Economies of Scale and Scope in the GCC Islamic Banks: About the Effects of the 2008 Financial Crisis

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A few studies are found in the literature covering the cost structure of Islamic banks in the Gulf Cooperation Council (GCC) countries since the global financial crisis in 2008 onwards. Also, there is not a consensus among these studies yet. The object of this study is to examine the cost structure of Islamic banks in the GCC countries by using the financial data of banks covering 10-year period from 2001 to 2010 and discusses the cost structure by employing econometric techniques. This study is structured as follows: 1) after reviewing the literature on the cost function estimation of Islamic banks, we explain the model and estimation methods used in this study; 2) after describing the characteristics of the sample data, we examine the cost structure of Islamic banks by verifying the existence of economies of scale and scope from the results of cost function estimation; 3) we evaluate the influence of the risk on bank loans, the global financial crisis since mid-2008 and the global oil markets to the costs of Islamic banks in the GCC countries and discusses implications of these analytical results; 4) we summarises and concludes the study.

Key words: Islamic banks, cost structure, economies of scale and scope, global financial crisis

INTRODUCTION

In recent years, the number of Islamic banks in the GCC countries is increasing (Figure 1). As one factor, this reflects that Islamic banks have been playing a role in absolving excess liquidity thanks to an increase in oil prices. With an expansion of the banking sector in the GCC countries, the primary managerial agenda for Islamic banks is to reduce costs and increase profits, in order for Islamic banks to achieve more competitive advantage on prices than conventional banks. An empirical study for Islamic banks, in particular the cost study is not so many. Also, as regards an evaluation to operational efficiency of Islamic banks, a consensus has not been obtained yet. The object of this study is to examine the cost structure of Islamic banks in the GCC countries from the perspective of responding to changes in the market environment. In this study, using the financial data of Islamic banks in the GCC countries (Table 1 and Table 2), we clarify the cost structure of Islamic banks in an econometric analysis. Specifically, economies of scale and scope are calculated

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by estimating simultaneously the translog cost function and the cost share equation. And, we evaluate the influence of the risk on bank loans, the global financial crisis since mid-2008 and the global oil markets to the cost of Islamic banks in the GCC countries.

This study is divided into four sections. Section 2 reviews the literature on economies of scale and scope and outlines the estimated models and methodology, Section 3 measures the economies of scale and scope through using the estimated cost function and examines the cost structure of Islamic banks and also evaluates the influence of the risk on bank loans, Late-Great recession (Global Financial Crisis) since 2008 onwards and the global oil market to the cost of Islamic banks in the GCC countries and discusses implications of these analytical results, and Section 4 summarises and concludes the study.

MATERIALS AND METHODS

Literature review

A typical method to examine the cost structure in the banking industry is to verify the existence of economies of scale and scope. In general, decreasing-cost industries can reduce the long-run average cost through expanding the volume of outputs because of enjoying economies of scale, while industries that produce multiple products can curtail the total cost of producing them together less than the cost of producing each product individually. In particular, the main point in economies of scale and scope in the banking industry is a cost saving effect. The effect arises from an expansion of production and diversification of businesses. Here, economies of scope can exist when there are common factors of production available for producing two different products. The information is a typical common factor of production for the financial industries including banking. Also, as a basic function of banks is information production, banks can save the cost of activities on information production through the diversification of financial operations. For instance, Islamic banks can reuse for operations on securities investments the information acquired from operations on loans of Islamic banking.

As for previous studies on economies of scale and scope in the banking industry, there are a number of studies in the developed countries. By the way, the operational efficiency (cost efficiency, profit efficiency, technical efficiency, and allocative efficiency) has often been examined in recent years. Characteristics of these studies are to verify the efficiencies by employing

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2 The basic concept of economies of scale and scope used in our study is explained in Appendix 1.
3 One example of information on Islamic finance is information on the investee’s compliance with Islamic law (Shariah). Banks can use the information like this in investing securities, in particular selecting a stock investment name. When a problem on Islamic laws is found in the enterprise management issuing share certificate, Islamic bank which invested in the enterprise may lose a reputation.
4 There are studies such as Benston et al. (1982), Gilligan et al. (1984) in USA, and so on. Also, as for studies of cost structure including economies of scale and scope, the surveys such as Kasuya (1993) and Hori (1998) are useful.
parametric approach called as Stochastic Frontier Analysis (SFA) and non-parametric approach called as Data Envelopment Analysis (DEA). For instance, there are many empirical studies on the efficiencies of Islamic banking sector except the GCC countries such as: Samad (1999), Hussein (2003), Yudistria (2004), El-Gamal and Inanoglu (2004), Iqbal and Molyneux (2005), Brown and Skully (2005), Saaid (2005), Hassan (2005), El-Gamal and Inanoglu (2005), Hassan (2006), Sufian (2006 & 2007), Mokhtar et al. (2007), Bader et al. (2008), Mohamed et al. (2008), Hassan et al. (2009), Majid (2010), Onour and Abdalla (2011), and Kablan and Yousfi (2011). Also, there are empirical studies on efficiencies of the banking sector in the GCC countries as follows: Al-Jarrah and Molyneux (2006), Shams and Molyneux (2006), Ariss et al. (2007), Al-Jarrah (2007), and Maghyereh and Awartani (2012). Furthermore, there are empirical studies on the efficiencies of Islamic banking sector in the GCC countries such as: Srairi (2010), El-Moussawi and Obeid (2011), Srairi et al. (2011). Compared to the efficiency study, it is limited the studies that verified the existence of economies of scale and scope to examine the influence of changes in the market environment to the Islamic banking sector.

As our attention in this study is given to capturing the influence of changes in the market environment to costs rather than the efficiencies of banking industries, we estimate the deterministic frontier function under the assumption that firms minimize costs. Indeed, we estimate simultaneously the translog cost function being a flexible functional form and the cost share equation. We subsequently measure the economies of scale and scope by using estimated parameters and then examine the cost structure of Islamic banks. The major feature of this study is to focus on Islamic banking sector in the GCC countries and to evaluate the impact of the risk on bank loans, Late-Great recession (Global Financial Crisis) since 2008 onwards and the global oil markets to the costs of Islamic banks as well as the existence of economies of scale and scope.

From our reviewing previous empirical studies about the costs of banking, in this study we discuss four working hypotheses in order to examine the cost structure of Islamic banks in the GCC countries as follows:

Hypothesis 1: Economies of scale exist in the GCC countries,
Hypothesis 2: Economies of scope exist in the GCC countries,
Hypothesis 3: The lower share of equity to total assets (an increase of risk on bank loans) the banks have, the higher cost they have,
Hypothesis 4: The Global Financial Crisis since 2008 onwards forced banks to have higher costs.

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5 Recent empirical studies of the operational efficiency in Islamic banking sector of the GCC countries reported the characteristics as follows. That is to say, 1) Islamic banks are inferior to the conventional banks in cost efficiency and profit efficiency; 2) most of Islamic banks are facing a decrease in scale efficiency (scale inefficiency is increasing over time); 3) in terms of the asset size, the scale efficiency in the small size banks is higher than that in the large size and medium size banks; 4) a negative relationship exists between cost efficiency and bank size; 5) Islamic banks cannot enjoy scale efficiency because the operational size of the Islamic banks is still small; 6) a relationship between capital-to-asset ratio and technical efficiency or cost efficiency is negative.
Sample data
We use a data (on the end of the year) obtained from the financial statements of Islamic banks over the period 2001-2010. It is pooling data from 16 full-fledged Islamic banks (the commercial banks) in the GCC countries\(^6\). Also, we use a panel data that includes observations on financial institutions over multiple periods in order to increase the number of observations. As for the data of financial statements, our sample is an unbalanced panel data due to the different number of observations from bank to bank and the difficulty of access to the annual data in some cases. As the result, the number of samples is 122.

Theoretical framework
In this study, we focus on Islamic banks in the GCC countries and estimate the cost function. Our attention is to estimate the cost function and to measure economies of scale and scope at Islamic banks. The data used in our estimation is a panel data obtained from the financial statements of Islamic banks. By using the panel data, we can tackle an issue caused by scant data in a cross-sectional data.

Tsutsumi (2005) measured economies of scale by estimating general cost functions. Also, this study estimated the cost function which included operating costs as the dependent variables, and the number of bank loan, the amount of loans, wage rates, rental price of capital equipment, and dummy variables as explanatory variables. This study used as dummy variables time trend capturing the effect of technological change and business cycle, business category, year, and individual bank. We introduced into the cost function as dummy variables 2010 dummy capturing the impact of Late-Great recession since 2008 onwards to the bank business as well as time trend, year, county, and bank. Also, we use the translog cost function with the share of equity to total assets (Erate) as a proxy variable of the risk on bank loans and a controlled variable.

We examine six models of cost functions. Model I includes no dummy variable. A banking industry by country has different business environments and each bank has country-specific business environment in the same year. Model II includes country dummy capturing the size of their management resources. Also, it includes time trend dummy capturing the effect of technological change and business cycle. In Model III, we consider three dummy variables: country dummy in the same way as Model II, bank size dummy capturing the size of management resources in three bank

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\(^6\) The Islamic banks analyzed are Bahrain Islamic bank, Ithmaar Bank, Kuwait Finance House-Bahrain, and Al-Baraka Islamic Bank (in Bahrain); Al-Rajhi Bank, Bank al-Jazira, and Bank al-Bilad (in Saudi Arabia); Kuwait Finance House and Bubyan Bank (in Kuwait); Dubai Islamic Bank, Abu Dhabi Islamic Bank, Sharjah Islamic Bank, and Emirates Islamic bank (United Arab Emirates); Qatar Islamic Bank, Qatar International Islamic Bank, and Masraf al-Rayan (Qatar). In addition, Ithmaar Bank was operating by 2009 as an Investment bank and it has integrated their business operations with Shamil Bank that was its subsidiary and acquired a license as Islamic commercial bank. In this study, we use as sample data the financial data of Shamil Bank from 2001 to 2008 and the financial data of Ithmaar Bank in 2009 and 2010.
class by asset size, and 2010 dummy capturing the impact of Late-Great recession since 2008 onwards to the bank business. Each bank has bank-specific business environment in the same year. Model IV includes a bank dummy capturing the size of their management resources. Also, we consider time trend dummy and the 2010 dummy. In Model V, we use bank dummy in the same way as Model IV and a year dummy capturing changes in each period. In Model VI, we consider three dummy: a country dummy, year dummy and bank size dummy.

**Estimation of cost function**

Estimating the cost function of the banking industry, we need to determine bank’s inputs and outputs. Determining the inputs and outputs depends on a definition of banking industry. There is an idea focusing on financial intermediation functions of banking called the intermediation approach, which considers a bank as producing loans and securities investments by employing labor, physical capital, and deposits, while another approach focuses on bank’s production process of services called the production approach, which considers a bank as not only producing loans and securities investments by employing labor, physical capital, and deposits but providing all services to customers. We follow the intermediation approach, namely, in analysing the production activities of banks, defining the factors of production as labor L and deposits M and the bank outputs as the balance of loans on Islamic banking Y₁ (the balance before deducting allowance for impairment and including non-performing loans) and the balance of securities investments Y₂. The production function of banks is written:

\[ Y = F (L, M) \] (1)

when we define the inputs of labor and deposit which are factors of production, as Q_L and Q_M. C=L+M=P_L·Q_L+P_M·Q_M. Here, C is total cost including labor costs L and devidents to investment accountholders M. Also, P_L is the price of labor and P_M is the price of dividends to investment accountholders. The cost function with the duality theorem to the production function can be written as:

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7 In this study, we define bank’s outputs as the balance of loans and investments. However, in determining them on the production activities of banks, it is desirable to use a flow concept which reflects rightly the production activities during the period rather than to use a stock concept. Accordingly, it is appropriate to measure bank’s outputs by “profit” or “value added (ordinary profit minus cost of intermediate goods)”. But, it is difficult to get divided stock data by Islamic bank. In addition, avoiding the problem of few samples, we defined bank’s outputs by “the balance”.

8 As for the balance of loans on Islamic banking, normally, it is desirable to use the balance of performing loans. However, as we cannot obtain all data of non-performing loans, we analyzed using the balance of loans including non-performing.

9 In many studies on the bank costs, the price of physical capital (the price of equipment costs) as factors of production is used in the cost function. However, the price of physical capital is not defined clearly and the definition differs depending on the literatures. Also, because some Islamic banks don’t publish the details of fixed assets and other assets which requires calculating the price of equipment costs, we couldn’t calculate the price of equipment costs which reflected rightly the cost of physical capital per unit. As the result, we estimated the cost function by removing physical capital from factors of production.
\[ C = G (Y_1, Y_2, P_L, P_M) \]  

(2)

As was mentioned already, identifying a difference of the cost structure, we use year dummy, time trend dummy, 2010 dummy, country dummy, bank size dummy, and bank dummy. Also, identifying a difference of the cost structure by the effect of their management resources, we examine Model I that includes no dummy variable, Model II that includes country dummy and time trend dummy, Model III that includes country dummy, 2010 dummy, and bank size dummy, Model IV that includes bank dummy and 2010 dummy, Model V that includes bank dummy and year dummy, and Model VI that includes country dummy, year dummy, and bank size dummy.

We use the following translog cost function obtained by letting (2) derive a second order Taylor polynomial approximation of the logarithm near an given point:

\[
\ln C = [\alpha_0] + \sum_i [\alpha_i \ln Y_i] + \sum_j [\beta_j \ln P_j] + 0.5 \left( \sum_i \sum_k \sigma_{i,k} \ln Y_i \cdot \ln Y_k + \sum_j \sum_h \gamma_{j,h} \ln P_j \cdot \ln P_h \right) + \sum_i \sum_j [\delta_{i,j} \ln Y_i \cdot \ln P_j] + \kappa \ln \text{Erate} + \text{Dummy} + u
\]

(3)

where \( u \) denotes the error term \( (i, k=1, 2; j, h=L, M) \).

Also, in order for (3) to have a reasonable economic nature, the cost function must satisfy i) cross-equations symmetry (second-order differentiable functions), ii) linear homogeneity in input prices, iii) monotonicity condition on the outputs (positive marginal costs), and iv) monotonicity condition on marginal costs in factor-prices (concave function of factor-prices). In our econometric estimation, the restrictions i) and ii) are imposed \textit{a priori} on the translog cost function (3), and the restrictions iii) and iv) are checked \textit{ex post facto} on the estimated parameters of the cost function.

In the restrictions on parameters i), the coefficients of the translog cost function (3) must satisfy:

\[
\sigma_{i,k} = \sigma_{k,i}, \quad \gamma_{j,h} = \gamma_{h,j} \quad (i, k=1, 2; j, h=L, M)
\]

(4)

and, in the restrictions on parameters ii), it must satisfy:

\[
\beta_L + \beta_M = 1
\]

\[
\gamma_{j,L} + \gamma_{j,M} = 0 \quad (j=L, M)
\]

\[
\delta_{i,L} + \delta_{i,M} = 0 \quad (i=1,2)
\]

(5)

Given two restrictions, the translog cost function (3) is rewritten:
\[
\ln C = \alpha_0 + \alpha_1 \ln Y_1 + \alpha_2 \ln Y_2 + \beta_L \ln P_L + (1 - \beta_L) \cdot \ln P_M \\
+ 0.5[(\sigma_{11} \ln Y_1 \cdot \ln Y_1 + 2\sigma_{12} \ln Y_1 \cdot \ln Y_2 + \sigma_{22} \ln Y_2 \cdot \ln Y_2) \\
+ \{\gamma_{1L} \ln P_L \cdot \ln P_L - 2\gamma_{1L} \ln P_L \cdot \ln P_M + \gamma_{1M} \ln P_M \cdot \ln P_M\}] \\
+ \{\delta_{1L} \ln Y_1 \cdot \ln P_L - \delta_{1L} \ln Y_1 \cdot \ln P_M + \delta_{2L} \ln Y_2 \cdot \ln P_L - \delta_{2L} \ln Y_2 \cdot \ln P_M\} \\
+ \kappa \ln E_{rate} + \text{Dummy} + u
\] (6)

Also, by Shephard’s lemma, we can derive a cost-share equation \( S_j \):

\[
S_j = \frac{P \cdot Q}{C} = \frac{\partial \ln C}{\partial \ln P_j} = \beta_j + \sum_h \gamma_{j h} \ln P_h + \sum_i \sum_h \delta_{ji} + z_j \\
( i, k = 1, 2; j, h = L, M )
\] (7)

where the cost-share \( S_j \) is the ratio of the \( j \)-th input to total cost, while \( z_j \) represents the error term.

In our econometric estimation, the cost-share equation on \( j = M \) (dividends to investment account holders) was deleted avoiding singularity problems. In this study, the cost-share equation (7) is defined:

\[
S_L = \beta_L + \gamma_{1L} \ln P_L - \gamma_{1M} \ln P_M + \delta_{1L} \cdot \ln Y_1 + \delta_{2L} \cdot \ln Y + z_L
\] (8)

A number of explanatory variables in the translog function are likely to raise the multicollinearity problems. Therefore, it is easier for us to distinguish the coefficients of functions by estimating simultaneously equations of (8) the derived cost-share equation and (6). In this study, given that the error terms in (6) and (8) are correlated, the Seemingly Unrelated Regression (SUR) method is used. In our estimation, after the bank outputs, the factor-prices, total costs, and controlled variable are deflated by each county’s consumer price index (CPI), the values are normalized at their sample means. The data of exchange rates by country is obtained from the international financial statistics (IFS). The detail definition of data is presented in the Appendix 2.

RESULTS AND DISCUSSION
Overview of descriptive statistics
Table 3 shows the descriptive statistics of panel data used for estimating the cost functions. This indicates three points as follows. i) Regarding the balance of loans on Islamic banking, total assets, and bank capital, they have large differences between maximum and minimum. The differences are due to a difference in the operational size of observed 16 Islamic banks. ii) The average of valuables except the factor-price and share of equity to total assets is more than two times their median. This indicates that the banks with a relatively large asset make their average increase. iii) Dividends expenses to depositors are comparatively higher than labor costs. This may show a trend that Islamic banks reduce the labor costs and enlarge the equipment.

The estimation results
Table 4-1 and Table 4-2 report the parameter estimates of the translog cost function. The R-squared values of the cost functions are 0.836 in Model I, 0.941 in Model II, 0.937 in Model III, 0.963 in Model IV, 0.978 in Model V, and 0.963 in Model VI. These values except Model I are relatively high. We used as standard errors the White estimate that is robust to heteroscedasticity.

As for the results of the estimation, Table 4-1 (the left column) shows the results of Model I without dummy variables. Out of 16 estimates, the estimates report 5 as statically significant at more than 5 per cent level. On the results of Model II (the centre column) including country dummy and time trend dummy, out of 15 estimates except dummy variables, the estimates report 5 as statistically significant at more than 5 per cent level. The estimates of dummy variables (except time trend dummy) report that 1 (country dummy: the United Arab Emirates) out of 4 estimated parameters are significantly different from zero at the 1.0 per cent level. On the results of Model III (the right column) including 2010 dummy capturing the impact of Late-Great recession, country dummy, and bank size dummy, out of 15 estimates except dummy variables, the estimates report 4 as statistically significant at more than 5 per cent level. The estimates of dummy variables report that 3 (2010 dummy, and country dummy: the United Arab Emirates and Qatar) out of 7 estimated parameters are significantly different from zero at the 5.0 per cent level.

Furthermore, Table 4-2 (the left column) shows the results of Model IV including the bank dummy and 2010 dummy, out of 15 estimates except dummy variables, the estimates report 4 as statistically significant at more than 5 per cent level. The estimates of dummy variables report that 5 out of the 16 estimated parameters are significantly different from zero at more than 5.0 per cent level. On the results of Model V (the center column) including bank dummy and year dummy, out of 15 estimates except dummy variables, the estimates report 5 as statistically significant at more than 5 per cent level. The estimates of dummy variables report that 12 (year dummy: 2002, 2003, 2009, and 2010, and bank dummy) out of 24 estimated parameters are significantly different from zero at more than 5.0 per cent. On the results of Model VI (the right column) including country dummy, year dummy, and bank size dummy, out of 15 estimates except dummy variables, the estimates report 3 as
statistically significant at more than 5 per cent level. The estimates of dummy variables report that 8 (year dummy: 2002, 2003, 2009, 2010, and country dummy: the United Arab Emirates and Qatar, and bank size dummy: medium size and small size) out of 15 estimated parameters are significantly different from zero at the 5.0 per cent level.

The validity of the cost functions
Having a reasonable economic nature, the cost function must satisfy monotonicity condition on the outputs, that is to say positive marginal costs and monotonicity condition on marginal cost in factor-prices, namely concave function of factor-prices.
As for the monotonicity condition on the outputs,

\[
\frac{\partial C}{\partial Y_i} = (C / Y_i) \cdot (\partial \ln C / \partial \ln Y_i) > 0 \quad (i=1, 2) 
\]

\[
\frac{\partial C}{\partial P_j} = (C / P_j) \cdot (\partial \ln C / \partial \ln P_j) > 0 \quad (i=L, M) 
\]

As \( C / Y_i > 0 \), a sufficient condition for Equation (9) to hold is:

\[
\frac{\partial \ln C}{\partial \ln Y_i} = \alpha_i + \sum_k \sigma_i k \ln Y_k + \delta_i j \ln P_j > 0 \quad (i, k=1, 2; j=L, M) 
\]

As \( \ln Y_k = 0 \) and \( \ln P_i = 0 \), for Equation (11) to hold at least near a given point, it requires a sufficient condition:

\[
\alpha_i > 0 \quad (i=1, 2) 
\]

As was presented in the results of the estimation (see Table 4-1 and Table 4-2), the parameters \( \alpha_i \) in all Models are positive. Specifically, the parameter \( \alpha_1 \) (the balance of loans on Islamic banking \( Y_1 \)) is significantly positive in all models.

As \( C / P_j > 0 \), a sufficient condition for Equation (10) to hold is:

\[
\frac{\partial \ln C}{\partial \ln P_j} = \beta_j + \sum_i \gamma_j i h \ln P_h + \sum_i \delta_j i j \ln Y_i > 0 \quad (i, k=1, 2; j=h=L, M) 
\]

As \( \ln P_h = 0 \) and \( \ln Y_i = 0 \), for Equation (13) to hold at least near a given point, it requires a sufficient condition:

\[
B_j > 0 \quad (j=L, M) 
\]
As for the parameters $\beta_j$ are positive in all models.

In addition, in order to identify concave function of factor-prices, we use the following Hessian matrix that has negative semi-definite:

$$Hp = \{\partial^2 C / (\partial P_j \partial P_h)\} \quad (j, h=L, M)$$  \hspace{1cm} (15)

In order to satisfy concavity of cost functions, they require:

$$\det H_1 \leq 0 \text{ and } \det H_2 \geq 0$$  \hspace{1cm} (16)

Moreover, when we assume the conditions on cross-equation symmetry and linearly homogenous in factor-prices, the inequalities (16) can be reduced as a sufficient condition:

$$\gamma_{LL} + \beta_j \cdot (\beta_j - 1) \leq 0 \quad (j=L, M)$$  \hspace{1cm} (17)

The results of the estimation show that all models satisfy a negative sign condition.

**Cost structure of Islamic banks**

At first, we examine the existnce of economies of scale and scope\footnote{The Method to Measure Economies of Scale and Scope: Economies of scale with respect to all outputs (SCALE) are expressed:

$$\text{SCALE} = \sum_i (\partial \ln C / \partial \ln Y_i) = \partial \ln C / \partial \ln Y_1 + \partial \ln C / \partial \ln Y_2 \quad (i=1, 2)$$  \hspace{1cm} (A1)

Here, SCALE is written:

$$\text{SCALE} = (\alpha_1 + \sigma_{11} \ln Y_1 + \sigma_{12} \ln Y_2 + \delta_{1L} \ln P_L - \delta_{1M} \ln P_M)$$

$$+ (\alpha_2 + \sigma_{12} \ln Y_1 + \sigma_{22} \ln Y_2 + \delta_{2L} \ln P_L - \delta_{2M} \ln P_M) \quad (j=L, M)$$  \hspace{1cm} (A2)

In our verification, economies of scale are calculated by using the estimated parameters which are measured by the sample mean of outputs and factor-prices. Also, SCALE is evaluated near a given point of the translog cost function ($\ln Y_i=0$ and $\ln P_j=0$, that is to say $Y_i=1$ and $P_j=1$). Indeed, this is written:

$$\text{SCALE} = \sum_i \alpha_i$$  \hspace{1cm} (A3)

SCALE < 1 implies that economies of scale exist.

To estimate directly economies of scope (SCOPE) requires the data of the cost when an output is at zero. However, because of the non-admission of zero values in the translog cost function, the cost cannot be defined. To avoid this problem, as is well examined in previous studies, we identify the existence of cost complementarities that are a sufficient condition for economies of scope in
estimation, economies of scale and scope are calculated. Table 5 presents the estimation of economies of scale and scope which are measured by the average volume of production and average factor-prices of production.

As for economies of scale, the results of the chi-square tests (one degree of freedom)\(^{11}\) followed by the Wald statistic show that the values of Model V and Model VI are significantly less than one at the 1.0 per cent level. But values of scale elasticity on the balance of securities investments \(\alpha_i\) are not significant and any economic meaning couldn’t be found. Also, while the estimated values of Model II, Model III, and Model IV show constant returns to scale or scale diseconomies, their values are not statistically significant. Thus, we couldn’t identify the existence of scale economies in the Islamic banks of the GCC countries. These results imply that factors specific to each bank and country have a negative effect on scale economies of overall Islamic banking sector in the GCC countries. Specifically, the estimated parameters showing diseconomies of scale in Model III that considers the country dummy, 2010 dummy, and bank size dummy and Model IV that includes bank dummy and 2010 dummy are largely increasing. These results show that factors specific to each bank (in particular, two Islamic banks in the United Arab Emirates) and country (in particular, the United Arab Emirates and Qatar) have a negative effect on economies of scale.

As for economies of scope, the results of the chi-square tests (one degree of freedom)\(^ {12}\) followed by the Wald statistic show that cost complementarities do not exist in all models. Recently, the GCC

\[
\frac{\partial^2 C_i}{\partial Y_i \partial Y_k} < 0 \quad (i, k=1,2; i \neq k; j=L,M) \tag{A4}
\]

From cross partial derivative with respect to \(Y_i\) and \(Y_k\), cost complementarities (A4) are rewritten:

\[
\frac{\partial^2 C_i}{\partial Y_i \partial Y_k} = C / (Y_i \cdot Y_k) \times \left\{ \frac{\partial}{\partial \ln Y_i} \ln C_i / \frac{\partial}{\partial \ln Y_k} \ln C_k + \left( \frac{\partial}{\partial \ln Y_i} \ln C_i / \frac{\partial}{\partial \ln Y_k} \ln C_k \right) \right\} < 0 \tag{A5}
\]

In terms of translog cost function, this condition can be approximated:

\[
\frac{\partial^2 C_i}{\partial Y_i \partial Y_k} = C / (Y_i \cdot Y_k) \times \left\{ \sigma_{i,k} + (\alpha_i + \sum_k \sigma_{i,k} \ln Y_k + \sum_j \delta_{i,j} \ln P_j) \right\} \times (\alpha_k + \sum_i \sigma_{i,k} \ln Y_i + \sum_j \delta_{i,j} \ln P_j) \times \left\{ \alpha_k + \sum_i \sigma_{i,k} \ln Y_i + \sum_j \delta_{i,j} \ln P_j \right\} < 0 \tag{A6}
\]

In addition, as \(C / (Y_i \cdot Y_k) > 0\), cost complementarities between two outputs exist by condition:

\[
\sigma_{i,k} + (\alpha_i + \sum_k \sigma_{i,k} \ln Y_k + \sum_j \delta_{i,j} \ln P_j) \times (\alpha_k + \sum_i \sigma_{i,k} \ln Y_i + \sum_j \delta_{i,j} \ln P_j) = \text{SCOPE} (i, k) < 0 \tag{A7}
\]

Here, when SCOPE is evaluated near a given point of the translog cost function \((\ln Y_i=0, \ln Y_k=0 \text{ and } \ln P_j=0\), that is to say \(Y_i=1, Y_k=1\text{ and } P_j=1\), SCOPE is written:

\[
\text{SCOPE} (i, k) = \sigma_{i,k} + \alpha_i \times \alpha_k < 0 \tag{A8}
\]

SCOPE < 0 implies that economies of scope exist.

\(^{11}\) Here, we test the null hypothesis: \(\alpha_1+\alpha_2=1\), which means constant returns to scale.

\(^{12}\) Here, we test the null hypothesis: \(\alpha_1+\alpha_2=0\), which means that neither of the economies of scope or diseconomies of scope exist.
countries are undertaking the multilateralization of financial sector for system reforms based on the policy of financial liberalisation. However, in the Islamic banking sector do not exist cost complementaries that are a sufficient condition for economies of scope to hold. This result can be related to an increase in the share of income obtained from the Islamic banking to total income, that is to say that Islamic banks make their management policy shift into specializing in managing a fund's portfolio through Islamic financial instruments. In contrast to overall banking sector of the GCC countries undertaking the diversification of financial operations, the Islamic banking sector is not active in advancing it. Consequently, That shows that the Islamic banking sector of the GCC countries could not enjoy economies of scope.

In addition, we evaluate the impact of the share of equity to total assets as a proxy variable of the risk on bank loans to the costs of Islamic banks. Table 4-1 and Table 4-2 report that a parameter of Model II alone is significantly positive. This result implies that an increase in the share of equity to total assets may lead to an increase in the costs of Islamic banks.

Furthermore, we evaluate the impact of Late-Great recession since 2008 onwards to the bank business. Table 4-1 and Table 4-2 report that a parameter of 2010 dummy of Model III is significantly positive at the 5.0 per cent level. In addition, for the influence of the Global Financial Crisis since 2008 onwards to the costs of Islamic banks, the parameters of year dummy in 2010 of Model V and Model VI are significantly positive and higher than those of year dummy prior to 2009. Allowing for the fact like this, it is possible that negative effects of the Global Financial Crisis since 2008 onwards to Islamic banks appear remarkably in 2010.

Finally, as for the influence of the global oil market on the costs of Islamic banks, the Islamic banks which have originally been small size in the asset enlarged quickly its size in response to large capital inflows to the financial markets as a result of raising international oil price since 2004 onwards. However, the empirical results show that the Islamic banks of the GCC countries could not enjoy economies of scale. This implies that the Islamic banking sector still have room to reduce the average costs by enlarging the size of assets. Also, at the point of efficiency, in some models the values of scale elasticities calculated by the estimated parameters are less than 1.0. This shows that the operations of Islamic banks are not yet efficient in terms of cost efficiency. Consequently, the global oil market trends have a neutral or less effect to the costs of Islamic banks.

Implications of the results
The Islamic banks which have originally been smaller managerial size than the conventional banks are actively operating the Islamic financial instruments through enlarging the management resources such as the fixed assets and equipments. However, economie of scale are not observed in Islamic banks of the GCC countries. Two reasons should be pointed out.

First, it can be explained by a negative effect specific to each bank and country to scale economies
of overall Islamic banking sector. When it is considered that the size of management resources specific to the banking market of each country and each bank gave the influence on the costs of Islamic banks, it is possible to explain that the Islamic banking sector of a country or some Islamic banks specialized in managing a fund's portfolio by the Islamic financial instruments and that the inefficient use of factors of production had a negative effect to a. Secondly, the operational size of Islamic banks is smaller than the conventional banks, resulting in not reaching the stage where the Islamic banks can enjoy economies of scale. This implies that, despite an unfavorable situation in competition with the conventional banks, the Islamic banks may enjoy economies of scale through the cost saving effects produced by enlarging the managerial size by a merger.

Also, economies of scope are not observed. This result relates to the Islamic banks making the management policy shift into specializing in managing a fund’s portfolio by the Islamic financial instruments. It can be pointed out as the reason behind such activities of Islamic banks that they tried to aquire more customers through strengthening a difference from the conventional banks amid intensifying competition among commercial banks which are eager to aquire new customers.13 Also, the financial system in the GCC countries may give a negative effect to activities of the Islamic banks towards the diversification of financial operations, for instance, that the contents of a certain financial regulation or the financial system are not necessarily desirable for Islamic banks.

As for the impact of the share of equity to total assets as a proxy variable of the risk on bank loans to the costs of Islamic banks, it is shown that the higher share of equity to total assets banks have, the lower cost they have, which differs from the third working hypothesis in this study. In this context, the initial cost of equity financing is zero unlike borrowed capital because equity finance doesn’t require repaying the principal. However, to continue the equity financing requires securing a certain amount of profits such as dividends and capital gains to shareholders. This needs to save a certain net current profits (or minimum profitability to preserve enterprise value). At the same time, an expansion of equity capital gives banks an incentive to reduce the costs. However, the estimated result is contrary to the working hypothesis. This result shows that the cost efficiencies of Islamic banking sector are not necessarily high.

CONCLUSION
In this study, we examined the cost structure of Islamic banking sector of the GCC countries. Using the financial data of banks covering 10-year period from 2001 to 2010, we demonstrated the existence of economies of scale and scope in Islamic banks of the GCC countries by estimating

13 An attempt to utilize profit sharing financial contracts such as Mudharabah and Musharakah which are considered desirable to utilize in the Islamic finance, can be enumerated as an example. We can observe the situation that Islamic banks of the GCC countries are more active to manage a fund's portfolio by the profit sharing financial contracts than Islamic banks in the Southeastern Asia including Malaysia.
simultaneously the translog cost function and the cost share equation. In addition, we evaluated the influence of the risk on bank loans, the global financial crisis since mid-2008 onwards and the global oil markets on the costs of Islamic banks in the GCC countries. In Section 2, after we reviewed the literatures on the cost function estimation of Islamic banks, we explained the estimated models and methodology used in an econometric analysis. In Section 3, after explaining the characteristics of descriptive statistics, we measured the economies of scale and scope by using the estimated cost function and examined the cost structure of Islamic banking sector. Furthermore, we evaluated the influence of the risk on bank loans, Late-Great recession (Global Financial Crisis) since 2008 onwards and the global oil market on the costs of Islamic banks in the GCC countries and discussed implications of our analytical results.

We finally point out the problems on our examination. First, there is a problem on the estimation. Our examination has a problem that the cost functions have a lot of variables regardless of not so many samples, that is to say not enough degrees of freedom. As this problem makes a confidence level of the estimated parameters lower, further examinations are required in selecting explanatory variables. Secondly, there is a problem on the methodology. Though this study examined the existence of economies of scale and scope, we did not analyse the degree of cost efficiency for the Islamic banks. It would be significant to test the degree of cost inefficiency by employing DEA approach such as the deterministic cost frontier, which is useful method for testing the efficiency even in case of few samples, as well as for analysing the inefficiency by employing SFA approach.

Thirdly, there is a problem on the financial liberalisation and the diversification of Islamic banking. In this study, we concluded that Islamic banks in the GCC countries didn’t sufficiently enjoyed economies of scope because the Islamic banking sector didn’t actively tackle a diversification of financial operations. However, we could not clearly explain a relation between the cause and the system reforms based on the policy of financial liberalisation. We require examining this point further substantively.

Focusing on the Islamic banking sector, conventional banks have established the Islamic banking division inside the bank in most of cases. As the result, it would be unavoidable that competition between Islamic banks and other financial institutions or foreign financial institutions which operate the Islamic finance become intensifying in future. In this context, we pointed out that Islamic banks made their management policy shift into specializing in managing a fund’s portfolio by the Islamic financial instruments in order to strengthen a difference from the conventional banks amid intensifying competition. It would be required further examinations on to what degree customers who utilize the Islamic financial services understand this management policy and why they use Islamic banks.
APPENDIX 1

The cost function in the banking industries and economies of scale and scope

Here, the basic concept of economies of scale and scope is explained. Economies of scale with respect to all outputs means that the cost of output increase \( t \) times and less as an industry increases the outputs \( t \) times. When, the base output is defined as \( y_i \) (unit vector), the output \( Y_i \) is written:

\[
Y_i = t \cdot y_i \quad (i = 1, \ldots, N)
\]  

(B1)

where \( i \) denotes the individual goods of output.

The value of scale elasticity \( S_N \) with respect to the output \( Y_i \) is written:

\[
S_N = \frac{\partial \ln C (t \cdot y_i)}{\partial \ln t} = \sum_i \left( \frac{\partial \ln C}{\partial \ln Y_i} \right) \cdot \left( \frac{\partial \ln Y_i}{\partial \ln t} \right)
\]

(B2)

Here, as \( \partial \ln Y_i / \partial \ln t = \partial \ln t \cdot y_i / \partial \ln t = 1 \), the value of scale elasticity \( S_N \) is rewritten:

\[
S_N = \sum_i \left( \frac{\partial \ln C}{\partial \ln Y_i} \right) \quad (i = 1, \ldots, N)
\]

(B3)

\( S_N < 1 \) implies that economies of scale exist.

Economies of scale arises in an industry which needs fixed costs. This is why such industry can reduce the average costs through expanding the volume of outputs. In general, it is considered that economies of scale arise also in the financial institution with a larger number of fixed costs. As pointed out by Diamond (1984), banks engage in the activity to produce information and to do so, banks need a large amount of fixed costs. Consequently, banks can reduce the average costs through employing efficiently the factors of production with using a large amount of funds corrected from many lenders (depositors).

On the other hand, economies of scope mean that total costs when multiple products are produced together are less than total costs when multiple products are produced individually in each production process. For instance, through the use of the cost function \( C \), economies of scope with respect to two outputs \( Y_1 \) and \( Y_2 \) exist in the condition:

\[
C (Y_1 , Y_2) < C (Y_1 , 0) + C (0 , Y_2)
\]

(B4)
But the cost function \( C \) shows minimum cost by the input of production. Indeed, to verify the existence of economies of scope in this condition (B4) requires the data of the costs when an output is zero, which is a difficult problem for empirical analysis. Also, because economies of scope is a static concept at a given point on the curving cost function to a combination of two outputs, it has poor operability to pass the information on the cost function [Kasuya 1986: 51-53]. And, as a new concept that measures economies of multiple products, cost complementarities are used. In second-order differentiable cost function \( C = C(Y_1, Y_2) \), cost complementarities are defined:

\[
\frac{\partial^2 C}{\partial Y_1 \partial Y_2} < 0 \quad (B5)
\]

Here, it is considered that cost complementarities exist when marginal cost of one production decreases with an increase in the output of another production. It is known that economies of scope exist between \( Y_1 \) and \( Y_2 \) if cost complementarities exist. To prove the existence of cost complementarities indicates the existence of economies of scope\(^{14} \), that is to say cost complementarities are a sufficient condition for economies of scope to hold.

That economies of scope arise is the reason why more factors of production can be saved when a common factor of production used in production process of multiple products is produced together than when it are produced individually in each production process. The cost function \( C \) is a function of outputs \( Y_i \) and factor-prices \( P_j \) or also, total sum of products of quantity of each factor input \( X_j \) and \( P_j \). Indeed, the cost function is written:

\[
C = C(Y_1, P_j) = \sum X_j \cdot P_j \quad (B6)
\]

In addition, as \( X_j = X_j(Y_i) \) is defined as optimum function of factors of production, the cost function is rewritten:

\[
C = \sum X_j(Y_i) \cdot P_j \quad (B7)
\]

For instance, when two factors of production \( (j = 1, 2) \) are input to produce two goods \( (i = 1, 2) \), the cost function (B7) is written:

\(^{14}\) For this proof, see Kasuya (1993: 43-47).
\[ C = \sum_j X_j (Y_1, Y_2) \cdot P_j \quad \text{(B8)} \]

Here, economies of scope arise between \( Y_1 \) and \( Y_2 \) in the condition:

\[ C (Y_1, Y_2) < C (Y_1, 0) + C (0, Y_2) \quad \text{(B9)} \]

From (B8), (B9) is written:

\[ \sum_j X_j (Y_1, Y_2) \cdot P_j < \sum_j X_j (Y_1, 0) \cdot P_j + \sum_j X_j (0, Y_2) \cdot P_j \quad \text{(B10)} \]

And, (B10) is rewritten:

\[ \sum_j \{ X_j (Y_1, Y_2) - X_j (Y_1, 0) - X_j (0, Y_2) \} \cdot P_j < 0 \quad \text{(B11)} \]

Here, suppose there is a common factor between \( Y_1 \) and \( Y_2 \) when a factor of production is used in production process of both \( Y_1 \) and \( Y_2 \) and, as the result, the quantity of factor input is saved. When this common factor exists in production process of \( Y_1 \) and \( Y_2 \), a sufficient condition for economies of scope to arise in \( X_j (X_j \geq 1) \) as \( P_j > 0 \) is:

\[ X_j (Y_1, Y_2) - X_j (Y_1, 0) - X_j (0, Y_2) < 0 \quad \text{(B12)} \]

Examples of common factors in the banking industries are physical capital such as office and equipment and intangible assets such as information and know-how used in a plurality of businesses. In particular, because it is difficult to transact information and know-how in a market, it is highly possible that economies of scope arise by diversification of businesses in the banking industries.

**APPENDIX 2**

**The details of data**

\( Y_1 \): Balance of loans on Islamic banking (excluding receivables on leasing business)
$Y_2$: Balance of securities investments

$P_L$: Price of labor [cost of labor, $C_L$, divided by total asset]

$P_M$: Price of fund [dividends expenses to depositors, $C_M$, divided by the average balance of investment accounts]

$C$: Total cost, $C_L + C_M$

However, the average balance was calculated by $[(\text{the average balance in the first half year} + \text{the average balance in the second half year})/2]$. As for $P_L$ (the price of labor), it is obtained the data on the number of employee of all banks but some banks. Following Altunbas, Liu, and Molyneux (2000), we use as a proxy variable the cost of labor divided by total assets.

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Centre for Middle Eastern Studies, Harvard University.


**Japanese**
Tsutsui, Y. 2005 “Ginkougyo no Kyousoudo wa Koujyo sitaka (Did the Degree of Competition among Banks Improve?)”, In *Competition and Efficiency in the Financial Industry* (Chapter 8th), Toyo Keizai Shinposya, 223-235.
Figure 1. Market size of Islamic banking sector in the GCC countries by country.
Table 1. The major Islamic institutions in the GCC countries except Oman.

<table>
<thead>
<tr>
<th>Name of Institutions</th>
<th>Total Assets (Year 2010)</th>
<th>Country</th>
<th>The Ratio to Total assets of Islamic Banks in the GCC countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Rajhi Banking &amp; Investment Corp.</td>
<td>49,290</td>
<td>Saudi Arabia</td>
<td>19%</td>
</tr>
<tr>
<td>Kuwait Finance House</td>
<td>43,789</td>
<td>Kuwait</td>
<td>17%</td>
</tr>
<tr>
<td>Dubai Islamic Bank</td>
<td>24,543</td>
<td>U.A.E.</td>
<td>10%</td>
</tr>
<tr>
<td>Abu Dhabi Islamic Bank</td>
<td>20,492</td>
<td>U.A.E</td>
<td>8%</td>
</tr>
<tr>
<td>Qatar Islamic Bank</td>
<td>14,241</td>
<td>Qatar</td>
<td>6%</td>
</tr>
<tr>
<td>Masraf al-Rayan</td>
<td>9,528</td>
<td>Qatar</td>
<td>4%</td>
</tr>
<tr>
<td>Bank Al-Jazira</td>
<td>8,804</td>
<td>Saudi Arabia</td>
<td>3%</td>
</tr>
</tbody>
</table>

Note: The unit of the amount in the table is millions of US dollars.
Table 2. Overview of Islamic banking sector in the GCC countries except Oman (Year 2010)

<table>
<thead>
<tr>
<th>Financial Institutions</th>
<th>No. of Bank</th>
<th>Total Assets (1)</th>
<th>Total Equity (1)</th>
<th>ROA (%; Average)</th>
<th>ROE (%; Average)</th>
<th>No. of Branch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bahrain</strong></td>
<td>6</td>
<td>17,821,406</td>
<td>2,751,207</td>
<td>0.6</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Al-Baraka Islamic Bank</td>
<td></td>
<td>1,346,560</td>
<td>183,955</td>
<td>2.6</td>
<td>21.8</td>
<td>5</td>
</tr>
<tr>
<td>Al-Salam Bank</td>
<td></td>
<td>2,280,242</td>
<td>538,901</td>
<td>2.7</td>
<td>11.5</td>
<td>11</td>
</tr>
<tr>
<td>Bahrain Islamic Bank</td>
<td></td>
<td>2,488,518</td>
<td>266,122</td>
<td>-2.4</td>
<td>-22.0</td>
<td>13</td>
</tr>
<tr>
<td>Ithmaar Bank</td>
<td></td>
<td>6,743,569</td>
<td>654,016</td>
<td>-1.2</td>
<td>-12.7</td>
<td>11</td>
</tr>
<tr>
<td>Khaleeji Commercial Bank</td>
<td></td>
<td>1,114,946</td>
<td>314,253</td>
<td>-0.2</td>
<td>-0.6</td>
<td>2</td>
</tr>
<tr>
<td>Kuwait Finance House</td>
<td></td>
<td>384,756</td>
<td>793,959</td>
<td>2.3</td>
<td>9.9</td>
<td>8</td>
</tr>
<tr>
<td><strong>Saudi Arabia</strong></td>
<td>4</td>
<td>70,838,547</td>
<td>14,281,818</td>
<td>1.3</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>Alinma Bank</td>
<td></td>
<td>7,111,663</td>
<td>4,165,480</td>
<td>0.2</td>
<td>0.3</td>
<td>20</td>
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<tr>
<td>Al-Rajhi Bank</td>
<td></td>
<td>49,290,909</td>
<td>8,084,743</td>
<td>3.8</td>
<td>22.9</td>
<td>487</td>
</tr>
<tr>
<td>Bank al-Bilad</td>
<td></td>
<td>5,631,116</td>
<td>827,456</td>
<td>0.5</td>
<td>3.7</td>
<td>75</td>
</tr>
<tr>
<td>Bank al-Jazira</td>
<td></td>
<td>8,804,858</td>
<td>1,204,138</td>
<td>0.5</td>
<td>4.0</td>
<td>50</td>
</tr>
<tr>
<td><strong>Kuwait</strong></td>
<td>5</td>
<td>61,355,525</td>
<td>7,214,385</td>
<td>1.2</td>
<td>12.7</td>
<td></td>
</tr>
<tr>
<td>Al-Ahli United Bank</td>
<td></td>
<td>8,564,654</td>
<td>857,321</td>
<td>2.6</td>
<td>25.9</td>
<td>28</td>
</tr>
<tr>
<td>Kuwait International Bank</td>
<td></td>
<td>3,984,634</td>
<td>684,408</td>
<td>2.8</td>
<td>16.2</td>
<td></td>
</tr>
<tr>
<td>Kuwait Finance House</td>
<td></td>
<td>43,789,242</td>
<td>4,502,735</td>
<td>1.9</td>
<td>18.2</td>
<td>52</td>
</tr>
<tr>
<td>Boubyan Bank</td>
<td></td>
<td>4,593,213</td>
<td>831,187</td>
<td>1.1</td>
<td>6.3</td>
<td>17</td>
</tr>
<tr>
<td>Warba Bank</td>
<td></td>
<td>423,780</td>
<td>338,731</td>
<td>-2.4</td>
<td>-3.0</td>
<td></td>
</tr>
<tr>
<td><strong>United Arab Emirates</strong></td>
<td>8</td>
<td>76,085,435</td>
<td>8,002,824</td>
<td>2.0</td>
<td>19.1</td>
<td></td>
</tr>
<tr>
<td>Dubai Islamic Bank</td>
<td></td>
<td>24,543,981</td>
<td>2,608,427</td>
<td>2.5</td>
<td>23.5</td>
<td>68</td>
</tr>
<tr>
<td>Emirates Islamic Bank</td>
<td></td>
<td>8,916,682</td>
<td>772,426</td>
<td>2.2</td>
<td>25.6</td>
<td>30</td>
</tr>
<tr>
<td>Sharjah Islamic Bank</td>
<td></td>
<td>4,538,369</td>
<td>1,184,154</td>
<td>3.3</td>
<td>12.6</td>
<td>23</td>
</tr>
<tr>
<td>Abu Dhabi Islamic Bank</td>
<td></td>
<td>20,492,176</td>
<td>1,663,057</td>
<td>2.7</td>
<td>33.9</td>
<td>66</td>
</tr>
<tr>
<td>Dubai Bank (2)</td>
<td></td>
<td>4,736,601</td>
<td>469,897</td>
<td>1.9</td>
<td>19.6</td>
<td></td>
</tr>
<tr>
<td>Noor Islamic Bank</td>
<td></td>
<td>4,953,771</td>
<td>519,885</td>
<td>-0.1</td>
<td>-1.2</td>
<td></td>
</tr>
<tr>
<td>Al-Hilal Bank</td>
<td></td>
<td>7,023,159</td>
<td>510,794</td>
<td>2.5</td>
<td>34.6</td>
<td>19</td>
</tr>
<tr>
<td>Ajman Bank</td>
<td></td>
<td>880,693</td>
<td>274,184</td>
<td>1.3</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td><strong>Qatar</strong></td>
<td>4</td>
<td>30,923,270</td>
<td>6,296,146</td>
<td>3.7</td>
<td>17.8</td>
<td></td>
</tr>
<tr>
<td>Qatar Islamic Bank</td>
<td></td>
<td>14,241,785</td>
<td>2,506,594</td>
<td>3.4</td>
<td>19.5</td>
<td>18</td>
</tr>
<tr>
<td>Qatar International Islamic Bank</td>
<td></td>
<td>4,994,214</td>
<td>1,048,708</td>
<td>4.9</td>
<td>23.3</td>
<td>14</td>
</tr>
<tr>
<td>Masraf al-Rayan</td>
<td></td>
<td>9,528,398</td>
<td>1,957,815</td>
<td>5.1</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Barwa Bank</td>
<td></td>
<td>2,158,871</td>
<td>783,028</td>
<td>1.3</td>
<td>3.6</td>
<td></td>
</tr>
</tbody>
</table>

Sources: Financial statements of Islamic banks
Notes:
(1) The unit of the amount in the table is thousands of US dollars.
(2) Because the data on Year 2010 on total assets, total equity, ROA, and ROE in Dubai Bank is not available, we used the data of Year 2009, alternatively.
<table>
<thead>
<tr>
<th>Table 3. Descriptive statistics of dataset.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full Sample</strong></td>
</tr>
<tr>
<td>Loans of Islamic banking : $Y_1$</td>
</tr>
<tr>
<td>Investment in securities : $Y_2$</td>
</tr>
<tr>
<td>Total amounts : $Y_1 + Y_2$</td>
</tr>
<tr>
<td>Cost of labor : $L$</td>
</tr>
<tr>
<td>Dividends expenses to depositors : $M$</td>
</tr>
<tr>
<td>Total cost : $C$</td>
</tr>
<tr>
<td>Price of labor : $P_L$</td>
</tr>
<tr>
<td>Price of fund : $P_M$</td>
</tr>
<tr>
<td>Total assets : $A$</td>
</tr>
<tr>
<td>Bank capital : $E$</td>
</tr>
<tr>
<td>Equity to assets ratio : $E_r$</td>
</tr>
<tr>
<td>Time trend : $T$</td>
</tr>
<tr>
<td>Number of samples</td>
</tr>
</tbody>
</table>

Note: The unit of the amount in the table is thousands of US dollars.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Model I</th>
<th></th>
<th></th>
<th>Model II</th>
<th></th>
<th></th>
<th>Model III</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Standard error</td>
<td>Coefficient</td>
<td>Standard error</td>
<td>Coefficient</td>
<td>Standard error</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha_0$</td>
<td>-0.016</td>
<td>0.279</td>
<td></td>
<td></td>
<td></td>
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Notes:
(1) Time presents time trend dummy.
(2) DYear2010 presents 2010 dummy capturing the impact of Late-Great recession since 2008 onwards to bank business.
(3) DSaudi - DQatar present country dummy.
(4) Dintermediate and Dsmall present bank size dummy.
(5) R² is the adjusted coefficient of determination for the translog cost function and cost-share equation (L).
(6) LL is log-likelihood value.
(7) The standard errors are corrected by using White estimator. Also, ***, **, and * are significant at 1%, 5%, and 10%, respectively.
### Table 4-2. Estimates of the translog cost functions.

<table>
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<th>Parameters</th>
<th>Model IV</th>
<th>Model V</th>
<th>Model VI</th>
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<td>Standard error</td>
<td>Coefficient</td>
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<td>0.068***</td>
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Notes:

1. DYear2010 presents 2010 dummy capturing the impact of Late-Great recession since 2008 onwards to bank business.
2. D2002-D2010 present year dummy.
3. DSaudi - DQatar present country dummy.
4. DDIB-DMAR present bank dummy.
5. Dintermediate and Dsmall present bank size dummy.
6. R² is the adjusted coefficient of determination for the translog cost function.
7. LL presents log-likelihood value.
8. The standard errors are corrected by using White estimator. Also, ***, **, and * are significant at 1%, 5%, and 10%, respectively.
Table 5. Estimates of economies of scale and scope.

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<th>Parameters</th>
<th>Wald statistic</th>
<th>p-value</th>
<th>Parameters</th>
<th>Wald statistic</th>
<th>p-value</th>
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| $X^2_{0.01}$(1) | 6.634 |

Notes:
(1) Economies of scale and scope, respectively, are calculated by the sample mean of outputs and factor-prices of production.
(2) The Wald statistic follows the chi-square distribution with one degree of freedom.
(3) The Wald statistic for economies of scale indicates the test statistic under the null hypothesis: $\alpha_1+\alpha_2=1$. Also, the Wald statistic for economies of scope indicates the test statistic under the null hypothesis: $\alpha_1+\alpha_2=0$.
(4) The confidence level is 99% for a chi-square distribution with one degree of freedom.
(5) ***, **, and * are significant at 1%, 5%, and 10%, respectively.