*lnP2 | -0.0585 | -1.94 | \* | -0.0055 | -0.21 |  |
| lnP2\*lnP3 | -0.0133 | -0.26 |  | -0.0689 | -1.36 |  |
| lnY1\*lnP1 | 0.1640 | 4.80 | \*\*\* | 0.1108 | 3.83 | \*\*\* |
| lnY1\*lnP2 | -0.1330 | -3.10 | \*\*\* | -0.1897 | -4.46 | \*\*\* |
| lnY1\*lnP3 | -0.0230 | -0.34 |  | 0.0700 | 1.33 |  |
| lnY2\*lnP1 | -0.0531 | -1.81 | \* | -0.0114 | -0.47 |  |
| lnY2\*lnP2 | 0.1021 | 2.89 | \*\*\* | 0.1037 | 3.12 | \*\*\* |
| lnY2\*lnP3 | 0.0861 | 1.51 |  | 0.0061 | 0.13 |  |
| lnY3\*lnP1 | -0.0842 | -4.51 | \*\*\* | -0.0559 | -3.27 | \*\*\* |
| lnY3\*lnP2 | 0.0467 | 2.63 | \*\*\* | 0.1123 | 5.37 | \*\*\* |
| lnY3\*lnP3 | -0.0480 | -1.16 |  | -0.0527 | -1.32 |  |
| lnY1\*lnY2 | -0.0407 | -1.21 |  | -0.0372 | -1.30 |  |
| Variable | Coefficient | t-ratio |  | Coefficient | t-ratio |  |
| lnY1\*lnY3 | -0.0999 | -2.50 | \*\* | -0.1962 | -5.18 | \*\*\* |
| lnY2\*lnY3 | 0.0303 | 0.83 |  | 0.0136 | 0.43 |  |
| lnY1\*lnY1 | 0.0538 | 0.82 |  | 0.2057 | 3.40 | \*\*\* |
| lnY2\*lnY2 | 0.0356 | 1.77 | \* | 0.0394 | 2.74 | \*\*\* |
| lnY3\*lnY3 | 0.1044 | 4.86 | \*\*\* | 0.1893 | 9.60 | \*\*\* |
| BR | 0.0942 | 1.62 |  | 0.4268 | 7.36 | \*\*\* |
| KU | -0.0844 | -1.52 |  | 0.3781 | 7.28 | \*\*\* |
| OM | -0.0988 | -1.03 |  | 0.3926 | 6.64 | \*\*\* |
| QA | -0.0044 | -0.13 |  | -0.9494 | 0.00 |  |
| SA | 0.2102 | 4.76 | \*\*\* | 0.6574 | 13.23 | \*\*\* |
|  | Components of the mean of u | | | Components of the mean of u | | |
| NPL | 0.0060 | 0.53 |  | -0.0002 | -1.67 | \* |
| TIER1 | -0.0009 | -1.41 |  | 0.0000 | -0.93 |  |
| EA | 1.9778 | 1.89 | \* | -- | -- |  |
| SIZE | -0.3632 | -1.22 |  | -- | -- |  |
| PRIVATE | -- | -- |  | -0.0519 | -0.76 |  |
| ISLAM | -- | -- |  | 0.4951 | 5.53 | \*\*\* |
| BR | -2.2408 | -0.37 |  | -0.5517 | -2.93 | \*\*\* |
| KU | -1.9272 | -0.42 |  | -0.9594 | -1.53 |  |
| OM | -5.9606 | -0.30 |  | -1.2386 | 0.00 |  |
| QA | 0.8872 | 0.77 |  | 0.9355 | 0.00 |  |
| SA | 1.6683 | 1.52 |  | -0.7543 | -5.15 | \*\*\* |
|  | Components of the variance of u | | | Components of the variance of u | | |
| Constant | -1.3966 | -0.95 |  | -7.1025 | -3.78 | \*\*\* |
| NPL | 0.0299 | 1.19 |  | -0.0002 | -0.07 |  |
| TIER1 | -0.0004 | -0.90 |  | -0.0004 | -1.42 |  |
| EA | 1.9795 | 2.79 | \*\*\* | -- | -- |  |
| SIZE | -0.4138 | -2.24 | \*\* | -- | -- |  |
| PRIVATE | -- | -- |  | -1.2386 | -1.26 |  |
| ISLAM | -- | -- |  | 2.5153 | 1.64 |  |
| BR | -4.7110 | -1.02 |  | -- | -- |  |
| KU | -1.2896 | -0.96 |  | -- | -- |  |
| OM | -57.5951 | 0.00 |  | -- | -- |  |
| QA | 0.5389 | 0.78 |  | -- | -- |  |
| SA | 2.3351 | 3.62 | \*\*\* | -- | -- |  |
| Lambda | 4.5045 | 2.38 | \*\* | 2.5530 | 7.61 | \*\*\* |
| Sigma | 0.5675 | 2.50 | \*\* | 0.2222 | 22.14 | \*\*\* |

**Table 7 Single-step Heteroskedastic SF estimates for Profit Efficiency**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Coefficient | t-ratio |  | Coefficient | t-ratio |  |
| Constant | 8.4690 | 9.19 | \*\*\* | 9.4109 | 12.93 | \*\*\* |
| lnP1 | -0.3924 | -1.63 |  | 0.2413 | 1.44 |  |
| lnP2 | -0.4787 | -1.34 |  | -0.4863 | -1.37 |  |
| lnP3 | -0.1506 | -0.34 |  | -0.3329 | -1.00 |  |
| lnY1 | -0.0740 | -0.11 |  | -0.1669 | -0.35 |  |
| lnY2 | 0.0583 | 0.09 |  | -0.1195 | -0.27 |  |
| lnY3 | -0.1919 | -0.79 |  | -0.3662 | -2.06 | \*\*\* |
| 1/2\*lnP1\*lnP1 | 0.0255 | 0.35 |  | -0.0851 | -2.29 | \*\*\* |
| 1/2\*lnP2\*lnP2 | -0.0719 | -0.48 |  | 0.1862 | 1.21 |  |
| 1/2\*lnP3\*lnP3 | 0.1135 | 0.64 |  | 0.1070 | 0.87 |  |
| lnP1\*lnP2 | 0.0700 | 0.81 |  | 0.0244 | 0.41 |  |
| lnP2\*lnP3 | 0.0680 | 0.55 |  | 0.0665 | 0.55 |  |
| lnY1\*lnP1 | -0.1522 | -0.94 |  | 0.0597 | 0.52 |  |
| lnY1\*lnP2 | 0.2566 | 1.39 |  | -0.0260 | -0.23 |  |
| lnY1\*lnP3 | -0.0024 | -0.01 |  | 0.0685 | 0.35 |  |
| lnY2\*lnP1 | 0.1457 | 0.92 |  | -0.0601 | -0.54 |  |
| lnY2\*lnP2 | -0.0636 | -0.39 |  | 0.0534 | 0.51 |  |
| lnY2\*lnP3 | -0.0441 | -0.23 |  | -0.0583 | -0.30 |  |
| lnY3\*lnP1 | 0.0298 | 0.49 |  | -0.0220 | -0.54 |  |
| lnY3\*lnP2 | -0.1879 | -2.79 | \*\*\* | 0.0388 | 0.54 |  |
| lnY3\*lnP3 | 0.0506 | 0.44 |  | 0.0313 | 0.35 |  |
| lnY1\*lnY2 | 0.0240 | 0.19 |  | -0.0670 | -0.52 |  |
| lnY1\*lnY3 | 0.1390 | 0.85 |  | -0.1276 | -1.10 |  |
| lnY2\*lnY3 | -0.1202 | -0.80 |  | 0.1048 | 0.91 |  |
| lnY1\*lnY1 | -0.1296 | -0.50 |  | 0.2049 | 0.90 |  |
| lnY2\*lnY2 | 0.0704 | 1.20 |  | -0.0055 | -0.09 |  |
| lnY3\*lnY3 | 0.0015 | 0.02 |  | 0.0849 | 1.29 |  |
| BR | 0.1202 | 0.72 |  | 0.0356 | 0.27 |  |
| KU | 0.1401 | 0.79 |  | 0.2039 | 1.60 |  |
| OM | 0.0263 | 0.11 |  | -0.0851 | -0.47 |  |
| QA | 0.0372 | 0.18 |  | -0.0035 | -0.05 |  |
| SA | -0.0104 | -0.07 |  | 0.0821 | 0.89 |  |
|  | components of the mean of u | | | components of the mean of u | | |
| NPL | -0.0033 | -1.11 |  | 0.0121 | 3.36 | \*\*\* |
| TIER1 | 0.0026 | 1.65 | \* | 0.0025 | 1.60 |  |
| EA | -18.7568 | -4.51 | \*\*\* | -- | -- |  |
| SIZE | 0.4597 | 0.67 |  | -- | -- |  |
| PRIVATE | -- | -- |  | 5.4624 | 1.15 |  |
| ISLAM | -- | -- |  | -11.6603 | -3.02 | \*\*\* |
| BR | 0.8780 | 0.41 |  | 2.9627 | 0.59 |  |
| KU | 8.6128 | 2.47 | \*\* | 4.9358 | 1.05 |  |
| OM | 3.8498 | 1.09 |  | -2.8071 | -1.36 |  |
| QA | -2.8935 | -0.51 |  | -4.8702 | -1.00 |  |
| SA | -2.6462 | -0.94 |  | 4.8838 | 0.88 |  |
|  | Components of the variance of u | | | Components of the variance of u | | |
| Constant | -19.7572 | -9.74 | \*\*\* | -7.7299 | -7.51 | \*\*\* |
| NPL | 0.0689 | 3.75 | \*\*\* | 0.1326 | 13.69 | \*\*\* |
| TIER1 | 0.0001 | 0.22 |  | 0.0014 | 6.66 | \*\*\* |
| EA | -12.4924 | -20.27 | \*\*\* | -- | -- |  |
| SIZE | 1.7464 | 9.17 | \*\*\* | -- | -- |  |
| PRIVATE | -- | -- |  | -6.1671 | -6.08 | \*\*\* |
| ISLAM | -- | -- |  | -2.2364 | -19.12 | \*\*\* |
| BR | 1.3628 | 4.03 | \*\*\* | -- | -- |  |
| KU | 6.8068 | 14.55 | \*\*\* | -- | -- |  |
| OM | 3.4008 | 3.05 | \*\*\* | -- | -- |  |
| QA | 0.3385 | 0.55 |  | -- | -- |  |
| SA | 0.9943 | 2.88 | \*\*\* | -- | -- |  |
| Lambda | 3.8120 | 3.64 | \*\*\* | 7.3902 | 8.05 | \*\*\* |
| Sigma | 1.4545 | 5.14 | \*\*\* | 1.3835 | 13.06 | \*\*\* |

**Table 8 Ranking of banks based on cost efficiency, profit efficiency, and both**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bank | Cost Eff | Rank | Profit Eff. | Rank | Sum of Ranks |
| Ahli United Bank BSC | 0.7258 | 41 | 0.9323 | 8 | 49 |
| Arab Banking | 0.9189 | 6 | 0.6906 | 42 | 48 |
| Bahrain Saudi Bank BSC | 0.8386 | 24 | 0.7659 | 38 | 62 |
| BBK | 0.7911 | 33 | 0.9308 | 11 | 44 |
| Gulf International Bank | 0.8329 | 26 | 0.6448 | 43 | 69 |
| National bank of Bahrain | 0.8655 | 19 | 0.9213 | 15 | 34 |
| Alahli Bank of Kuwiat | 0.8765 | 14 | 0.9626 | 2 | 16 |
| Burgan Bank | 0.8797 | 13 | 0.8043 | 30 | 43 |
| Gulf Bank | 0.9220 | 4 | 0.3547 | 45 | 49 |
| National Bank of Kuwait | 0.9153 | 7 | 0.7915 | 34 | 41 |
| Commercial Bank of Kuwait SAK | 0.9095 | 9 | 0.8620 | 25 | 34 |
| Bank Dhofar | 0.9411 | 3 | 0.9101 | 18 | 21 |
| Bank Muscat | 0.7605 | 39 | 0.9324 | 7 | 46 |
| National Bank of Oman | 0.8016 | 30 | 0.9312 | 10 | 40 |
| Oman Arab Bank | 0.8726 | 17 | 0.8887 | 20 | 37 |
| Oman International Bank | 0.8682 | 18 | 0.8970 | 19 | 37 |
| Ahli Bank QSC | 0.7715 | 36 | 0.9330 | 6 | 42 |
| Commercial bank of Qatar | 0.8620 | 20 | 0.8787 | 23 | 43 |
| Doha Bank | 0.7939 | 32 | 0.8853 | 21 | 53 |
| International Bank of Qatar | 0.8347 | 25 | 0.9162 | 17 | 42 |
| Qatar Development Bank | 0.8823 | 11 | 0.8546 | 27 | 38 |
| Qatar National Bank | 0.8559 | 22 | 0.8657 | 24 | 46 |
| Qatar International Islamic Bank | 0.8809 | 12 | 0.9264 | 14 | 26 |
| Arab National Bank | 0.7794 | 34 | 0.7492 | 39 | 73 |
| Bank Al-Jazira | 0.6817 | 43 | 0.8519 | 28 | 71 |
| Banque Saudi Fransi | 0.7728 | 35 | 0.8321 | 29 | 64 |
| National Commercial Bank | 0.7690 | 38 | 0.5971 | 44 | 82 |
| Riyad Bank | 0.7970 | 31 | 0.7347 | 40 | 71 |
| Samba Financial Group | 0.8514 | 23 | 0.7861 | 36 | 59 |
| Saudi British Bank | 0.6519 | 44 | 0.8017 | 31 | 75 |
| Saudi Hollandi Bank | 0.7351 | 40 | 0.7918 | 33 | 73 |
| Abu Dhabi Commercial Bank | 0.9843 | 2 | 0.7883 | 35 | 37 |
| Arab Bank for Investment &Foreign Trade | 0.9999 | 1 | 0.9316 | 9 | 10 |
| Bank of Sharjah | 0.9199 | 5 | 0.9629 | 1 | 6 |
| Commercial Bank of International PSC | 0.7700 | 37 | 0.9480 | 4 | 41 |
| **Table 8 (Contd.)** |  |  |  |  |  |
| Bank | Cost Eff | Rank | Profit Eff. | Rank | Sum of Ranks |
| Emirates Bank International | 0.8612 | 21 | 0.8551 | 26 | 47 |
| First Gulf Bank | 0.8765 | 15 | 0.9173 | 16 | 31 |
| Mashreqbank | 0.8199 | 27 | 0.7701 | 37 | 64 |
| National Bank of Abu Dhabi | 0.8750 | 16 | 0.7931 | 32 | 48 |
| National Bank of Dubai Public Joint Co. | 0.5645 | 45 | 0.7346 | 41 | 86 |
| National Bank of Fujairah | 0.8184 | 28 | 0.9489 | 3 | 31 |
| National Bank of Umm Al-Qaiwain | 0.9107 | 8 | 0.9301 | 12 | 20 |
| National Bank of Ras Al-Khaimah | 0.6847 | 42 | 0.9411 | 5 | 47 |
| Union National Bank | 0.8152 | 29 | 0.8845 | 22 | 51 |
| United Arab Bank | 0.8858 | 10 | 0.9272 | 13 | 23 |
| Average | 0.8317 |  | 0.8435 |  |  |

1. On May 25, 1981, six countries of the Arab Gulf region (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) ratified the charter that established the Cooperation Council for the Arab States of the Gulf (GCC countries hereafter). [↑](#footnote-ref-1)
2. In 2008, a GCC common market was established. It allows for citizens of any of the six countries to travel and trade freely within the region. [↑](#footnote-ref-2)
3. GCC countries have deepened and the proportion of credit allocated to the private sector as a percentage of GDP has increased, indicating that banks in these countries have become more efficient in allocating financial resources in respective countries (e,g., see p. 113, Molyneux and Iqbal, 2005). [↑](#footnote-ref-3)
4. For example, Ariss, Rezvanian, and Mehdian (2007) use a non-parametric approach and they compare and contrast the performance efficiency, technological progress and productivity growth of banks in GCC countries over the 1999-2004 period. Al-Muhrrani, Matthews, and Khabari (2006) investigate the market structure of Arab GCC banking over the 1993-2002 period. [↑](#footnote-ref-4)
5. Hughes and Mester (2008) provide an excellent literature review on theory, practice and evidence of efficiency in banking. [↑](#footnote-ref-5)
6. There are several advantages using SFA over Data Envelopment Analysis (DEA): (1) SFA is based on a parametric (econometric) approach that distinguishes between inefficiency and other stochastic shocks, and therefore, it can be considered superior to non-parametric approach such as the DEA (Yildirim and Philippatos, 2007); (2) prior research suggests that if one attempts to identify the impact of regulatory environment on banks’ cost and profit efficiency over time, then efficiency is better studied and modeled by combining the use of SFA with panel data ( e.g., Baltagi and Griffin, 1988; Cornwell et al., 1990; and Kumbhakar, 1993); (3) the DEA does not suggest the cause or identify the determinants of inefficiencies. [↑](#footnote-ref-6)
7. The use of SFA with panel data provides more degree of freedom in the estimation of parameters. Given the possibility that managers may learn from prior knowledge about the production process, inefficiency may change in some persistent pattern over time (Coelli et al., 1999). In addition, regulatory or environmental factors may affect the performance of banks over time. Further, it is argued in the literature that measures of bank efficiency (cost and profit efficiency) based on the parametric efficiency scores may contain additional information about the bank performance compared to the DEA efficiency scores (e.g., Berger and Humprey, 1991; and Bauer et al., 1998) and thus, the SFA with panel data is considered to be appropriate for evaluating bank efficiency for specific set of N firms (e.g., Lang and Welzel, 1996; and Altunbas et. al., 2000). [↑](#footnote-ref-7)
8. *Shariah* is the Islamic Law and is based on the Quran. In some countries it is recognized as a source of legal law. [↑](#footnote-ref-8)
9. 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. Both parties ex-ante agrees to a profit-sharing plan. Murabahah, in contrast, is a contract based on cost-plus-profit approach. [↑](#footnote-ref-9)
10. Fee-based services include the widely used contracts of Murabahah and Ijarah. The bank arranges to sell a good to a customer and it charges a risk-adjusted fee. Ijarah is a lease contract where the bank leases an asset to a customer who pays fees to use the asset. [↑](#footnote-ref-10)
11. Carvallo and Kasman (2005) document a wide range of estimates of inefficiency across countries. Bonin et al. (2005) find that country-specific factor is significant in explaining differences in inefficiency measures. [↑](#footnote-ref-11)
12. For example, see Allen and Rai, 1996; Rai, 1996; Berger and DeYoung, 1997; Berger and Mester, 1997; Resti, 1997; DeYoung and Hasan, 1998; Lieu et al., 2005; Berger, Hasan, and Zhou, 2010, among others use two-step approach to estimate cost or profit efficiency. [↑](#footnote-ref-12)
13. Wang and Schmidt (2002) show that the two-step estimation procedure can lead to biased results for two reasons. First, the model estimated in the first step is misspecified if input prices (e.g., cost of labor and cost of capital) and firm characteristics (e.g., size, ownership, and loan quality) are correlated. Second, they argue that if the dependence of inefficiency on firm characteristics is ignored, the estimated firm-level efficiencies are “spuriously under-dispersed”, which causes the second-step estimate of the effect of firm characteristics on inefficiency to be biased downward. Wang and Schmidt (2002) also provide Monte Carlo evidence showing that the bias related to the two-step estimation procedure can be very severe. For example, see Wang and Schmidt (2002) for a detailed discussion on “Why is the Two-Step Estimator Biased?” [↑](#footnote-ref-13)
14. Kumbhakar and Hjalmarsson (1995) emphasize that the failure to include firm-specific variables in the SF model is likely to bias the estimate of the one-sided error, , which is one of the important elements of the estimation process. The reason for the bias is that the measure of inefficiency is based on the composite error term, which in turn is influenced by the parameter estimates of the frontier model. [↑](#footnote-ref-14)
15. See Berger, Hanweck and Humphrey (1987) for a detailed discussion on the issue. [↑](#footnote-ref-15)
16. BankScope database does not provide complete data for all Islamic banks operating in these six GCC countries. Hence those banks with incomplete information are dropped from our sample. [↑](#footnote-ref-16)