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FINANCIAL EFFICIENCY ANALYSIS OF ISLAMIC BANKS IN THE QISMUT COUNTRIES

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ABSTRACT

Six rapid growth markets (QISMUT) as abbreviated from Qatar, Indonesia, Saudi Arabia, Malaysia, UAE and Turkey) will play an important role in the globalization of the Islamic banking industry. Two thirds of the 38 million Islamic bank customers in the world reside in QISMUT countries. Having a wide pool of intellectual capital and funds, these countries may well be the drivers of a growth wave in current and new markets. This study compares the scale efficiency using a set of indicators generated from the financial statements of 55 Islamic banks operating in QISMUT countries. 6 Islamic banks operating in Qatar, 15 in Indonesia, 11 in Saudi Arabia, 13 in Malaysia, 7 in UAE, and 3 in Turkey were included in the analysis involving the period between 2012 and 2016. Data Envelopment Analysis (DEA) was used in the efficiency measurements while the Malmquist Total Factor Productivity Index was used to measure the total factor productivity change. Half of these QISMUT Islamic banks meet the technical productivity (CCR) value. In other words, half of these QISMUT Islamic banks are able to use their Total Assets and Total Equities efficiently. When QISMUT countries are considered as a whole, it was found that Technical Efficiency Change (EFFCH) value was never recorded above 1 for any time period. It was found that the Islamic Banks of QISMUT countries are unlikely to reach their production limit.

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QISMUT ÜLKELERİNDEKİ İSLAMİ BANKALARIN FİNANSAL ETKİNLİK ANALİZİ

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ÖZ

Hızlı büyüyen altı ülke (kısaltması 6 ülkenin baş harflerinden oluşan QISMUT ülkeleri-Katar, Endonezya, Suudi Arabistan, Malezya, Birleşik Arap Emirlikleri, Türkiye) İslami bankacılık sektörünün küreselleşmesinde önemli bir rol oynayacaklardır. Halen sektörde geniş entelektüel sermaye ve fon havuzlarına sahip olan bu ülkeler mevcut ve yeni pazarlardaki büyüme dalgasının lokomotifi olabileceklerdir. Dünya genelindeki yaklaşık 38 milyon İslami banka müşterisinin üçte ikisi halen QISMUT ülkelerinde yaşamaktadır. Bu çalışmada; QISMUT ülkelerinde faaliyet gösteren İslami bankalardan oluşan 55 bankanın mali tablo verilerinden oluşturulmuş göstergeler seti kullanılarak ölçek etkinliği karşılaştırılması yapılmıştır. 2012-2016 dönemi için, Katar'da faaliyet gösteren 6, Endonezya'da faaliyet gösteren 15, Suudi Arabistan'da faaliyet gösteren 11, Malezya'da faaliyet gösteren 13, Birleşik Arap emirliklerinde faaliyet gösteren 7 ve Türkiye'de faaliyet gösteren 3 İslami banka analize dâhil edilmiştir. Etkinliğin ölçülmesinde Veri Zarflama Analizi; etkinlik değişimleri ve toplam faktör verimlilik değişimi ölçümünde ise Malmquist Toplam Faktör Verimlilik Endeksi kullanılmıştır. QISMUT İslami bankaların yarısı teknik etkinlik (CCR) değerine sahiptir. Yani QISMUT İslami bankalarının yarısı sahip oldukları Toplam Varlıklar ile Toplam Özkaynaklarını etkin olarak kullanamamaktadır. QISMUT ülkelerini bir bütün olarak değerlendirdiğimizde hiçbir dönem Teknik Etkinlikteki Değişim (EFFCH) 1'in üzerinde değer almamıştır. QISMUT ülkelerindeki İslami Bankaların üretim sınırını yakalama etkisinin düşük olduğu görülmektedir.

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Islamic banking has been growing consistently since the 1970s, when it was established. It claimed an important share from the global finance market in time (Mallin, Faraga and Yonga, 2014). The working principle behind Islamic banks is based on the profit and loss sharing (Bellalah and Ellouz, 2004). According to the Islamic faith, paying or charging interest on any loan is not permitted. Muslims who do not want to enjoy interest yield turn to Islamic banks which operate in accordance with the Islamic principles.

Globalization, an important trigger for growth, will prove challenging for Islamic banks operating in these countries. Rapidly growing trade routes are especially turning out to QISMUT countries' advantage. Banks which are able to build connections with key countries and industries will prevail. Another important point to note here is that Islamic finance markets are heterogeneous and they involve significant differences in terms of customer preferences, legal regulations and profitability. Islamic banks need to adapt their offers, operating models, systems, tools and processes in order to be able to see and seize international opportunities. Performance measures need to be analyzed in order to see if the Islamic banking system operations achieve their objectives. One of the methods commonly used in system performance measurements is the efficiency analysis. Efficiency analysis aims to define how efficiently and productively systems use resources (inputs) when producing goods and services (outputs).

QISMUT countries play an important role in the globalization of the Islamic finance industry. The Islamic banking assets in QISMUT countries have increased steadily every other year. This study focuses on the QISMUT countries which are predicted to have a say in the future Islamic finance and banking field. Efficient functioning of Islamic banks in QISMUT countries is critical for the future of Islamic banking. This study assumes even more importance in light of the assessments mentioned above.

This study aims to investigate the efficiency of QISMUT Islamic banks which are anticipated to improve their profits in a global scale in the years to come. This study measures and compares the efficiency of Islamic banks operating in the QISMUT countries. Individual efficiency scores of Islamic banks operating in these 6 countries and the efficiency scores of QISMUT countries as a whole were taken into consideration in the interpretation of the analysis results.

LITERATURE REVIEW

It is possible to find several studies in the literature which used Data Envelopment Analysis (DEA) method in order to establish the efficiency of Islamic banks. Some of these studies conduct an efficiency analysis among Islamic banks while others compare Islamic banks and traditional banks. It is possible to find studies based on a single country and multiple countries. Literature involves studies performed in order to include countries in this group such as research on the Middle-Eastern (including Gulf Cooperation Council countries) countries, North African (MENA) countries, Gulf Cooperation Council (GCC) countries, and Organization of the Islamic Conference (OIC) countries.

Rahman and Rosman (2013); Said (2013); Sufian and Noor (2009); Olson and Zoubi (2011); and Sufian, Noor and Majid (2008) focused on the MENA countries in their studies. Rahman and Rosman (2013) compared the efficiency of Islamic banks selected from MENA countries and Asian countries. Their study uses DEA analysis in order to measure the efficiencies of 63 Islamic banks for the period between 2006 and 2009. It was found that Islamic banks operating in Asian countries were more efficient than the rest included in this research. Said (2013) also used DEA method for the analysis of the efficiencies of Islamic banks operating in MENA countries for the period between 2006 and 2009. Sufian and Noor (2009) reported Technical, Pure Technical and Scale Efficiency analyses of Islamic banks operating in MENA countries and Asia for the period between 2001-2006. It was shown that Islamic banks operating in Asia had a better technical efficiency. Olson and Zoubi (2011) used DEA analysis in order to report on the efficiency of Islamic banks operating in MENA countries. Sufian, Noor and Majid (2008) applied the DEA method in order to analyze the efficiencies of 16 Islamic banks operating in MENA and Asia countries for the period between 2001 and 2006. It was shown that Islamic banks operating in the MENA countries were more efficient when compared to the ones operating in Asian countries.

Siraj and Pillai (2012), Srairi (2010), and Yudistira (2004) focused on the countries participating in the Gulf Cooperation Council (GCC) for their studies. Siraj and Pillai (2012) analyzed the efficiencies of Islamic banks and conventional banks operating in GCC countries for the period between 2005 and 2010. The results showed that Islamic bank were more efficient than the conventional banks. Srairi (2010) measured the cost and profit efficiencies of 71 conventional and Islamic banks operating in countries participating in the Gulf Cooperation Council (GCC) for the period between 1999 and 2007. It was found that Islamic banks were more efficient. Yudistira (2004) analyzed the efficiencies of 18 Islamic banks using the DEA method for the period

between 1997 and 2000. Their study involved Islamic banks operating in Gulf Cooperation Council (GCC) countries, the Middle East, Eastern Asia and Africa.

Rosman, Wahab, Zainol (2014), Majid, Saal and Battisti (2014), Beck, Kunt and Merrouche (2013), Al-Khasawneh et al. (2012), Said (2012), Kablan and Yousfi (2011), Ahmad and Noor (2011), Tahir and Haron (2010), Majid, Saal, and Battisti (2010), Hassan et al. (2009), Bader et al. (2008), Viverita and Skully (2007), Hassan (2006), Griogorian and Manole (2005), Brown and Skully (2003) included banks from multiple countries in their research.

Rosman, Wahab, Zainol (2014) investigated the efficiency levels of 79 Islamic banks operating in the Middle East and Asia during the financial crisis for the period between 2007 and 2010. They reported that Islamic bank are equipped with the means to come through financial crises yet most of them are not operating efficiently. Majid, Saal and Battisti (2014) investigated the efficiencies of Islamic and conventional banks operating in 10 countries using the DEA method for the period between 1996 and 2002. Beck, Kunt and Merrouche (2013) reported the efficiency analysis of 510 Islamic and traditional banks from 22 countries. Al-Khasawneh et al. (2012) investigated the efficiencies of conventional and Islamic banks operating in Arabic countries of North Africa in terms of cost income efficiency for the period between 2003 and 2006.They reported that the Islamic banks operating in this region have a higher level of average income efficiency when compared to the conventional banks operating in the same region. Said (2012) analyzed 26 Islamic banks operating in the Middle East and 21 Islamic banks operating out of the Middle East for the period between 2006 and 2009. Kablan and Yousfi (2011) analyzed the efficiency of Islamic banks operating in 17 countries using the DEA method for the period of 2001 and 2008. It was found that the Islamic banks operating in Asian countries had a higher level off efficiency. Ahmad and Noor (2011) analyzed 78 Islamic banks from 25 countries using the DEA method for the period between 1992 and 2009. It was shown that Islamic banks in general had a higher pure technical efficiency.

Tahir and Haron (2010) measured the cost and profit efficiencies of Islamic banks operating in Africa, the Far East and Middle Asia, Europe and the Middle East using the DEA analysis for the period between 2003 and 2008. It was found that Islamic banks in Europe were relatively more efficient than the rest of the research sample. Majid, Saal, and Battisti (2010) measured the efficiencies of Islamic and conventional banks from 10 countries for the period between 1996 and 2002. Hassan et al. (2009) conducted a comparative analysis of the efficiencies of 40 Islamic and conventional banks operating in 11 Islamic Conference (OIC) countries using the DEA method for the period between

1990 and 2005.It was reported that there was no significant difference between Islamic banks and conventional banks in terms of total efficiency. Bader et al. (2008) measured the efficiencies of 37 Islamic and conventional banks from 21 countries using DEA analysis for the period between 1990 and 2005.Their results showed that Islamic banks were more efficient than conventional banks. Viverita and Skully (2007) measured the efficiencies of Islamic banks operating in the Middle East, Africa and Asia using Malmquist Total Factor Productivity (TFP) Index for the period between 1998 and 2002. Hassan (2006) analyzed the cost and profit efficiencies of 43 Islamic banks operating in 21 countries using the DEA method for the period between 1995 and 2001. It was found that Islamic banks were less efficient. Griogorian and Manole (2005) compared the efficiency indicators of banks operating in Kuwait, Qatar, UAE, and Singapore using the DEA method for the period between 1997 and 2002. Brown and Skully (2003) analyzed the efficiencies of 35 Islamic banks operating in Iran and Sudan.

Malaysia is the most prevalent case for the studies available in the literature which are performed for a single Islamic country. Norbaizura, Rosmanira, Mohd (2014), Ahmad and Abdul-Rahman (2012), Ahmad Mokhtar et al. (2008), Kamaruddin et al. (2008), Sufian (2007), Mokhtar, Abdullah and Al-Habsh (2006), Ahmad Mokhtar et al. (2006) included the Islamic banks operating in Malaysia into their studies. Norbaizura, Rosmanira, Mohd (2014) measured the efficiencies of 10 Islamic banks operating in Malaysia for 2011 using the DEA method. Ahmad and Abdul-Rahman (2012) analyzed the efficiencies of Islamic and conventional banks operating in Malaysia using the DEA method for the period between 2003 and 2007. It was found that the conventional banks were more efficient than the Islamic banks in terms of managerial efficiency and technologic improvements. Ahmad Mokhtar et al. (2008) analyzed technical and cost efficiencies of Islamic and conventional banks operating in Malaysia using the DEA method for the period between 1997 and 2003.It was found that Islamic banks were less efficient than conventional banks. Kamaruddin et al. (2008) analyzed the efficiencies of local and international Islamic banks operating in Malaysia using the DEA method for the period between 1998 and 2004.Sufian (2007) analyzed the efficiencies of Islamic banks operating in Malaysia using the DEA method for the period between 2001 and 2005. It was found that the Islamic banks operating in Malaysia show insufficient scale efficiency. Mokhtar, Abdullah and Al-Habsh (2006) analyzed the efficiencies of Islamic and conventional banks operating in Malaysia. It was reported that the efficiency level of Islamic banks was lower than the level of conventional banks. Ahmad Mokhtar et al. (2006) analyzed the efficiencies of Islamic banks operating in Malaysia using the DEA method for the period between 1997 and 2003.

Ada and Dalkılıç (2014), Gishkori and Ullah (2013), Sufian et al. (2013), Said, Rachida and Azza (2011), Al-Maghaireh (2005), Hussein (2003) conducted studies on a single Islamic country. Ada and Dalkılıç (2014) measured the efficiencies of 4 Islamic banks operating in Turkey and 18 Islamic bank operating in Malaysia using the DEA method for the period between 2009 and 2011. Gishkori and Ullah (2013) analyzed the efficiencies of conventional banks and Islamic banks operating in Pakistan using the DEA method for the period between 2007 and 2011. It was found that pure technical efficiency was the major reason behind the lower efficiency levels of these banks. Sufian et al. (2013) analyzed the efficiencies of Islamic and conventional banks operating in Pakistan using the DEA method for the period between 2007 and 2011.This study revealed that conventional banks performed better than the Islamic banks. Said, Rachida and Azza (2011) analyzed the efficiencies of Islamic and conventional banks operating in Indonesia using the DEA method in a study based on the data collected between March, 2010 and July, 2011. Al-Maghaireh (2005) analyzed the efficiencies of 3 Islamic banks and 5 conventional banks operating in the UAE using the DEA method for the period between 2000 and 2004. The results showed that Islamic banks were more efficient than the conventional banks. Hussein (2003) measured the operational efficiencies of 17 Islamic banks operating in Sudan for the period between 1990 and 2000.

METHODS

Production is the process of converting input into output. The efficiency of this process depends on obtaining maximum output using a specific amount of input within the scope of current technology and technological changes. In other words, it depends on obtaining a specific output using the minimum amount of input. The terms, efficiency and productivity, differentiate in their respective meanings, however they are used interchangeably at times. Productivity is the ratio of total output to one unit of total input.

Data Envelopment Analysis (DEA) was first suggested by Chames, Cooper and Rhodes (1978) in 1978. Researchers developed the DEA model without any limitations to the production technology in order to create the most practical frame. DEA's methodology serves more for the frontiers rather than the central trends (Charnes et al., 1978). This methodology has recently been adopted fully by several authors for their scientific studies. Data Envelopment Analysis first showed up in the literature with the research conducted by

Charnes, Cooper and Rhodes, namely "Measuring The Efficiency of Decision Making Units". DEA as a nonparametric method, more commonly used to measure the efficiency of nonprofit organizations. The bibliographic review conducted by Gattoufi et al. (Gattoufi, et al., 2004) showed that many studies preferred this method. The studies of Seiford and Thrall (1990), Fried et al. (1993), Fare et al. (1994), Ganley ve Cubbin (1992), Charnes et al. (1995) and Coelli et al. (1998) provide a good source for further investigation into the DEA methodology.

In this process, some of the units reach up to 100% efficiency and they are referred to as "relatively efficient units". On the other hand, units with less than 100% efficiency are considered inefficient (Keh et al., 2006: 268). This efficiency frontier predicts the amount of output which may be produced using the minimum amount of resources or the maximum amount of output which may be produced using the given input (Yu and Lee, 2009: 572). One of the advantages DEA method provides is that it can be used for analyses even with lesser amounts of data and using a relatively small sample (Canhoto and Dermine, 2003).

This method allows for formulation as a fractional or linear program provided that input or output orientation is taken into consideration.

The measurement approach involving technical efficiency, scale efficiency and technical change is explained in for a case involving a single input and a single output Figure 1 using a graphic. x-index specifies the amount of input, while y-index specifies the amount of output for a particular point. They are rendered to the original production frontier, y=f(x), y=g(x), as a result of the technical change. The points A, B, C, and D are technically efficient as they are in the area above the production frontier of technology function. The points P, Q, and R are inefficient as they are not in the area above the production frontier. The points A*, B* and Z represent production combinations which are impossible for the technology function.

Figure 1. *Production Function*

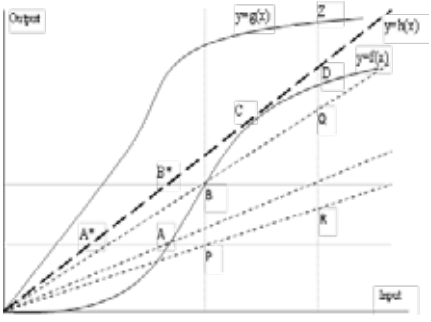


Figure 2. *Efficient Frontier*

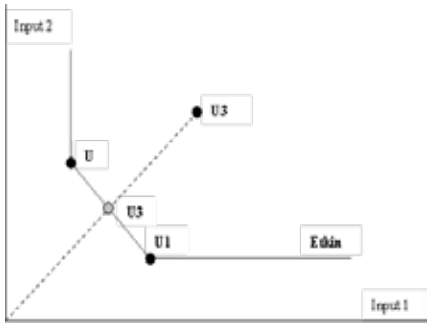


Figure 2 addresses the case in which there are two inputs and one output and the input amounts are necessary in order to obtain a unit of output from the production unit are given in an input-input space. In this space, as the unit U1 uses the least amount of input 2 and unit U2 uses the least amount of input 1, both are relatively efficient when prices are not concerned. However, it is impossible to say that unit U3 is relatively efficient. Assuming that all linear combinations of U1 and U2 are possible, then unit U3 should have been located at the point U3★ in order to be able to perform an efficient production for the same input set. It is obvious that U3★ uses fewer amounts of input 1 and input 2 in order to produce 1 unit output. Farrell, based on the production units, defined the linear convex set which is generated by the relatively efficient ones where no production unit resides on the area to the left and below as the "efficient frontier". This frontier "envelopes" the observations. Observations above the efficient frontier are relatively efficient to the fullest. Observations in the envelope are efficient proportionally to their radial distance to the efficient frontier. In this context, the efficiency of unit U3 can be represented with 0U3★/0U3 ratio. The concepts explained here with the input-input space can easily be adapted to the output-output space (Farrell, 1957).

The fractional programming model suggested by Charnes et al. (1978) who built upon the definition coined by Farrell (1957) and its co-linear programming model (Charnes-Cooper-Rhodes Model, CCR Model) are shown below. These models have led to the dual model which involves some important managerial information.

CCR Method

The problem to be analyzed is assumed to include "m" input, "s" output, and "n" units each. The parameter of Xij > 0 represents the amount of "i" input used by "j" decision making unit (DMU). The parameter of Yij > 0 represents the amount of "r" output produced by "j" decision making unit (DMU). The decision depends on the weights the decision making unit "k" places on inputs "i" and outputs "r". These weights are represented as vik and urk . The objective function of the linear-fractional programming model is defined as the optimization of the total weighted outputs to weighted total inputs ratio for "k" decision-making unit.

$$Enbh_j = \frac{\sum_{r=1}^{n} u_r y_r}{\sum_{i=1}^{m} v_i x_i} \quad (1)$$

In Equation (1), DMU must select "k" weights in order to give efficiencies below 1 when the other DMUs use the selected weights. Otherwise, when the DMU reaches to the value of 1, some other DMUs might be efficient above 1. Thus, the limit can be represented as follows;

$$\frac{\sum_{r=1}^{n} u_r y_r}{\sum_{i=1}^{m} v_i x_i} \leq 1 \quad (2)$$

DMU must select "k" weights in order to give efficiencies below 1.0 when the other DMUs use the selected weights. Otherwise, when the DMU efficiency value reaches to 1.0, some other DMUs might be efficient above 1.0. This limit can be represented as follows;

$$\begin{aligned} u_r &\geq 0 \quad ; \quad r = 1..., n \\ v_i &\geq 0 \quad ; \quad i = 1,..., m \end{aligned} \quad (3)$$

Also, it is obvious that the weights of inputs and outputs used by the DMU, k, cannot take a negative value:

The fractional programming model can be converted into a linear programming model (Charnes and Cooper, 1962) and this new model can be solved using a Simplex algorithm. The model obtained after this conversion is called the CCR model:

As mentioned above, solution of the fractional programming set is more relatively challenging than linear programming. Equations (2) and (3) give the Equations (4) and (5) when they are interpreted using the linear programming logic.

$$Enbh_j = \sum_{r=1}^{n} u_r y_r \quad (4)$$

$$\sum_{i=1}^{m} v_i x_i = 1$$

$$\sum_{r=1}^{n} u_r y_r - \sum_{i=1}^{m} v_i x_i \geq 0 \qquad (5)$$
$$u_r, v_i \geq 0$$

Equations (4) and (5) are rearranged for input-oriented basis. When CCR method is to be used for output-oriented basis, then the linear programming model will be as shown in Equations (6) and (7).

$$Enkg_j = \sum_{i=1}^{m} v_i x_i \qquad (6)$$

$$\sum_{r=1}^{n} u_r y_r = 1$$

$$-\sum_{r=1}^{n} u_r y_r + \sum_{i=1}^{m} v_i x_i \geq 0 \qquad (7)$$
$$u_r, v_i \geq 0$$

The mathematical construction of the Data Envelopment Analysis was composed by Charnes, Cooper and Rhodes using the fractional programming model below (Charnes, Cooper and Rhodes, 1978: 431 – 432).

BCC Method

This is a model achieved through employment of specific changes to the assumptions of the CCR model. This model is based on the assumption of variable return to scale in principle. It is developed by Banker, Charnes, and Cooper. It is also possible to define the type of return to scale for all decision making units using BCC model. BCC frontier is always lower than the CCR frontier. Therefore, CCR efficiency score is either lower or equal to the BCC efficiency score.

With the assumption of variable return to scale, the only difference between BCC model and CCR model is that total sum of the λ (the value that gives the required information for a possible efficient input-output combination for an inefficient decision making point) values obtained from the result of the

linear program solution for each DMU adds up to 1. The model for BCC method is given in Equation (8).

Objective Function,

$$Enk\Theta_k$$

Limits,

$$\sum_{j=1}^{N} y_{rj}\lambda_{jk} \geq y_{rk} \tag{8}$$

$$\Theta_k x_{ik} - \sum_{j=1}^{N} x_{ij}\lambda_{jk} \geq 0$$

$$\sum_{j=1}^{N} \lambda_j = 1$$

Malmquist Total Factor Productivity Index

Malmquist Total Factor Productivity (TFP) Index measures the change in the total factor productivity between two variables by calculating each observation's relative distance rate to common technology. The "distance function" is employed for this calculation. Developed by Caves et al. (1982a), (1982), this index was named after Sten Malmquist'in (1953) who forged the idea to create an index using distance functions for the first time. Distance function is used in order to define multi-input and multi-output technologies without indicating objectives such as cost minimization or profit maximization. Output distance function is defined as $d(x,y) = \min\{\delta : (y/\delta) \in S\}$. When the values to be assigned to the distance function, d(x,y), are 1.0 where y vector is above the S frontier; while these values are >1.0 where y vector defines a point in S which is technically inefficient; and these values are <1.0 where y vector defines a point out of S which is impossible.

Malmquist TFP change index is calculated according to the output between the baseline s period and the following t period and within the scope of "distance function", as suggested by Fare et al. (1994);

$$m(Y_s, X_s, Y_t, X_t) = \sqrt{\left[\frac{d^s(Y_t, X_t)}{d^s(Y_s, X_s)} \times \frac{d^t(Y_t, X_t)}{d^t(Y_s, X_s)}\right]} \qquad (9)$$

$d^s(X_t, Y_t)$ formulation represents the distance of t period observation from the technology of s period. m(.) function values greater than 1.0 indicate an increase in TFP from the s period to the t period; while values less than 1.0 indicate an decrease in TFP for the same periods. The equilibrium stated above can be written as follows;

$$m(Y_s, X_s, Y_t, X_t) = \frac{d^t(Y_t, X_t)}{d^s(Y_s, X_s)} \sqrt{\left[\frac{d^s(Y_t, X_t)}{d^t(Y_t, X_t)} \times \frac{d^s(Y_s, X_s)}{d^t(Y_s, X_s)}\right]} \qquad (10)$$

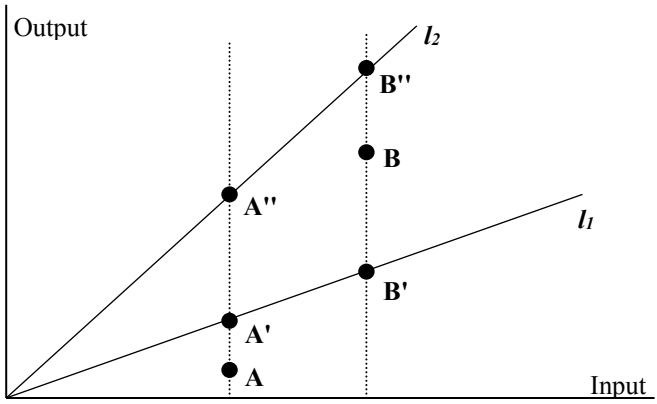
The first term on the right side of the equation is the measure of the Farrell's total technical efficiency change between the periods s and t. The term in brackets, on the other hand, represents the technical change. This approach is further explained in Figure 3 with a graph.

A Single-input and single-output condition is examined in the Figure under the assumptions of CRS. An observation A was made in the s period under the technology l1, while observation B was made in the t period under the technology l2. In this case;

$$\text{efficiency change} = \frac{y_B / y_{B''}}{y_A / y_{A'}}$$

$$\text{technical change} = \left[\frac{y_B / y_{B'}}{y_B / y_{B''}} \times \frac{y_A / y_{A'}}{y_A / y_{A''}}\right]^{1/2}$$

Figure 3. *Malmquist Total Factor Productivity Index*



An empirical study requires all four distance functions in order to be able to make calculations for two consecutive periods. This calculation, on the other hand, can be performed using either mathematical programming or econometric techniques. A detailed review of Malmquist TFP index was conducted by Fare et al.(1997).

The most commonly used approach of our time in distance function calculations for TFP index, the mathematical programming models developed by Fare et al. (1994) are given below with the matrix notation:

$$\left[d^t(y_t,x_t)\right]^{-1} = \max_{\phi,\lambda}\ \phi$$
$$st$$
$$-\phi y_{it} + Y_t\lambda \geq 0$$
$$x_{it} - X_t\lambda \geq 0$$
$$\lambda \geq 0$$

$$\left[d^s(y_s,x_s)\right]^{-1} = \max_{\phi,\lambda}\ \phi$$
$$st$$
$$-\phi y_{is} + Y_s\lambda \geq 0$$
$$x_{is} - X_s\lambda \geq 0$$
$$\lambda \geq 0$$

$$\left[d^t(y_s,x_s)\right]^{-1} = \max_{\phi,\lambda}\ \phi$$
$$st$$
$$-\phi y_{is} + Y_t\lambda \geq 0$$
$$x_{is} - X_t\lambda \geq 0$$
$$\lambda \geq 0$$

$$\left[d^s(y_t,x_t)\right]^{-1} = \max_{\phi,\lambda}\ \phi$$
$$st$$
$$-\phi y_{it} + Y_s\lambda \geq 0$$
$$x_{it} - X_s\lambda \geq 0$$
$$\lambda \geq 0$$

Calculations of any period and observation of the distance values defined above require solution of n(3t-2) linear programming models, n being the number of observations and t being the number of periods.

Scope and Data

The scope of this research includes 55 Islamic banks operating in QISMUT countries for the period between 2012 and 2016. The number of decision making units (firms) was included in the scope of Data Enveloping Analysis while it was important for these units to be similar in terms of their production technologies and not to be lower than the requirements of the linear programming model.

Requirement of m+p+1 units is an important limit for the reliability of the research, where the number of inputs is m and the number of outputs is p. Another limit is that the number of DMUs included in the research must be at least twice as much as the total number of variables available (Boussofiance et al., 1991:1-15).

In accordance with the above-mentioned criteria and as we used 3 input and 3 output variables, then the number of DMUs (firms) must be at least;

$$\#\text{ of inputs} + \#\text{ of outputs} + 1 = 3 + 3 + 1 = 7$$

$$2x(\#\text{ of inputs} + \#\text{ of outputs}) = 2x(3 + 3) = 12$$

Table 1. *General Profiles of QISMUT Countries 2016*

	Population (million)	Islamic finance assets	Share among QISMUT countries	Global distribution of Islamic banking assets
Qatar	2.2million	US$ 83billion	10%	8.1%
Indonesia	248.5million	US$ 25billion	3%	2.5%
Saudi Arabia	31million	US$ 343billion	43%	33%
Malaysia	29.8million	US$ 148billion	18%	15.5%
UAE	9.3million	US$ 150billion	19%	15.4%
Turkey	76.1 million	US$ 52billion	6%	5.1%

Source: Ernst and Young; World Islamic Banking Competitiveness Report 2016

Efficiency of this study involved 6 Islamic banks operating in Qatar, 15 in Indonesia, 11 in Saudi Arabia, 13 in Malaysia, 7 in UAE, and 3 in Turkey.

Profiles of these countries with respect to other QISMUT countries are given in Table 1.

Table 2. *Banks which are Included in the Analysis*

QISMUT Countries	Number of banks	Banking List
Qatar	6	Masraf Al Rayan – Qatar, Al Khaliji Commercial Bank and Islmaic Banking, Commercial Bank, Qatar Islamic bank
Indonesia	15	PT Bank Syariah Bukopin, PT Bank Syariah Jabardan Banten (BJB), PT Bank Danamon, PT Bank Permata, PT Bank Syariah Mega Indonesia, PT Bank Sinarmas, PT Bank Syariah BNI, Bank Pembangunan Daerah (BPD) Banda Aceh, PT Bank Syariah BRI, PT Bank Syariah Mandiri, PT Bank Syariah Panin, PT Bank Syariah Victoria, PT CIMB Niaga, PT OCBC NISP, PT Bank Tabungan Pensiunan Nasional (BTPN)
Saudi Arabia	11	The Saudi Investment Bank, Al Rajhi Banking & Investment Corporation, Bank AlJazira, Bank Albilad, Riyad Bank, Samba Financial Group, The National Commercial Bank, Alinma Bank, Arab National Bank, Banque Saudi Fransi, Islamic Banking, Saudi Hollandi Bank
Malaysia	13	Malayan Banking Berhad, Al Rajhi Banking & Inv. Corp. (Malaysia), Asian Finance Bank, Bank Kerjasama Rakyat Malaysia Berhad, Bank Pembangunan Malaysia Berhad, CIMB Islamic Bank Berhad, Bank Islam Malaysia Berhad, Hong Leong Islamic Bank Berhad, OCBC Al-Amin Bank Berhad, Public Islamic Bank Berhad, RHB Islamic Bank Berhad, Alliance Islamic Bank Berhad, Maybank Islamic Berhad,
UAE	7	Sharjah Islamic Bank, Abu Dhabi Islamic Bank, Emirates Islamic Bank, First Gulf Bank, Emirates NBD PJSC, Siraj Islamic Banking, Union National Bank, Ajman Bank,
Turkey	3	Albaraka Turk Participation Bank, Kuweyt Turk Participation Bank, Türkiye Finance Participation Bank

Indonesia is the most crowded QISMUT country with a population of 248.5 million people. However, Islamic banking in Indonesia is the lowest of all proportionally. The total share of these 6 QISMUT countries in the global Islamic banking market is 80%. QISMUT member Saudi Arabia has a 33% market share in the global Islamic banking market. QISMUT member Indonesia, on the other hand, has the smallest market share with 2.5%. Saudi

Arabia is the leading country in terms of Islamic financial assets with 43% when compared to other QISMUT countries. Indonesia, on the other hand, accounts for the lowest share in this respect.

This share is slightly higher in countries with strict Islamic rules in effect (see Table 1). The names of the banks included in the analysis are given in Table 2.

6 Islamic banks operating in Qatar, 15 in Indonesia, 11 in Saudi Arabia, 13 in Malaysia, 7 in UAE, and 3 in Turkey were included in the analysis.

Inputs and outputs of the study must be selected with utmost attention as they provide the basis for DMU comparison. Meaningful inputs and outputs must be selected for their causative connection with the production process, as different input and output groups will give different efficiency rates for the same DMUs. Input and output variables used in this study were selected with the consideration of previous research in this field. Table 3 shows the input and output values selected for this study.

Table 3. *Input and Output Variables Used in this Study*

Period	Input	Output
2012-2016	Total Assets	Total Deposits
	Total Equity	Net Profit/Loss

Total assets and total equities were used as inputs while total deposits and net profit/loss were used as outputs in the efficiency calculations of these banks. All the input and output values are in USD.

FINDINGS

This research uses the input-oriented approach for technical efficiency measurement. Pure technical efficiency and scale efficiency are among the components of technical efficiency. Pure technical efficiency predicts the technical efficiency value without the need for any assumptions for return to scale. Scale efficiency is the case when a company operates on invariable return to scale (Kim, 2000:46). Total efficiency measures will be obtained for each decision making point when this model is solved for each decision making point. These measures, when equal to 1, are representative of efficiency while when lower than 1, are representative of inefficiency.

Efficiency Results

Table 4 shows the average technical efficiency values and pure technical and scale efficiencies as components of technical efficiency for 55 Islamic banks operating in QISMUT countries for the period between 2012 and 2016.

Table 4. *Efficiency Values of the Islamic Banks*

Year	Technical Efficiency (CCR)	Pure Technical Efficiency (BCC)	Scale Efficiency
2012	0,9230	0,9821	0,9325
2013	0,9302	0,9952	0,9425
2014	0,9215	0,9863	0,9354
2015	0,9430	0,9934	0,9532
2016	0,9357	0,9896	0,9523

The technical efficiency (CCR) value of the Islamic Banks of QISMUT for 2012 is 92%, i.e. their technical inefficiency vale is 8%. This technical inefficiency value reveals that Islamic banks would have been able to obtain the same amount of output (Total Deposits, Net Profit/Loss) using 8% less input. Pure technical efficiency and scale efficiency values for the same year are 98% and 93%, respectively. The reason behind the technical inefficiency of 2015 is the scale inefficiency. Technical efficiency (CCR), pure technical efficiency (BCC) and scale efficiency values of QISMUT countries for the other years remain the same levels. 2015 was the year with highest technical efficiency (CCR) for the Islamic banks of QISMUT, while, 2014 sees the lowest technical efficiency level.

Technical Efficiency (CCR) Results

Table 5 shows technical efficiency (CCR) results from Islamic banks included in this study for each country. Banks with efficiency values equal to 1 are referred to as efficient banks and the total and percentage of efficient banks were calculated accordingly.

Among the 55 Islamic banks operating in QISMUT countries included in the analysis, 24 banks in 2012 (43,6%); 27 bank in 2013 (49%); 24 banks in 2014 (43,6%); 29 banks in 2015 (52,7%); 26 banks in 2016 (47,3%) were found to have technical efficiency (CCR). In other words, these Islamic banks are able to use their Total Assets and Total Equities efficiently.

According to the data obtained from the period between 2012 and 2016 it was found that the average efficiency of banks of Qatar increased in the last

year (0.903 in 2012, 0.900 in 2013, 0.906 in 2014, 0.902 in 2015, 0.940 in 2016). Among the 6 Islamic banks operating in Qatar included in the analysis, 3 banks in 2012 (50%); 4 banks in 2013 (66.6%); 4 banks in 2014 (66.6%); 4 banks in 2015 (66.6%); and 3 banks in 2016 (50%) were found to have technical efficiency (CCR).

Table 5. *Technical Efficiency (CCR) Values of the Islamic Banks of QISMUT Countries*

Countries		2012	2013	2014	2015	2016
Qatar	*Total Average Efficiency*	0,903	0,900	0,906	0,902	0,940
	Total Percentage of Efficiency	90,3%	90%	90,6%	90,2%	94%
	Total of Efficiency Bank	3	4	4	4	3
	Efficiency Bank Percentage	50%	66,6%	66,6%	66,6%	50%
Indonesia	*Total Average Efficiency*	0,868	0,901	0,899	0,917	0,856
	Total Percentage of Efficiency	86,8%	90,1%	89,9%	91,7	85,6%
	Total of Efficiency Bank	6	6	6	7	5
	Efficiency Bank Percentage	40%	40%	40%	46,6%	33,3%
Saudi Arabia	*Total Average Efficiency*	0,936	0,935	0,935	0,961	0,965
	Total Percentage of Efficiency	93,6%	93,5%	93,5%	96,1%	96,5%
	Total of Efficiency Bank	5	4	4	6	6
	Efficiency Bank Percentage	45,4%	36,3%	36,3%	54,5%	54,5
Malaysia	*Total Average Efficiency*	0,834	0,853	0,848	0,894	0,884
	Total Percentage of Efficiency	83,4%	85,3%	84,8%	89,4%	88,4%
	Total of Efficiency Bank	3	6	5	6	6
	Efficiency Bank Percentage	23%	46,2%	38,5%	46,2%	46,2%
United Arab Emirates	*Total Average Efficiency*	0,942	0,907	0,876	0,970	0,964
	Total Percentage of Efficiency	94,2%	90,7%	87,6%	97%	96,4%
	Total of Efficiency Bank	5	5	3	4	5
	Efficiency Bank Percentage	71,4%	71,4%	42,9%	57,1%	71,4%
Turkey	*Total Average Efficiency*	0,937	0,969	0,995	0,936	0,924
	Total Percentage of Efficiency	93,7%	96,9%	99,5%	93,6%	92,4%
	Total of Efficiency Bank	2	2	2	2	1
	Efficiency Bank Percentage	66,7%	66,7%	66,7%	66,7%	33,3%
QISMUT	*Total of Efficiency Bank*	24	27	24	29	26
	Efficiency Bank Percentage	43,6%	49%	43,6%	52,7%	47,3%

It was found that the average efficiency of banks of Indonesia was decreased in the last year (0.868 in 2012, 0.901 in 2013, 0.899 in 2014, 0.917 in 2015, 0.856 in 2016). Among the 15 Islamic banks operating in Indonesia included

in the analysis, 6 banks in 2012, 2013, and 2014 (40%); 7 banks in 2015 (46.6%); and 5 banks in 2014 (33.3%) were found to have technical efficiency (CCR).

According to the data obtained from the period between 2012 and 2016 it was found that the average efficiency of 11 banks operating in Saudi Arabia was increased (0,936 in 2012, 0,935 in 2013, 0,935 in 2014, 0,961 in 2015, 0,965 in 2016). Among the Islamic banks operating in Saudi Arabia , 5 banks in 2012 (45.4%), 4 banks in 2013, and 2014 (93.5%); and 6 banks in 2015, and 2016 (54.5%) were found to have technical efficiency (CCR).

According to the data obtained from 13 Islamic banks operating in Malaysia, it was found that the average efficiency was increased in the recent years (0.834 in 2012, 0.853 in 2013, 0.848 in 2014, 0.894 in 2015, 0.884 in 2016). Only 3 out of 13 (23%) Islamic banks operating in Malaysia had technical efficiency for 2012. 6 banks in 2013, 2015, and 2016 (46.2%), and 5 banks in 2014 (38.5%) had technical efficiency.

The average efficiency values of 7 Islamic banks of UAE included in the analysis ranged between 0.876 and 0.974 (0,942 in 2012, 0,907 in 2013, 0,876 in 2014, 0,970 in 2015, 0,964 in 2013). 5 UAE banks had technical efficiency in 2012, 2013, and 2016 (71.4%). This number is 3 for 2014 (42.9%) and 4 for 2015.

The average efficiency of Islamic banks of Turkey sees a decline in the recent years (0,937 in 2012, 0,969 in 2013, 0,995 in 2014, 0,936 in 2015, 0,924 in 2016). 2 out of 3 (66.7%) Islamic banks included in the analysis from Turkey had technical efficiency for 2012, 2013, 2014, and 2015. Only 1 out of these 3 banks had technical efficiency for 2016.

Malmquist Total Factor Productivity (TFP) Index Results

Malmquist Total Factor Productivity (TFP) Index is measured with multiplication of the change in technical efficiency and technological change (Angelidis and Lyroudi 2005).

Malmquist TFP Index involves the variables of Change in Technical Efficiency (EFFCH), Technologic Change (TECHCH), Change in Pure Technical Efficiency (PECH), Change inn Scale Efficiency (SECH) and Change in Total Factor Productivity (TFPCH) (Raphael, 2013). The change in total factor productivity (TFPCH) is calculated as follows;

Change in Technical Efficiency (EFFCH) = (PECH) X (SECH)

Change in Total Factor Productivity (TFPCH) = (EFFCH) X (TECHCH)

Table 6. *Malmquist Total Factor Productivity (TFP) Index Results*

Countries	Period	EFFCH	TECHCH	PECH	SECH	TFPCH
Qatar	2012-2013	0,9594	0,984	0,976	0,983	0,9441
	2013-2014	0,9712	0,974	0,980	0,991	0,9459
	2014-2015	0,9545	1,025	0,972	0,982	0,9784
	2015-2016	1,0736	1,012	1,010	1,063	1,0865
Indonesia	2012-2013	1,0281	1,032	1,003	1,025	1,0610
	2013-2014	0,9732	1,006	0,981	0,992	0,9790
	2014-2015	0,9025	0,985	0,948	0,952	0,8890
	2015-2016	0,9526	0,945	0,971	0,981	0,9002
Saudi Arabia	2012-2013	1,0578	1,001	1,025	1,032	1,0589
	2013-2014	1,0170	1,003	1,003	1,014	1,0201
	2014-2015	0,9380	0,972	0,975	0,962	0,9117
	2015-2016	0,9535	0,962	0,982	0,971	0,9173
Malaysia	2012-2013	0,8153	0,954	0,892	0,914	0,7778
	2013-2014	0,8879	0,932	0,923	0,962	0,8275
	2014-2015	0,9269	1,004	0,941	0,985	0,9306
	2015-2016	0,8975	1,002	0,932	0,963	0,8993
United Arab Emirates	2012-2013	0,9722	0,965	0,991	0,981	0,9381
	2013-2014	1,0346	1,008	1,044	0,991	1,0429
	2014-2015	0,9413	1,018	0,947	0,994	0,9583
	2015-2016	0,9860	0,983	1,000	0,986	0,9692
Turkey	2012-2013	0,9640	0,958	0,965	0,999	0,9235
	2013-2014	0,8807	1,006	0,907	0,971	0,8860
	2014-2015	0,9800	1,045	0,982	0,998	1,0241
	2015-2016	0,8795	0,998	0,902	0,975	0,8777
QISMUT	2012-2013	0,9415	1,012	0,952	0,989	0,9528
	2013-2014	0,9555	1,063	0,974	0,981	1,0157
	2014-2015	0,9235	1,087	0,958	0,964	1,0039
	2015-2016	0,9399	0,993	0,961	0,978	0,9333

Change in Technical Efficiency (EFFCH), Technologic Change (TECHCH), Change in Pure Technical Efficiency (PECH), Change inn Scale Efficiency (SECH) and Change in Total Factor Productivity (TFPCH) values were calculated separately for QISMUT countries for the period between 2012 and 2016. Accordingly, Change in Total Factor Productivity (TFPCH), when greater than 1, represents an increase in total factor productivity; when less than 1, represents a decrease in total factor productivity; and when equal to 1, represents "no change" in total factor productivity. Table 6 shows the Malmquist TFP Index results.

Change in Total Factor Productivity (TFPCH) was calculated for each country in QISMUT region. Nevertheless, another calculation was made for the QISMUT countries as a whole. Technical and technologic advancements will be represented by Change in Technical Efficiency (EFFCH) and

Technologic Change (TECHCH) indexes as components of Change in Total Factor Productivity (TFPCH) assume values greater than 1. When QISMUT countries are considered as a whole on a year by year basis, it was found that Change in Technical Efficiency (EFFCH) value was never recorded above 1 for any time period. It was found that the Islamic Banks of QISMUT countries are unlikely to reach their production limit. Saudi Arabian Islamic banks prove to be better performaning in terms of seizing the production frontier effect.

Technologic Change (TECHCH) index was greater than 1 for all of the QISMUT countries except for the period between 2015 and 2016. Technologic Change (TECHCH) index, when greater than 1, is indicative of an upward shift in production frontier.

Pure Technical Efficiency (PECH) and Change in Scale Efficiency (SECH) as components of Change in Technical Efficiency (EFFCH), when greater than 1, are representatives of the banks' managerial efficiency and ability to produce on a sufficient scale. QISMUT countries, when analyzed as a whole, do not give results greater than 1 for Change in Scale Efficiency (SECH) as components of Change in Technical Efficiency (EFFCH) in any of the years investigated. It is clear that the Islamic banks operating in QISMUT countries fail to provide managerial efficiency and are not able to produce on a sufficient scale.

When it comes to the Change in Total Factor Productivity (TFPCH) for the QISMUT country results, it was found that the period between 2015 and 2016 was the one with the greatest decline. This period was governed by the decline in the Change in Technical Efficiency (EFFCH), in other words, unfavorable trajectory of the input-output values.

Change in Total Factor Productivity (TFPCH) results are given based on both individual and integrated levels for QISMUT countries. Change in Total Factor Productivity (TFPCH) has shown a continuous increase for Islamic banks of Qatar. Indonesian and Saudi Arabian Islamic banks have shown a decline in performance for the recent years and Change in Total Factor Productivity results are similar for these two countries. Change in Total Factor Productivity has shown a continuous increase for Islamic banks of Malaysia except for the last year. Fluctuating results were obtained from Islamic banks of UAE and Turkey in terms of Change in Total Factor Productivity. QISMUT countries as a whole showed an increase only in the period between 2013 and 2014 in terms of Change in Total Factor Productivity while the remaining years, particularly the last year, saw sharp declines.

The recent decline in TFPCH of QISMUT countries is a result of Change in Technical Efficiency (EFFCH) and Technologic Change (TECHCH).

CONCLUSION

This study measures and compares the current efficiency levels of Islamic banks operating in the QISMUT countries. Efficiency scores obtained from Islamic banks operating in these 6 countries were taken into account for the interpretation of the results. Nearly half of the Islamic banks analyzed in this study have the technical efficiency. These Islamic banks are using their total assets and total equities efficiently. 29 out of 55 Islamic banks had technical efficiency in 2015.

Technical efficiency scores of the Islamic banks operating in Qatar have increased in the recent years. The highest level of efficiency for Qatar was observed in 2016 (0.940). Qatar has the highest results in terms of Islamic bank efficiency when compared to the other QISMUT countries. Economic development potential of Qatar in the recent years proved favorable for the Islamic banks. Average efficiency of Islamic banks operating in Indonesia is in decline. Technical efficiency scores of Indonesian Islamic banks have seen a sharp decline as of 2016. As of the last research year (2016), Indonesian Islamic banks have failed to use their total assets and total equities efficiently. In contrast to Indonesian Islamic banks, technical efficiency levels of Saudi Arabian Islamic banks increased in the recent years. The number of efficient Islamic banks has recently grown in order to exceed 50%. Similarly, Malaysian Islamic banks have seen a slight increase in technical efficiency. The average efficiency values of 7 Islamic banks of UAE included in the analysis ranged between 0.876 and 0.974. The average efficiency of the Islamic banks of Turkey sees a decline in the recent years and 1 out of these 3 banks had technical efficiency for 2016.

Change in Total Factor Productivity (TFPCH) was calculated for each country in QISMUT region. Nevertheless, another calculation was made for the QISMUT countries as a whole. When QISMUT countries are considered as a whole on a year by year basis, it was found that Change in Technical Efficiency (EFFCH) value was never recorded above 1 for any time period. It was found that the Islamic Banks of QISMUT countries are unlikely to reach production limit. Saudi Arabian Islamic banks prove a better performance in terms of seizing the production frontier effect. Technologic Change (TECHCH) index was greater than 1 for all of the QIZMUT countries except for the period between 2015 and 2016. Technologic Change (TECHCH) index, when greater than 1, is an indicative of an upward shift in production frontier.

QISMUT countries, when analyzed as a whole, do not give results greater than 1 for Change in Scale Efficiency (SECH) as components of Change in

Technical Efficiency (EFFCH) in any of the years investigated. It is clear that the Islamic banks operating in QISMUT countries fail to provide managerial efficiency and are not able to produce on a sufficient scale. When it comes to the Change in Total Factor Productivity (TFPCH) for the QISMUT country results, it was found that the period between 2015 and 2016 was the one with the greater decline. This period was governed by the decline in the Change in Technical Efficiency (EFFCH), in other words, unfavorable trajectory of the input-output values.

Efficiency levels of Islamic banks operating in QISMUT countries are not always increasing. QISMUT countries are expected to lead the Islamic banking industry in the future. However, technical efficiency levels are not satisfying even though some of the data obtained from the period between 2012 and 2016 showed a sustainable increase. Scale inefficiency is the major reason behind the technical inefficiency of QISMUT Islamic banks. Islamic banks are not operating in an optimal scale.

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