Economies of Scale and Scope at Islamic Banks: Evidence from the Gulf Cooperation Council Countries *

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1. Introduction

The number of Islamic banks in the Gulf Cooperation Council (GCC) countries has increased (Figure 1). This indicates that Islamic banks have played a role in absorbing excess liquidity caused by the 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 to gain a competitive advantage in prices over their conventional counterparts. However, there are relatively few empirical studies on the cost structure of Islamic banks. Further, to the best of our knowledge, no consensus has been reached on the productivity growth of Islamic banks.

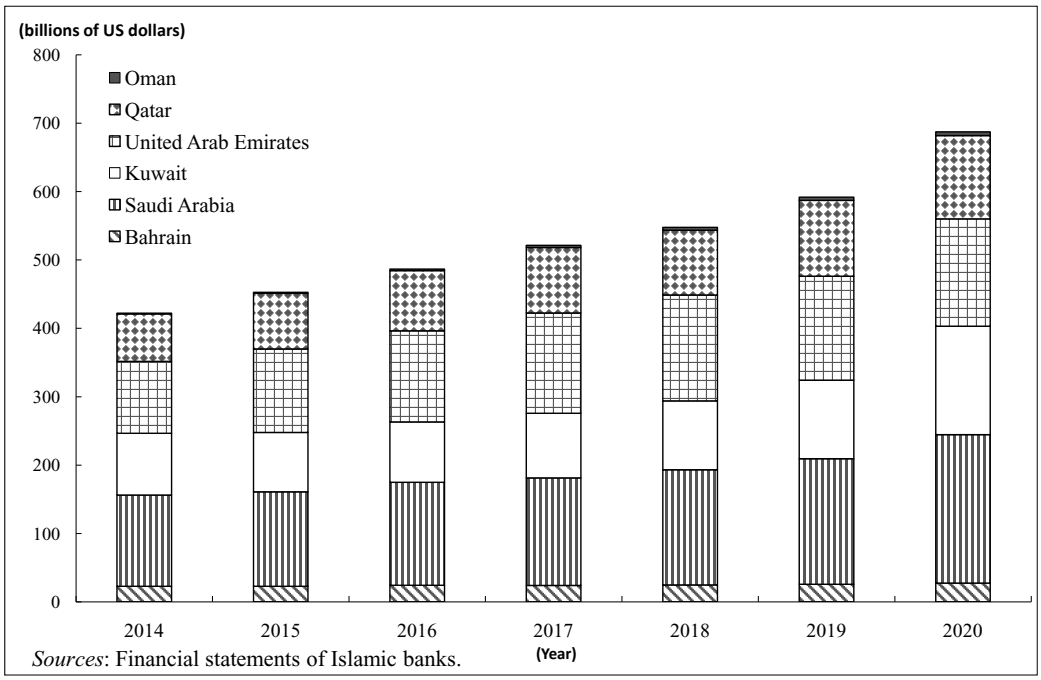

Figure 1. Market Size of the Islamic Banking Sector in the GCC Countries

Table 1. Major Islamic Banks in the GCC Countries, except Oman

Name of Bank	Total Assets (2014)	Country	Percentage of Total Assets of Islamic Banks in the GCC Countries
Al-Rajhi Bank	82,056	Saudi Arabia	22%
Kuwait Finance House	60,390	Kuwait	16%
Dubai Islamic Bank	33,733	United Arab Emirates	9%
Abu Dhabi Islamic Bank	30,470	United Arab Emirates	8%
Qatar Islamic Bank	26,402	Qatar	7%
Masraf al-Rayan	22,033	Qatar	6%
Alinma Bank	21,563	Saudi Arabia	6%
Bank al-Jazira	17,747	Saudi Arabia	5%

Notes: Total assets are expressed in millions of US dollars.

Table 2. Overview of the Islamic Banking Sector in the GCC Countries, except Oman (2014)

Financial Institutions	No. of Banks	Total Assets	Total Equity	ROA (%; Average)	ROE (%; Average)	No. of Branch
Bahrain	6	22,739,858	3,012,025	0.4	3.4	—
Al-Baraka Islamic Bank	—	1,835,021	169,877	0.1	1.2	6
Al-Salam Bank	—	5,200,307	874,484	0.8	4.8	13
Bahrain Islamic Bank	—	2,327,700	210,361	1.0	11.7	11
Ithmaar Bank	—	7,860,904	523,386	−0.1	−1.6	18
Khaleeji Commercial Bank	—	1,574,281	274,090	0.5	2.9	8
Kuwait Finance House	—	3,941,644	959,825	0.3	1.4	11
Saudi Arabia	4	133,428,601	19,169,286	1.5	11.0	—
Alinma Bank	—	21,563,162	4,783,795	1.4	6.4	58
Al-Rajhi Bank	—	82,056,414	11,172,318	2.2	16.3	553
Bank al-Bilad	—	12,061,310	1,571,027	1.8	14.3	116
Bank al-Jazira	—	17,747,714	1,642,145	0.6	6.9	70
Kuwait	5	90,274,650	10,790,942	0.9	7.9	—
Al-Ahli United Bank	—	12,642,482	1,192,641	1.4	11.6	—
Kuwait International Bank	—	5,843,622	846,420	1.2	8.2	26
Kuwait Finance House	—	60,390,980	7,370,679	0.9	7.6	63
Boubyan Bank	—	9,306,944	1,058,313	1.2	10.6	30
Warba Bank	—	2,090,620	322,887	0.0	1.3	—
United Arab Emirates	7	105,206,095	13,769,561	1.3	10.6	—
Dubai Islamic Bank	—	337,33,794	4,821,261	2.2	15.8	—
Emirates Islamic Bank	—	11,685,015	1,225,942	0.8	8.0	57
Sharjah Islamic Bank	—	7,083,115	1,248,030	1.3	7.6	30
Abu Dhabi Islamic Bank	—	30,470,742	3,726,798	1.5	12.5	88
Noor Islamic Bank	—	7,900,055	891,279	2.6	23.8	—
Al-Hilal Bank	—	11,275,118	1,555,863	0.0	0.6	24
Ajman Bank	—	3,058,213	300,386	0.5	5.8	9
Qatar	4	69,449,370	10,353,415	2.0	13.8	—
Qatar Islamic Bank	—	26,402,874	3,893,314	1.7	11.7	30
Qatar International Islamic Bank	—	10,548,751	1,474,770	2.1	15.3	17
Masraf al-Rayan	—	22,003,919	3,219,917	2.5	17.2	12
Barwa Bank	—	10,493,824	1,765,412	1.8	11.0	5

Notes: The amounts are expressed in thousands of US dollars.

Sources: Financial statements of Islamic banks.

The objective of this study is to examine the cost structure of the GCC Islamic banks in responding to changes in the market environments. We use financial data obtained from the GCC Islamic banks (Tables 1

and 2) to clarify the cost structure of Islamic banks. Specifically, economies of scale and scope are calculated by simultaneously estimating the Translog cost function and the cost share equation. In addition, the study evaluates the influence of the global financial crisis that began in mid-2008 on the cost of Islamic banks.

The rest of this study is organized as follows. Section 2 reviews previous studies. Section 3 introduces the data used in this study and outlines the estimation models and methodology. Section 4 measures the economies of scale and scope using the estimated cost function, examines the cost structure of Islamic banks, and evaluates the influence of the global financial crisis on the cost of the GCC Islamic banks. Section 5 discusses the empirical results. Finally, Section 6 presents the conclusions.

2. Literature Review

A typical method to examine the cost structure of the banking industry is to verify the existence of economies of scale and scope. In general, decreasing-cost industries can reduce long-run average costs by expanding output because of economies of scale. However, industries that produce multiple products can curtail costs because the total cost of producing the products is less than the cost of producing each product individually. In particular, the main advantage of the economies of scale and scope in the banking industry is cost savings. The effect arises from an expansion and diversification of production. Here, economies of scope come into being when there are common factors of production for two different products. For instance, information is a common factor of production in financial industries. Moreover, as one of the primary functions of banks is production information, they can save on the cost of information production through the diversification of financial operations. For instance, Islamic banks can reuse the information acquired from lending activities for investment operations.[(1)]

Numerous studies have examined economies of scale and scope in the banking industry of developed countries (e.g., Benston et al. 1982; Murray and White 1983; Gilligan et al. 1984).[(2)] In addition, operational efficiency (such as cost, profit, technical, and allocative efficiencies) has been examined in recent years. These studies verify the efficiencies by employing a parametric approach (such as the stochastic frontier analysis (SFA)) and a nonparametric approach (such as the data envelopment analysis (DEA)). Many previous studies have also examined the efficiencies of Islamic banks in non-GCC countries (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; Kablan and Yousfi 2011). Some empirical studies have focused on the efficiencies of the GCC banking sector (Al-Jarrah and Molyneux 2006; Shams and Molyneux 2006; Ariss et al. 2007; Al-Jarrah 2007; Maghyereh and Awartani 2012). Furthermore, other studies have examined the efficiencies of the GCC Islamic banks (Srairi

2010; El-Moussawi and Obeid 2011; Srairi et al. 2011; Miah and Uddin 2017; Slimen et al. 2022[3]).

Thus, numerous previous studies have examined the efficiencies of the Islamic banking sector in non-GCC countries, but to the best of our knowledge, only a few studies have focused on the characteristics of the industrial organization (such as economies of scale and scope) in the Islamic banking sector of the GCC countries. Therefore, this study examines the cost structure of the GCC Islamic banks by estimating their cost function. Based on a review of the literature, the following hypotheses are proposed:

Hypothesis 1: Economies of scale exist in the GCC Islamic banks.

Hypothesis 2: Economies of scope exist in the GCC Islamic banks.

Hypothesis 3: The global financial crisis that started in mid-2008 forced the GCC Islamic banks to incur higher costs.

3. Materials and Methods

Sample Data

The data used in this study are from the financial statements of Islamic banks from 2004 to 2014, covering the period of the global financial crisis, and are pooled data from 18 full-fledged Islamic commercial banks in the GCC countries[4]. Further, the dataset used in this study includes observations of financial institutions over multiple periods to increase the number of observations. Our sample is an unbalanced dataset due to difficulties in accessing the annual data of some banks. The total number of observations is 142.

Theoretical Framework

This study intends to estimate the cost function using the deterministic frontier method under the assumption that firms minimize costs, thereby measuring economies of scale and scope in Islamic banks. Tsutsui (2005) measured economies of scale by estimating general cost functions; he used operating expenses as a dependent variable and used the number of loans, the amount of loans, wage rates, the rental price of capital equipment, and dummy variables as the explanatory variable. In addition, the study estimated the cost function by including dummy variables for *time trend*, *business category*, *year,* and *individual bank*.

In this study, the cost function is estimated using the cost of production as a dependent variable, and outputs, factor prices of production, and dummy variables are as the explanatory variable. We introduce dummy variables for *year* and *individual bank* into the cost function. Specifically, this study considers three models for the cost function. Model I includes no dummy variables. Model II includes a *year dummy* variable to capture the influence of time trends. In Model III, we include two dummy variables — a *year dummy* variable and a *bank dummy* variable — to capture the size of a bank's management resources.

Estimation of Cost Function

We need to determine the banks' inputs and outputs to estimate the cost function of the banking industry. Determining the inputs and outputs is dependent on the definition of the banking industry. The intermediation approach focuses on the financial intermediation functions of banks and considers that a bank produces loans and securities investments by employing labor, physical capital, and deposits. In contrast, the production approach focuses on the bank production process in services. This approach considers that a bank produces loans and securities investments by employing physical capital, labor, and deposits and provides all services to customers. However, as the deposits have characteristics of both inputs and outputs, Hori (2003), Aly et al. (1990), and Yamamoto (2011) specified outputs and inputs based on two aspects of deposits. This study follows Hori (2003), who defined demand deposits, such as checking and savings deposits, as outputs and other deposits used for bank's working funds as inputs. In this study, the factors of production used are physical capital (K), labor (L), and deposits (M). The bank outputs used here are the balance of loans of Islamic banks (Y_1) (the balance before deducting an allowance for impairment and after deducting nonperforming loans), the balance of securities investments (Y_2) and the current account balance due from customers, excluding banks and financial institutions (Y_3). The production function of banks is as follows:

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

where the inputs of physical capital, labor, and profit-bearing deposits are defined as Q_K, Q_L, and Q_M, respectively; therefore $C = K + L + M = P_K \times Q_K + P_L \times Q_L + P_M \times Q_M$. Here, C denotes the total cost, including physical capital costs (K), labor costs (L), and dividends on investment of deposit account holders (M), which are denoted by P_K, P_L, and P_M, respectively. The cost function of the duality theorem to the production function is as follows:

$$C = G(Y_1, Y_2, Y_3, P_K, P_L, P_M). \quad [2]$$

As mentioned earlier, *year* and *bank* dummy variables are used to identify differences in the cost structure. Moreover, Models I, II, and III are used to identify differences in the cost structure by the effect of management resources.

The Translog cost function is obtained by using Equation [2] to derive a second-order Taylor polynomial approximation of the logarithm near a given point, that is,

$$\ln C = [\alpha_0] + \sum_i \alpha_i \ln Y_i + \sum_j \beta_j \ln P_j + 0.5\left(\sum_i \sum_k \sigma_{ik} \ln Y_i \cdot \ln Y_k + \sum_j \sum_h \gamma_{jh} \ln P_j \cdot \ln P_h\right) + \sum_i \sum_j \delta_{ij} \ln Y_i \cdot \ln P_j + Dummy + u \quad [3]$$

where u denotes the error term ($i, k = 1, 2, 3$; $j, h = K, L, M$).

The cost function should be (i) cross-equation symmetry (second-order differentiable functions), (ii) linearly homogenous in input prices, (iii) monotonic in outputs and (iv) monotonic in factor prices (quasi-concave in input prices). In our econometric estimation, restrictions (i) and (ii) are imposed *a priori* on the Translog cost function [3], and restrictions (iii) and (iv) are checked *ex post facto* on the parameter estimates of the cost function.

To satisfy restriction (i), the coefficients of the Translog cost function［3］are required

$$\sigma_{ik}=\sigma_{ki},\ \gamma_{jh}=\gamma_{hj}\quad (i,\ k=1,\ 2,\ 3;\ j,\ h=K,\ L,\ M) \qquad [4]$$

and they are also required to satisfy restriction (ii),

$$\begin{aligned}&\beta_K+\beta_L+\beta_M=1\\&\gamma_{jK}+\gamma_{jL}+\gamma_{jM}=0 \qquad (j=K,\ L,\ M)\\&\delta_{iK}+\delta_{iL}+\delta_{iM}=0 \qquad (i=1,\ 2,\ 3).\end{aligned} \qquad [5]$$

Given these restrictions, the Translog cost function［3］is as follows:

$$\begin{aligned}\ln C=&[\alpha_0]+\alpha_1\ln Y_1+\alpha_2\ln Y_2+\alpha_3\ln Y_3+\beta_K\ln P_K+\beta_L\ln P_L+(1-\beta_K-\beta_L)\cdot\ln P_M\\&+0.5[(\sigma_{11}\ln Y_1\cdot\ln Y_1+2\sigma_{12}\ln Y_1\cdot\ln Y_2+2\sigma_{13}\ln Y_1\cdot\ln Y_3\\&+\sigma_{22}\ln Y_2\cdot\ln Y_2+2\sigma_{23}\ln Y_2\cdot\ln Y_3+\sigma_{33}\ln Y_3\cdot\ln Y_3)\\&+\{-(\gamma_{KL}+\gamma_{KM})\ln P_K\cdot\ln P_K+2\gamma_{KL}\ln P_K\cdot\ln P_L+2\gamma_{KM}\ln P_K\cdot\ln P_M\\&-(\gamma_{KL}+\gamma_{KM})\ln P_L\cdot\ln P_L+2\gamma_{LM}\ln P_L\cdot\ln P_M-(\gamma_{KM}+\gamma_{LM})\ln P_M\cdot\ln P_M\}]\\&+\{\delta_{1K}\ln Y_1\cdot\ln P_K+\delta_{1L}\ln Y_1\cdot\ln P_L-(\delta_{1K}+\delta_{1L})\ln Y_1\cdot\ln P_M\\&+\delta_{2K}\ln Y_2\cdot\ln P_K+\delta_{2L}\ln Y_2\cdot\ln P_L-(\delta_{2K}+\delta_{2L})\ln Y_2\cdot\ln P_M+\delta_{3K}\ln Y_3\cdot\ln P_K\\&+\delta_{3L}\ln Y_3\cdot\ln P_L-(\delta_{3K}+\delta_{3L})\ln Y_3\cdot\ln P_M\}+Dummy+u.\end{aligned} \qquad [6]$$

Using Shephard's lemma, the cost-share (S_j) equation is derived as follows:

$$\begin{aligned}S_j=\frac{P_j\cdot Q_j}{C}&=\partial\ln C/\partial\ln P_j\\&=\beta_j+\sum_h\gamma_{jh}\ln P_h+\sum_i\delta_{ij}\ln Y_i+z_j\ (i,\ k=1,\ 2,\ 3;\ j,\ h=K,\ L,\ M)\end{aligned} \qquad [7]$$

where the cost-share is the ratio of the j^{th} input to the total cost, and z_j represents the error term. In our econometric estimation, the cost-share equation on j=K (physical capital costs) is deleted, avoiding the problem of singularity. In this study, the cost-share Equation［7］is defined as follows:

$$\begin{aligned}S_L=&\beta_L+\gamma_{KL}\ln P_K-(\gamma_{KL}+\gamma_{KM})\ln P_L+\gamma_{LM}\ln P_M\\&+\delta_{1L}\cdot\ln Y_1+\delta_{2L}\cdot\ln Y_2+\delta_{3L}\ln Y_3+z_L.\end{aligned} \qquad [8]$$

$$\begin{aligned}S_M=&\beta_M+{}_{KM}\ln P_K+{}_{LM}\ln P_L-(\gamma_{KM}+\gamma_{LM})\ln P_M\\&-(\delta_{1K}+\delta_{1L})\ln Y_1-(\delta_{2K}+\delta_{2L})\ln Y_2-(\delta_{3K}+\delta_{3L})\ln Y_3+z_M.\end{aligned} \qquad [9]$$

Numerous explanatory variables in the Translog function can cause multicollinearity. Therefore, the parameter estimates are obtained by simultaneously estimating Equations［8］,［9］(the derived cost-share equation), and［6］to improve the reliability of the coefficients. In this study, the seemingly unrelated regression method is used because the error terms in Equation［6］,［8］, and［9］are correlated. In our estimation, besides the bank outputs, factor prices and total costs were deflated with each county's GDP deflator (the finance and insurance sector), the values are normalized at their sample means. The data for exchange rates by country are obtained from the International Financial Statistics database. A detailed definition of the data is presented in the Appendix.

4. Empirical Results

Overview of the Descriptive Statistics

Table 3 presents the descriptive statistics of the dataset that is used to estimate the cost function. The table reveals three main findings. First, there are large differences between the maximum and minimum balances of loans in Islamic banking, securities investments, and current accounts, as well as between those of total assets. The differences are due to the difference in the operational size of the 18 Islamic banks. Second, the means of the variables, except the balance of securities investment, labor costs, the factor prices, and total assets are more than two times the median. This indicates that banks with relatively large assets can cause the means to increase. Third, labor costs are comparatively higher than physical capital. This may indicate that Islamic banks increased their labor costs and reduced investment in physical capital.

Table 3. Descriptive Statistics of the Dataset

Full Sample		Average	Median	Standard Deviation	Minimum	Maximum
Loans of Islamic banks	: Y_1	8,060,548	3,187,751	10,794,582	147,492	55,594,282
Investment in securities	: Y_2	1,182,041	595,500	1,386,695	11,836	6,465,178
Current accounts	: Y_3	4,294,800	1,144,475	9,815,057	31,844	61,010,937
Total amounts	: Y (Y_1+Y_2+Y_3)	13,537,389	5,419,684	20,195,041	245,504	117,434,384
Cost of physical capital	: K	104,816	47,563	138,593	5,221	751,761
Cost of labor	: L	128,425	72,686	144,291	7,369	670,427
Dividends to investment depositors	: M	152,970	71,047	209,342	1,569	1,108,657
Total cost	: C	386,211	222,705	435,657	18,115	2,177,490
Price of physical capital	: P_K	0.29792	0.21866	0.22465	0.07579	1.26342
Price of labor	: P_L	0.01100	0.01050	0.00463	0.00183	0.03559
Price of funds	: P_M	0.03244	0.02674	0.02190	0.00242	0.11365
Total assets	: Asset	13,415,968	6,892,819	15,995,014	524,970	82,056,415
Number of banks		18	—	—	—	—
Number of samples		142	—	—	—	—

Notes: The amounts are expressed in thousands of US dollars.

Estimation Results

Table 4 reports the parameter estimates of the Translog cost functions. The adjusted R-squared values of the cost functions are 0.877 in Model I, 0.922 in Model II, and 0.958 in Model III. Except for those of Model I, these values are relatively high. Further, we use White's estimator with robust standard errors to heteroscedasticity to obtain the covariance matrix of fitted coefficients.

Table 4. Parameter Estimates for the Translog Cost Functions for Models I, II and III

Parameters	Model I		Model II		Model III	
	Coefficient	Standard Error [e]	Coefficient	Standard Error [e]	Coefficient	Standard Error [e]
α_0	0.299	0.069***				
α_1	0.486	0.126***	0.492	0.116***	0.625	0.137***
α_2	0.309	0.064***	0.271	0.056***	0.137	0.082
α_3	0.179	0.091*	0.185	0.088**	0.193	0.122
β_K	0.256	0.215	0.251	0.169	0.262	0.163
β_L	0.334	0.228	0.333	0.202	0.335	0.143**
σ_{11}	0.472	0.213**	0.502	0.158***	0.100	0.190
σ_{12}	−0.115	0.088	−0.118	0.085	0.150	0.111
σ_{13}	−0.286	0.146*	−0.283	0.100***	−0.034	0.117
σ_{22}	0.050	0.043	0.051	0.041	0.007	0.040
σ_{23}	0.070	0.068	0.070	0.063	−0.189	0.092**
σ_{33}	0.200	0.117*	0.180	0.082***	0.081	0.084
γ_{KL}	−0.024	0.225	−0.028	0.227	0.000	0.209
γ_{KM}	−0.011	0.106	−0.003	0.086	−0.024	0.078
γ_{LM}	−0.113	0.185	−0.110	0.157	−0.094	0.110
δ_{1K}	−0.015	0.130	−0.024	0.111	−0.016	0.101
δ_{1L}	0.000	0.200	0.002	0.201	−0.004	0.167
δ_{2K}	−0.029	0.097	−0.026	0.083	−0.020	0.082
δ_{2L}	−0.022	0.135	−0.022	0.138	−0.027	0.098
δ_{3K}	0.044	0.110	0.050	0.098	0.036	0.114
δ_{3L}	0.022	0.159	0.020	0.159	0.031	0.132
D2005 [a]			−0.197	0.133	0.067	0.111
D2006			−0.011	0.111	0.231	0.136*
D2007			0.160	0.109	0.328	0.139**
D2008			0.293	0.082***	0.471	0.107***
D2009			0.332	0.084***	0.528	0.105***
D2010			0.516	0.130***	0.697	0.130***
D2011			0.384	0.077***	0.524	0.099***
D2012			0.376	0.082***	0.491	0.100***
D2013			0.376	0.091***	0.492	0.107***
D2014			0.383	0.112***	0.508	0.119***
DARB [b]					−0.871	0.419**
DKFH					−0.005	0.175
DDIB					0.065	0.123
DADIB					0.042	0.143
DQIB					−0.330	0.109***
DMAR					−0.623	0.330*
DBAJ					−0.212	0.135
DBAB					−0.602	0.250**
DEIB					−0.280	0.098***
DQIIB					−0.367	0.161**
DBB					0.021	0.135
DIB					0.629	0.398
DSIB					0.244	0.224

DASB					−0.033	0.184
DKFHB					0.461	0.256*
DAB					0.206	0.317
DABIB					0.270	0.315
	$R^{2\,c}$	LL^{d}	$R^{2\,c}$	LL^{d}	$R^{2\,c}$	LL^{d}
Equation [6]	0.877	−138.927	0.922	−137.028	0.958	−134.245
Cost-share equation (L)	0.752	153.438	0.750	153.340	0.791	156.074
Cost-share equation (M)	0.795	89.602	0.781	88.663	0.786	88.996

Notes: [a] D2005-D2014 represent the *year dummy* variables. [b] DARB-DABIB represent the *bank dummy* variables. They are listed in descending order of total assets. [c] R^2 is the adjusted coefficient for determining the Translog cost function and cost-share equation (L) and (M), respectively. [d] LL represents the log-likelihood value. [e] The White standard errors are used; ***, **, and * are significant at the 1%, 5%, and 10% levels, respectively.

The left column of Table 4 presents the results of Model I; six of the 28 estimates are statistically significant at the 5% level. The results of Model II (center column) indicate that 8 of 27 estimates (excluding dummy variables) are statistically significant at the 5% level. We find that 7 out of 10 dummy variable estimates (*year dummy* : from 2008 to 2010) are significantly different from zero at the 1% level. The results of Model III (right column) indicate that 5 of the 27 estimates (excluding dummy variables) are statistically significant at the 5% level. The estimates for 13 (*year dummy* (from 2007 to 2014), and *bank dummy*) out of 27 dummy variables are significantly different from zero at the 5% level.

Validity of Cost Functions

The cost function must satisfy the monotonicity restrictions in outputs and factor prices.

For the monotonicity restriction in outputs,

$$\partial C / \partial Y_i = (C / Y_i) \cdot (\partial \ln C / \partial \ln Y_i) > 0 \qquad (i = 1, 2, 3) \qquad [10]$$

and for the monotonicity restriction in factor prices,

$$\partial C / \partial P_j = (C / P_j) \cdot (\partial \ln C / \partial \ln P_j) > 0 \qquad (j = K, L, M). \qquad [11]$$

As $C / Y_i > 0$, a sufficient condition for Equation [10] to hold is

$$\partial \ln C / \partial \ln Y_i = \alpha_i + \sum_K \sigma_{ik} \ln Y_k + \delta_{ij} \ln P_j > 0 \quad (i, k = 1, 2, 3; j = K, L, M). \qquad [12]$$

As $\ln Y_k = 0$ and $\ln P_j = 0$, a sufficient condition for Equation [12] to hold at least near a given point is

$$\alpha_i > 0 \quad (i = 1, 2, 3). \qquad [13]$$

As presented in Table 4, α_i is positive in all models. Specifically, α_1 (the balance of loans of Islamic banks (Y_1)) is significantly positive in all models.

As $C / P_j > 0$, a sufficient condition for Equation [11] to hold is

$$\partial \ln C / \partial \ln P_j = \beta_j + \sum_h \gamma_{jh} \ln P_h + \sum_i \delta_{ij} \ln Y_i > 0 \qquad (i, k = 1, 2, 3; j, h = K, L, M). \qquad [14]$$

As $\ln P_h = 0$ and $\ln Y_i = 0$, a sufficient condition for Equation [14] to hold at least near a given point is

$$\beta_j > 0 \quad (j = K, L, M). \qquad [15]$$

β_j is positive in all models. Specifically, β_M (the price of dividends to investment deposit account holders (P_M)) is significantly positive in all models.

In addition, this study uses a Hessian matrix that has negative semidefinite characteristics to identify the quasi-concave function of factor prices. This matrix is

$$H_P=\{\partial^2 C / (\partial P_j \partial P_h)\} = \begin{bmatrix} \gamma_{KK}+\beta_K\cdot(\beta_K-1) & \gamma_{KL}+\beta_K\cdot\beta_L & \gamma_{KM}+\beta_K\cdot\beta_M \\ \gamma_{LK}+\beta_L\cdot\beta_K & \gamma_{LL}+\beta_L\cdot(\beta_L-1) & \gamma_{LM}+\beta_L\cdot\beta_M \\ \gamma_{MK}+\beta_M\cdot\beta_K & \gamma_{ML}+\beta_M\cdot\beta_L & \gamma_{MM}+\beta_M\cdot(\beta_M-1) \end{bmatrix} (j, h=K, L, M). \quad [16]$$

To satisfy the quasi-concavity conditions of cost functions of the factor prices, it is necessary that

$$\det H_1 \leq 0, \det H_2 \geq 0, \text{ and } H_3 \leq 0. \quad [17]$$

Moreover, we assume the conditions of cross-equation symmetry and linearly homogeneity in input prices; therefore, the Inequalities [17] are reduced as a sufficient condition

$$\gamma_{jj}+\beta_j\cdot(\beta_j-1)\leq 0 \quad (j=K, L, M). \quad [18]$$

Table 5 presents the verification results of the quasi-concavity of the cost function. These results indicate that the conditions are satisfied in all models.

Table 5. Wald Test for Quasi-concavity of Cost Function [a]

		Parameters [d]	Wald Statistic [b]	p-value
Model I	H_1	−0.154***	95.261	0.000
	H_2	0.013***	18.842	0.000
	H_3	−0.001***	14.426	0.000
Model II	H_1	−0.155***	102.980	0.000
	H_2	0.012***	22.636	0.000
	H_3	−0.001***	17.044	0.000
Model III	H_1	−0.169***	341.425	0.000
	H_2	0.021***	81.870	0.000
	H_3	−0.002***	46.418	0.000
$\chi^2_{0.01}(1)$ [c]		6.634		

Notes: [a] Each element of the Hessian is calculated using the sample means of the factor prices of production. [b] The Wald statistic follows a chi-square distribution with one degree of freedom; the Wald statistic for quasi-concavity of the cost function indicates the test statistic under the null hypothesis: det H_1=0, det H_2=0, or det H_3=0. [c] The confidence level is 99% for a chi-square distribution with one degree of freedom. [d] *** denotes significance at the 1% level.

5. Discussion and Implications

Cost Structure of Islamic Banks

First, we examine the existence of economies of scale and scope.[(5)] Economies of scale and scope are calculated using the estimated parameters of the cost function. Table 6 presents estimates of the economies

of scale and scope, which are evaluated using the sample means of outputs and factor prices of production.

Table 6. Estimates of the Economies of Scale and Scope [a]

	Economies of Scale			Economies of Scope		
	Parameters [d]	Wald Statistic [b]	p-value	Parameters [d]	Wald Statistic [b]	p-value
Model I	0.974	0.415	0.520			
$SCOPE_{12}$				0.035	0.538	0.464
$SCOPE_{13}$				−0.199***	6.877	0.009
$SCOPE_{23}$				0.125**	6.565	0.011
Model II	0.949	2.448	0.119			
$SCOPE_{12}$				0.014	0.149	0.700
$SCOPE_{13}$				−0.191***	9.514	0.002
$SCOPE_{23}$				0.120***	9.753	0.002
Model III	0.956	0.698	0.404			
$SCOPE_{12}$				0.236***	16.615	0.000
$SCOPE_{13}$				0.086	0.989	0.321
$SCOPE_{23}$				−0.163**	5.856	0.016
$\chi^2_{0.01}(1)$ [c]			6.634			

Notes: [a] Economies of scale and scope are calculated using the sample means of outputs and factor prices of production, respectively. [b] The Wald statistic follows a chi-square distribution with one degree of freedom; the Wald statistic for economies of scale indicates the test statistic under the null hypothesis: $\alpha_1+\alpha_2+\alpha_3=1$; the Wald statistic for economies of scope indicates the test statistic under the null hypotheses: $\sigma_{12}+\alpha_1\times\alpha_2=0$, $\sigma_{13}+\alpha_1\times\alpha_3=0$, or $\sigma_{23}+\alpha_2\times\alpha_3=0$. [c] The confidence level is 99% for a chi-square distribution with one degree of freedom. [d] *** and ** denote significance at the 1% and 5% levels, respectively.

For economies of scale, the results of the Wald chi-square tests (with one degree of freedom[(6)]) indicate that economies of scale exist as SCALE < 1 in all the models. However, the estimates are not statistically significant. This result is consistent with those of previous studies which report that Islamic banks in the GCC countries do not enjoy economies of scale (Srairi 2010; Srairi et al. 2011). In this study, the finding may indicate that a factor specific to each bank has a negative effect on the economies of scale of the overall Islamic banking sector in the GCC countries.

For economies of scope, the results of the Wald chi-square tests (with one degree of freedom[(7)]) indicate that cost complementarities exist between loans and current accounts in Models I and II, as well as between securities investments and current accounts in Model III. Further, the estimates are significantly less than zero at the 5% level. Instead, diseconomies of scope are found between securities investments and current accounts in Models I and II, as well as between loans and investment securities in Model III. The estimates are significantly less than zero at the 5% level. However, as for cost complementarities between securities investments and current accounts, we could not determine whether they yield economies of scope because the results of Models I and II are opposite to those of Model III. Hence, significant economies of scope are detected between loans and current accounts, while weak evidence of scope diseconomies is found between

loans and securities investments.

This study reveals that cost complementarities exist between loans and current accounts. This finding may indicate that there is useful information that is common to both lending and borrowing (such as interest free deposits). However, there is weak evidence of scope diseconomies between loans and securities investments. On the whole, the GCC countries have undertaken diversification in the financial sector under financial liberalization policies. Nevertheless, there is week evidence of scope diseconomies between loans and investment securities. This result can be related to an increase in the proportion of income obtained from Islamic banks to total income since the late 2000s. In other words, Islamic banks made a policy shift to specialize in fund management through Islamic financial instruments. This result may indicate that the Islamic banking sector is not active in the diversification of financial operations as compared with the conventional banking sector in the GCC countries. Accordingly, the GCC Islamic banks could not enjoy economies of scope in lending and investment activities.

Finally, we evaluate the impact of the global financial crisis since mid-2008 on the banking sector. Table 4 reports that the *year dummy* variables for 2008-2014 in Models II and III are significantly positive at the 5% level. Regarding the influence of the global financial crisis on the cost of Islamic banks, the *year dummy* variable for 2010 in Models II and III is significantly positive and higher than the *year dummy* variables prior to 2009. This implies that the negative effects of the global financial crisis on Islamic banks were noticeable in 2010[(8)]. Furthermore, this result is somewhat consistent with that of Belanès et al. (2015), who found that Islamic banks witnessed a slight decrease in their efficiency level to the subprime crisis after the global financial crisis occurred.

Implications

Islamic banks that were originally smaller than their conventional counterparts were actively engaging in fund management through Islamic financial instruments by enlarging management resources, including fixed assets and equipment. However, economies of scale are not observed in the GCC Islamic banks. There are two possible reasons behind this result.

First, as pointed out previously, this result could be explained by the negative effect specific to each bank on scale economies of the overall Islamic banking sector. As the size of the management resources of each bank influences on the cost of Islamic banks, it had a negative effect on economies of scale, thereby not enabling for some Islamic banks to use factors of production efficiently. Second, the operational size of Islamic banks was smaller than that of their conventional counterparts (e.g., Srairi 2010); therefore, the Islamic banks have not reached the stage where they can enjoy economies of scale. This implies that in contrast to the unfavorable situation in competition with conventional counterparts, Islamic banks may achieve cost savings by enlarging managerial size by merging with other Islamic banks to enjoy economies

of scale.

This study reveals that economies of scope between loans and current accounts are observed. As mentioned earlier, this result indicates that there are common inputs for two different outputs, namely loan and current deposit account services. For instance, customer information is a common input for Islamic banks. In this regard, Islamic banks applied large amounts of customer information accumulated through loan services to depository services and thus attained the efficiency of their settlement services for funds. Therefore, the GCC Islamic banks should place considerable emphasis on realizing cost savings by making efficient use of information accumulated through loan services.

Economies of scope between loans and securities investments are not observed. This result relates to the fact that the Islamic banks changed their policy to specialize in fund management through Islamic financial instruments. The reason behind such activities of Islamic banks is that as they have to compete with their conventional counterparts, they try to emphasize the difference between them and their conventional counterparts to acquire new customers. Moreover, the financial system in the GCC countries can have a negative effect on the activities of Islamic banks to diversify financial operations. For instance, regulations over Islamic financial products and instruments or the financial system inhibits the diversification of Islamic banks. Therefore, regulatory bodies need to emphasize on improving the business diversification of Islamic banks.

6. Conclusion

This study examines the cost structure of the GCC Islamic banks. Specifically, using their financial data for 2004-2014, the study verifies economies of scale and scope in the GCC Islamic banks by simultaneously estimating the Translog cost function and the cost share equations. In addition, the study evaluates the influence of the global financial crisis on the cost of Islamic banks in the GCC countries.

Our major conclusions are as follows. First, the regression results indicate that economies of scale do not exist in the GCC Islamic banks. Similar results are found in earlier studies on the GCC Islamic banks (e.g., Srairi 2010; Srairi et al. 2011). Therefore, Hypothesis 1 is rejected. Second, significant economies of scope between loan and current deposit account services are observed, whereas there is no evidence of economies of scope between lending and investment activities. Therefore, Hypothesis 2 is partially accepted. Third, the regression results imply that the negative effects of the global financial crisis on Islamic banks were noticeable in 2010. Therefore, Hypothesis 3 is accepted.

Finally, we point out the limitations of this study. First, this study investigates the existence of economies of scale and scope in the GCC Islamic banks, but it does not analyze their cost efficiencies. It is essential to reconsider the cost efficiency of Islamic banks by employing a deterministic DEA model as a

nonparametric technique and employing a SFA model. Further, it would be useful to estimate economies of scale and scope using the Fourier flexible functional form instead of the Translog functional form. Third, this study confirms that the GCC Islamic banks do not sufficiently enjoy economies of scope because Islamic banks do not actively engage in the diversification of financial operations; however, we do not clearly explain the relationship between the reason behind such activities of Islamic banks and the financial liberalization policies. This point would be examined in future analyses.

Appendix

Details of Data

Y_1: Balance of loans of Islamic banks (excluding receivables on leasing business)

Y_2: Balance of securities investments

Y_3: Current account balance due from customers (excluding banks and financial institutions)

P_K: Price of physical capital [cost of capital equipment (K) divided by the average balance of property, equipment and other assets]

P_L: Price of labor [cost of labor (L) divided by total asset]

P_M: Price of funds [dividends to investment deposit account holders (M) divided by the average balance of investment deposit accounts]

C: Total cost (K+L+M)

The average balance is calculated by the average balance of the amount at the end of the current year and the previous one. Regarding P_L(the price of labor), the data on the number of employees are not available for some banks. Accordingly, following Altunbas et al. (2000), we use the cost of labor divided by total assets as a proxy variable for the price of labor.

Notes

＊ This manuscript has been significantly revised to the original content of my doctoral dissertation submitted to Hitotsubashi University.

(1) One example of information related to Islamic finance is information on the investees' compliance with Islamic law (*sharī'ah*). Banks can use information like this in investment securities, in especially selecting a stock name. When a problem concerning Islamic laws is found in the management of a publicly listed company, an Islamic bank that invested in the company can lose its reputation.

(2) Regarding previous studies on cost structure, including economies of scale and scope, the studies of Kasuya (1993) and Hori (1998) are helpful.

(3) These studies report the following: 1) Islamic banks are inferior to their conventional counterparts in terms of cost and profit efficiency; 2) most Islamic banks are facing a decrease in scale efficiency (scale inefficiency is increasing over time); 3) in terms of asset size, the scale efficiency in small size banks is higher than that in large and medium size banks; 4) there is a negative relationship between cost efficiency and bank size; 5) Islamic banks do not achieve enjoy scale efficiency because their bank size is still small; and 6) there is an inverse relationship between the capital-to-asset ratio and technical or cost efficiency.

(4) The Islamic banks included in our sample are Bahrain Islamic bank, Ithmaar Bank, Kuwait Finance House-Bahrain, Al-Baraka Islamic Bank, and Al-Salam 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, Emirates Islamic bank, and Ajman Bank in the United Arab Emirates; and Qatar Islamic Bank, Qatar International Islamic Bank, and Masraf al-Rayan in Qatar. In addition, Ithmaar Bank was operating as an investment bank until 2009, integrated its business operations with Shamil Bank, which was its subsidiary, and acquired a license as an Islamic commercial bank. The financial data of Ithmaar Bank included in this study are from 2009 to 2014.

(5) The method to measure economies of scale and scope:

Economies of scale of all outputs (SCALE) are expressed as follows:

$$SCALE = \sum_i (\partial \ln C / \partial \ln Y_i) = \partial \ln C / \partial \ln Y_1 + \partial \ln C / \partial \ln Y_2 + \partial \ln C / \partial \ln Y_3 \quad (i=1, 2, 3). \qquad [N1]$$

Here, SCALE is

$$\begin{aligned} SCALE = {} & \{\alpha_1 + \sigma_{11} \ln Y_1 + \sigma_{12} \ln Y_2 + \sigma_{13} \ln Y_3 + \delta_{1K} \ln P_K + \delta_{1L} \ln P_L \\ & + (1 - \delta_{1K} - \delta_{1L}) \ln P_M\} + \{\alpha_2 + \sigma_{12} \ln Y_1 + \sigma_{22} \ln Y_2 + \sigma_{23} \ln Y_3 \\ & + \delta_{2L} \ln P_K + \delta_{2L} \ln P_L + (1 - \delta_{2K} - \delta_{2L}) \ln P_M\} \\ & + \{\alpha_3 + \sigma_{13} \ln Y_1 + \sigma_{23} \ln Y_2 + \sigma_{33} \ln Y_3 + \delta_{3L} \ln P_K + \delta_{3L} \ln P_L \\ & + (1 - \delta_{3K} - \delta_{3L}) \ln P_M\} \quad (j=K, L, M). \end{aligned} \qquad [N2]$$

In this study, economies of scale are calculated using the estimated parameters, which are evaluated at the sample means of outputs and factor prices. Moreover, SCALE is evaluated near a given point of the Translog cost function ($\ln Y_i=0$ and $\ln P_j=0$; thus, $Y_i=1$ and $P_j=1$). This yields

$$SCALE = \sum_i \alpha_i. \qquad [N3]$$

SCALE < 1 implies that economies of scale exist.

To directly exhibit economies of scope (SCOPE), we require data on the cost when the production of at least one of the outputs is zero. However, due to the nonadmission of zero values in the Translog cost function, the cost cannot be defined. To avoid this problem, as described in previous studies, we estimate cost complementarities that are a sufficient condition for the presence of scope economies in twice differentiable cost functions. The cost complementarities are

$$\partial^2 C / \partial Y_i \partial Y_k < 0 \quad (i, k=1, 2, 3; i \neq k). \qquad [N4]$$

From a cross partial derivative of Y_i and Y_k, the cost complementarities [N4] are

$$\partial^2 C / \partial Y_i \partial Y_k = C / (Y_i \cdot Y_k) \times \{\partial^2 \ln C / \partial \ln Y_i \cdot \partial \ln Y_k + (\partial \ln C / \partial \ln Y_i) \cdot (\partial \ln C / \partial \ln Y_k)\} < 0. \qquad [N5]$$

In terms of the Translog cost function, this condition can be approximated as

$$\begin{aligned} \partial^2 C / \partial Y_i \partial Y_k = {} & C / (Y_i \cdot Y_k) \cdot \{\sigma_{ik} + (\alpha_i + \sum_k \sigma_{ik} \ln Y_k \\ & + \sum_j \delta_{ij} \ln P_j) \times (\alpha_k + \sum_i \sigma_{ki} \ln Y_i + \sum_j \delta_{kj} \ln P_j)\} < 0 \quad (j=K, L, M). \end{aligned} \qquad [N6]$$

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

$$\begin{aligned} & \sigma_{ik} + (\alpha_i + \sum_k \sigma_{ik} \ln Y_k + \sum_j \delta_{ij} \ln P_j) \\ & \times (\alpha_k + \sum_i \sigma_{ki} \ln Y_i + \sum_j \delta_{kj} \ln P_j) \equiv SCOPE \quad (i, k) < 0. \end{aligned} \qquad [N7]$$

Here, when SCOPE is evaluated near a given point of the Translog cost function ($\ln Y_i=0$, $\ln Y_k=0$ and $\ln P_j=0$; thus, $Y_i=1$, $Y_k=1$ and $P_j=1$), SCOPE is

$$SCOPE (i, k) = \sigma_{ik} + \alpha_i \times \alpha_k < 0 \quad (j=K, L, M). \qquad [N8]$$

SCOPE < 0 implies that economies of scope exist.

(6) Here, we test the null hypothesis: $\alpha_1 + \alpha_2 + \alpha_3 = 1$, implying constant returns to scale.

(7) Here, we test the null hypotheses: $\sigma_{12} + \alpha_1 \times \alpha_2 = 0$, $\sigma_{13} + \alpha_1 \times \alpha_3 = 0$, or $\sigma_{23} + \alpha_2 \times \alpha_3 = 0$, implying that neither economies of scope nor diseconomies of scope exist.

(8) The negative effect of the global financial crisis that started in September 2008 on the GCC banking sector became noticeable during late 2009 and mid-2010. However, the global finacial crisis had less impact on Islamic banks compared with their conventional counterparts (e.g., International Monetary Fund 2010).

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